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TOBACCO.

The results of the first year's experiment with tobacco at Maha-iluppalama are now out, and show, roughly, that the tobacco sold for cne-quarter of what it cost.

This does not mean that tobacco must be a failure in the north—we mean of course tobacco-growing for the European market—but that there will not be any "run-away" success in it, and that, to make it a permanent success, while it can doubtless be done, will involve the spending of large amounts of money and much time.

To transform the experiment just concluded into a paying proposition, expenditure would have to be halved, price obtained doubled, and yield increased by 50 per cent. There is littl doubt that the yield could fairly easily be increased by 40-75 per cent., and the price obtained doubled. Mr. Cowan was of opinion that, if cured in large quantity, the tobacco would have been equal to average Sumatra, which obtains about 75-80 pfennigs a kilo against the 35 we obtained.

There remains then the question "can the expenditure be halved, or price and yield still further increased?" Though the coolies were inefficient, it would not seem likely that their wages, which make the bulk of the cost, could be reduced by a half, and we must therefore look to still better yields and prices. This is a mattter for long, detailed, and careful work by an expert who shall give his whole time, and that is how the matter rests at present.

GUMS, RESINS, SAPS AND EXUDATIONS.

FOURTH ANNUAL MEETING OF THE HAWAIIAN GROWERS' ASSOCIATION.

(From the *Hawaiian Forester and Agriculturist*, Vol. VIII., No. 3, March, 1911.)

On January 23, 1911, in the rooms of the Chamber of Commerce, in Honolulu, was held the Fourth Annual Meeting of the Hawaiian Rubber Growers' Association. After opening remarks by the President, Mr. F. L. Waldron, Mr. W. A. Anderson, manager of the Nahiku Rubber Company was called upon for an address.

ADDRESS OF MR. W. A. ANDERSON.

Mr. Anderson's subject was the "Results of Tapping." His address, in part, is as follows:—

"We had very little data on the commercial tapping of Ceara trees, because practically no work had been done, and therefore we started more or less independently at the beginning. At present, however, there is quite a good deal of tapping of Ceara trees in South America and South Africa, reports of which are available from time to time, and they are of assiscance to us.

"We are now tapping Ceara trees by making a vertical channel up to a height of about five or six feet, the spout being inserted at the bottom. Then on one side we make diagonal cuts about six inches apart, beginning at a point six inches above the spout and leading into the vertical channel. On the other side of the channel similar vertical cuts are made half way between those first made, each cut extending a quarter of the way around the tree. In this manner one-half of the circumference of the tree is being tapped. At the next tapping these diagonal cuts, but not the vertical channel, are pared on the lower side, removing a strip of bark about a third of an inch wide. At the third tapping this new cut is pricked along its upper edge, and at the fourth it is pricked along its lower edge; after which it is again pared and pricked in the same manner, so that one paring is followed by two prickings, making one paring in every three tappings.

"This system was evolved after trying paring alone, pricking alone and pricking at the same time. Pricking is more rapid than paring, and gives larger returns for a given amount of labour. The paring alone gives a profitable yield. The fewer parings, as compared with the number of prickings, the better, and while the paring alone gives a profitable yield, the pricking done as described gives a better yield. After the outer bark has been removed a new and tough bark soon forms, which makes pricking alone unprofitable in a few weeks after the bark is removed.

FOR BEST RESULTS.

"For best results tapping should be done during the first few days after the bark is removed, for the reason that otherwise the latex cells appear to dry up with the action of the air and soon wither. If the trees are not tapped during these first few days, they should not be tapped till after several weeks. Hence, before the tree can be thoroughly tapped, the new bark will have reached the stage where pricking cannot well be accomplished. For this reason, removing the bark by paring over a space only wide enough to prick in the next two or three days. proves better than removing all the bark at once and then trying to prick for a long series. Also by using the paring knife as above described—not going too deep—profitable tapping is made while removing the bark.

"Of course, objections have been made to pricking, but objections have also been made by good authorities to paring, and would be made to any method of extraction. The only course open to us is to find the method that looks best, and, if it has not already been proven objectionable, use it until it is shown to be so. It was thought at one time that pricking was responsible for injury suffered by some of the trees in a series of tappings last year, but later experience has brought the conviction that not the pricking, as pricking, but the removal of bark at that time was chiefly responsible, aided, no doubt, by the rather severe tapping that closely followed.

The system outlined here may be rather severe. In a herring-bone with diagonals only six inches apart, the top of one cut extends above the lowest point in the cut above the lowest point in the cut next above it, and for this reason must interfere somewhat with the horizontal movement of materials in the bark. This objection, however, would be stronger in the case of the vertical cuts, and as the flow of materials in the bark is chiefly up and down or diagonally across, it is rather difficult to determine what strength this objection would have. Also, since the paring is to be followed by pricking, the former is not as deep as it otherwise would be, and therefore does not interfere with the circulation as seriously as it might otherwise. The paring alone was expected to get all the latex. These close cuts have been made for several months, but not yet long enough to determine whether they might be injurious. Of course, the chance of injury can be lessened by the avoidance of too frequent tappings.

TAPPING INTERVALS.

"The yield from a given tree appears to increase for the first six to twelve tappings, after which it decreases somewhat till a point is reached where it remains about constant. The word 'tapping' includes the pricking too. Hence a series of six, nine or twelve tappings may well be followed by a rest. For instance, if the yield diminishes after six tappings, it might be well to rest it. Probably twelve tappings should be made. We have found that a rest of a week is sufficient at some periods. In this way we remove all the bark we can. If we start from the tree, our next two parings will remove that portion, and then the next time we take off some more bark, when pricking comes immediately after the removal of the bark. This pricking takes place as soon as the bark is removed.

"If a third of an inch is removed at each paring, then in three parings, or nine tappings, one inch of bark will have been removed, and there is plenty of authority for advocating a rest at this stage. We have found that a rest of a week or ten days is sufficient, and then we start again and get about the same result. At this rate, also, fifty-four tappings will take off all the bark between adjacent cuts. Therefore, tapping for one week and resting for three weeks would remove all the bark on one side of the tree in about six months, when it must be rested before beginning on the other side.

"The more rubber we get from each tree at each tapping, the more economical the tapping. After the bark on one side of the tree has been removed for tapping, after six months' rest we would go around to the other side of the tree. It has been found by the experiment station reports and observations that, if the tapping is carefully done and not too deeply, it will renew in less than a year. It is only in certain points and when the pricking is too deep, that swellings on the wood are caused. If the pricking is carefully done, it does not swell, but the pricking does go into the most prolific cells, while in order to get there with the knife we would have to cut deep, because the bark is so thin. Thus far we have not found satisfactory knives.

ALTERNATE TAPPINGS.

"A movement is on foot, and growing, in the Far East, to limit tapping operations in any one year to a quarter or a third of the tree, instead of to a half, as heretofore, thus giving three years instead of two for the tapping surface to be renewed. This might well be considered by us, in which case, instead of the full herring-bone going half around the tree, the half herring-bone going one third around, might be used. Of course this system of tapping is not the last word in the tapping of Ceara trees, but in practice it has shown advantages over any of the other methods tried, and is the best we have found so far; furthermore, the best returns, in the use of this method, were obtained in the series of experiments carried out by the Board of Agriculture and Forestry and the Experiment Station last year, and these were obtained by making two vertical cuts, two in each place and at each tapping. They were made with knives, and a number of the cuts were too deep; a number of the trees have been thus injured. The chief objection to it in my mind is that it does not admit of a sufficient number of tappings in each year. If we can discover some other method of getting at the same result, I think we will find it better, provided we can secure sufficient labour.

"When the vertical cut is made, there is a tendency in the bark to crack open—that is, the wood part of the bark cracks open, and this is apt to cause an injury that is difficult to heal, and it makes the bark rust. Aside from that, I have not seen any reason to believe that one will heal before the other. I have not seen any difference in that respect. We did try making vertical cuts on the tree, and found it more difficult to do the tapping in that way without injuring the tree.

OTHER TRIED METHODS.

"Other methods that have been tried with Ceara trees are: vertical cuts—paring, spiral cuts, V's, pricking and collecting, pricking and acetic acid, paring and pricking simultaneously.

"The latex cells lie so near the cambium in these trees that it is difficult to cut with a knife deep enough to get all the latex without injuring the cambium. A knife with the right sort of guard will in a measure overcome this difficulty, but no satisfactory knife of this sort has yet been found. The guard should be so constructed as to run in the bottom of the cut and not on the outside of the bark, as is the case with the only locally made knife of this sort that has been produced. Such a guard would not need to be adjustable, as it would always run in the bottom of the old cut, regulating the new cut to the same depth as the old one. Then; due care having been exercised in making the first cut, the others could be regulated by it. In the use of such a knife, by the time it reaches the bottom of the bark you get the maximum amount of cut. I think that possibly this knife might be adjusted by altering the guard. The guard itself takes up one-sixteenth or one-twentieth of an inch. The Bowman-Northway paring knife has a guard on this principle, but is made for Hevea trees, where the bark is thicker and the parings thinner than with us.

WANTED—A KNIFE.

"I have no doubt but that a knife suitable to our uses can be produced. I think that perhaps some mechanical inventor here can produce one. We now have coming from the Far East all the knives they have, I mean, one of each of all the knives they have. They stick to the knife with the gouge. They have a bent-in gouge. They have one or two push-and-pull knives. I brought one with me which makes a new cut and the guard runs on the outside of the bark. In order to make a paring of an ordinary cut, we have to make a "V" cut or else a "U" cut that is very narrow. We are at present using the Yates-Burgus or "Burgus" knife, which, being a push-and-pull knife and making a very clean, sharp cut and both right and left-handed, has shown itself to be a very good all-round knife, after slight alteration to make the cut more nearly "V" shaped in place of the wide "U" cut, which serves on the thicker barked Hevea. This knife has no guard, or gouge, but, since our paring is to be followed by the prickings, we do not try to go very near the cambium, and on trees of proper tapping size, the cut can be rapidly made without injury. Of course, we started paring and pricking at the same time, so that a man could do his paring with that knife and then turn around and do his pricking. If you pull, you can gauge the depth to which you go.

"A very good pulling knife for making first or original cuts in the vertical tapping system has been developed locally along the line of the modified farrier's knife, used in the experiments of last year. A few of these have been made by Mr. Sylvester, and should do good work in making this style of cut. As a rule, the Japanese prefer to draw it, while the Portuguese or Hawaiians will push it. I brought this knife back with me at the same time I brought the gouge that they are using, and we observed both. The knife lies about flat on the cut and makes a clean, sharp cut, while the gouge is a bit beveled and is apt to drag.

"We would be glad if some enterprising person would produce a knife that could be made to produce a cut from four to six inches apart, that could be fairly well controlled as to the depth of the cut and width of the paring made. Such a knife would reduce the cost of paring considerably. It seems to me that we should find someone that could produce a tool with which we can make more than one cut at the same time. If we could secure such a tool – a knife that one man can handle—it would save us a great deal in the cost of paring.

"A pricker perfectly adapted to all the conditions has not yet been found, but, of course, one will be evolved in time. We are at present using a tool designed for an entirely different purpose, but which does very good work, following the paring in the system now employed.

COAGULATION PROBLEMS.

"The most interesting problems to be solved in the future of rubber planting are those in connection with improved methods of coagulating the latex and curing the rubber, and those bearing upon the possible relation of fertilizers to the latex yield.

"Not only have tapping knives been invented and successfully used, that we have never seen and probably have never heard of, but several machines and processes have been invented for smoking either the latex or the rubber. Smoked plantation rubber is quoted at about ten cents per pound higher than the best unsmoked. This additional ten cents per pound may some time mean to us the difference between profits and no profits, and in any case will mean additional income at comparatively little cost. Besides this, the first factory is just being planned, and for this alone two machines which are unquestionably essential have been ordered—a washing machine and drying apparatus. To equip this factory to the very best advantage, it will not be sufficient to have observed one or two successful factories in operation; one should know all the improvements that have been made since these successful factories were erected.

ALL EXPERIMENTAL.

"The making of rubber plantation machinery is in its infancy, and for that reason every advance is likely to be a big advance. Our factories, when built, should be of the highest possible efficiency, for only by the use of machinery in its highest point of efficiency and economy can we hope to overcome the handicap under which we are placed by local labour conditions. It would be folly to sit at home and hope we may start at the beginning and work out the problems that others have already gone far in solving. We should learn all the others know and then improve on their accomplishments. For this reason I believe this association, if this is the proper medium for joint action by all the plantations and planters, should send someone to the London Exhibition next summer. Here all the rubber machinery in the world will be represented, and especially the products of English manufacturers who have for several years specialized in plantation machinery. These will not only be exhibited, but demonstrated, and no better opportunity could possibly be offered, or more timely for us.

"It seems to me we should send some one familiar with the problems here, who can adapt to our local conditions what he learns from the discussions and exhibits there. He can there obtain the best the world affords in tools for tapping and curing our product. I believe the person should have some authority to purchase, for he might find just the knife we require to overcome our difficulties, or he might find just the pricker we need, and if so, should be able to purchase in such quantities as to enable us to use them at once. This would also enable us to get the best possible equipment for our factories. Were he to wait until his return home and make his report for Directors to act upon, before orders could be given that must be filled in England, delay of months would ensue, while, should he order on the ground, the goods might arrive nearly as soon as he did. Purchases have got to be made anyway, and why not go shopping to the one place where all there is to choose from can be seen at one time. He will be able to compare prices.

"The members of the Association have spent in the neighbourhood of $300,000 to bring the industry to its present state, where the trees are ready to give their product; $1,000 more, or whatever it might cost to insure the making of this product as valuable as possible, would be well spent. The factory now under way, and all that may hereafter be built, should have a suitable apparatus, whatever it may prove to be, or at least the most suitable yet discovered or invented for properly smoking its rubber, if by so doing it can obtain ten cents per pound more for that rubber, or even three cents per pound more.

"Reports are just now coming to hand of the invention of a successful machine for doing chemically what the smoking process used in fine hard Para does. The late Mr. W. W. Hall had this in mind when he suggested to me several years ago the use of pyroligneous acid for the purpose. If this machine is all that it is hoped it will be, we should have it, if it is adaptable to our product. The only way to learn whether it is, is to see it work.

DRYING APPARATUS.

"We have found that we shall need some sort of artificial drying apparatus. If the rubber is kept for any length of time exposed to the air, a mold forms on it and it takes anyway three or four weeks to dry the rubber out here, and for that reason the rubber company has come to the conclusion that it is wise for us to invest a little money in a vacuum dryer for the reason that we are not ready at this time to spend money on expensive machinery.

YIELD PER TREE.

"Our trees yield about a pound of rubber from one hundred trees at a tapping, or at one hundred tappings from the same tree. We find trees that are not more than ten inches in circumference that will give a profitable yield, while some sixteen-inch trees do not give a profitable yield. We find, too, that removing the bark all at once is apt to injure the tree, but we will probably try to find some way of removing all of the outside bark at once. This knife does very good work cutting through even the original tough bark as well as the new bark that might form.

"We have over 1,200 trees, and I think it will work out to tap about nine times and then rest the tree for a week.

"We cannot tap one tree one hundred times in a year unless we make our cuts wider than this. Of course, if we made our tappings twice as far apart, we would get twice as much rubber. We may find that it will be wiser in the long run to make our tappings farther apart. I do not think that we shall want to tap all the year round. The trees should be rested from the first of February until the first of May. It will probably be found wiser to tap the tree nine times and then rest it for three weeks, and then make another tapping, in which case we remove one inch of the bark. By this scheme we make eight or ten cuts each side of the channel, and that makes sixteen or twenty cuts on the tree. Of course the expert will prick a great many more than he will pare. We select the more skilful ones for the tapping. We are not using any acid. We tried a scheme that I believe is being used in South Africa. We found the same difficulty there that we found in trying to grow without paring. I am firmly convinced that more or less injury is done to the tree every time the bark is taken off. The scheme that we have now adopted avoids that difficulty."

PAPER BY MR. L. F. TURNER.

After the conclusion of the discussion following Mr. Anderson's paper, Mr. L. F. Turner read an address on "Cultivation of Rubber Trees and its Results." It was as follows :—

"I have been asked to prepare a paper on Cultivation and Soil Conditions. I presume that the request refers entirely to rubber culture, as it is to be read at a Convention of rubber planters.

"Several conditions are necessary for success, with rubber as with all other crops; we must have soil to cultivate, and we must cultivate the soil to a reasonable extent at least. To this may be added that heat and moisture, and proper climatic conditions are also essential. This much will be conceded by all, and then each man has his own opinion of what cultivation means.

Different conditions require different methods of treatment; each manager probably recognizes that the stirring of the soil is of prime importance; each one knows that the roots of the trees must not be cut; and the benefits of fertilizers have been so thoroughly demonstrated that they need no further argument. How best to accomplish the cultivation with the utmost benefit to the trees, and at the smallest expense, is the problem to be solved, and perhaps the best way to get at it is for each of us to speak of our own conditions and compare results.

"Puna is pre-emintly a volcanic district; its soils are, with the exception of the organic matter on the surface, entirely of volcanic origin; every process of the change from rock or sand, to fertile soil, is here laid before us as an open book. The abundance of moisture combined with the warmth of the climate, and its freedom from winds gives surpassing fertility, and the old saying: 'Everything grows in Puna,' is more than borne out by the results spread out before us on all but the most barren rocks; and even among those trees and bushes are springing up, and in some parts dense jungles of lauhala are growing almost to the water's edge.

"The enormous flows of pahoehoe, and the out-bursts of sand and ashes are everywhere apparent, leaving no doubt whatever as to the agencies that have been at work to produce the present conditions. Layers of pahoehoe over deep soil show that fertile land has been covered, and speak either of the vast time that must have elapsed to produce this soil, or of alternate outbreaks of sand and ashes and of lava. And with the exception of the 1840 flow, which came from Kilauea, and the legend of Pele chasing the chief who had bested her in a game, there is no record nor tradition of activity in any of the numerous craters in this portion of the district.

"The action of rain on the sand and ashes beats down the surface, and then a little lichen or moss, a few ferns or shrubs, and vegetation has commenced, and the decaying vegetation combined with the moisture from the atmosphere, quickly absorbed by the sand and ashes, forms the beginning of the soil which deepens and increases in richness, until in some cases it becomes almost a muck. Such are the soils of our better lands, our arable lands.

"The grinding and wearing of the rocks as they rolled or were pushed along, and filling-in of some of the crevices by weathering; the above processes repeated, followed by the further breaking down, disintegration, and decomposition of the rocks by the roots of shrubs and young trees, form the beginning of our almost impenetrable forests, and with the abundant rainfall sufficiently account for the richness of our lands.

"The change from the absolutely sterile rock below, porous as a sponge, and with every vestige of life burnt out of it to the fertile soil of the surface, is illustrated in the numerous upheavals; the gradual deepening of colour as the rocks slowly absorb oxygen from the atmosphere, and humus from the decaying vegetation, is apparent to every observer. Every class of disintegration is shown, and every class of stone, from the impervious rock, hard as flint and heavy as lead formed under enormous pressure, to the light and friable scoria which can almost be crushed in our hands, and the transformation from the immense boulder to smaller and smaller rocks until the rock soil—the base of all soils—is formed, takes place almost before our eyes.

"The process of disintegration may be greatly hastened by cultivation. Anything that will stir the rocks and break or chip off small portions from time to time makes it easier for the rootlets to enter the pores, and so hurries along the disintegration and decomposition.

"On such soils as these ordinary methods of culture have to be abandoned; add to this fallen trees lying all over the fields, and culture as generally understood becomes impossible; all that we can do is to keep down the weeds and clean around the trees while they are young; in this we have derived great benefit from a suggestion of Dr. Wilcox—the arsenic spray. This is a solution of arsenic and washing soda dissolved in water by boiling, and applied by force pumps in the form of a fine mist; it will not take the place of cultivation, but is a valuable auxiliary.

"We have found that on our lands the best and cheapest method is to leave all the debris on the field to rot back into soil; it keeps down the weeds and adds to the humus; it must, of course, be laid in windrows, and gradually pulled together as portions of it disappear; two or three years tell the tale. If the land is planted as soon as cleared of forest—and no other method should be adopted—there will be nearly a year in which no great expense for weeding will be required; but sooner or later the weeds creep in, and then if the trees have not made a good growth in the meantime, the trouble and expense commence. Intercrops may be called to our assistance for the first two years; after that they will have to be abandoned to a great extent, as the roots of the two crops will have interlaced and both will suffer. Our best soils, our arable land! Sand and volcanic ash saturated with humus and thoroughly pervious to air and moisture require less cultivation than more compact soils; even here, however, a thorough stirring produces new combinations; new supplies of food are presented to the innumerable bacteria, and they in turn produce large supplies of soluble food material for the trees—which promptly respond to it—and if fertilizer is liberally supplied in addition at this time, two or more years' growth may be condensed into one. This requires money, and men!—but it is money well and wisely expended.

"Fertilizing is a necessary part of cultivation; it reduces the expense of weeding, not by eradicating the weeds, but by hastening the growth of the crop; two weedings with fertilizer will bring the trees to the same size as three or more without it; it gives them increased vigour, and makes them better fitted to withstand unfavourable conditions later on. We have found that from one-half to one pound, applied around the tree, gives good results, and that two applications are better than one, even if only the same amount of material is used. As to the kind—any good, complete fertilizer will work well, and the higher grades are the cheaper, as the cost of transportation is proportionately less. The best proportions of the phosphates, nitrogen and potash, will have to be matters of experiment; analysis of the soil cannot be entirely relied on; there is in all probability vastly more of each in the soil than you are likely to apply, and it is safe to say that if leaching or washing out can be avoided none of the material will be wasted.

"We have found that a heavy growth of weeds even in the middle of the lines is better avoided; that by cutting everything down there was a great and immediate improvement in the trees. Weeds choke the tiny feeding roots, and by forming a sod prevent the air from entering the soil; this is doubly true of Hilo grass; unless this latter is kept under control the inevitable result with the rubber tree, as with most other trees or plants, is loss of vigour, deterioration, and eventually death."

DISCUSSION.

Mr. Ewart: Do you fertilize all the trees?

Mr. Turner: No; just the younger trees. There is no question whatever about the value of the fertilizing.

Mr. Ewart: What kind of fertilizer do you use?

Mr. Turner: Just the ordinary fertilizer of a high grade. The fertilizer that we use was prepared especially for us by the Hackfield Fertilizer Works. The formula comes from a California fertilizer man, and was given to me as a matter of good will: 10% ammonia from nitrate, 8% to 9% of phosphate from steel bean, 5% muriate of potash. I have never used any straight potash. I used it on one tree and killed the tree. It was a small tree, and I put it on around the roots. I may say that arsenic spray is an exceedingly valuable suggestion of Dr. Wilcox. It takes two or three applications, but after that it does the work.

Mr. Ewart: What is the formula?

Mr. Turner: One pound arsenic, four pounds soda, one gallon water. We dilute about twenty times.

Mr. Cooke: What does it cost to spray an acre?

Mr. Turner: The cost of spraying is very little. On ordinary land it amounts to a dollar or $1·25 an acre, but on our land it would cost more than that, because our land is very rough. I am figuring more on the labour; the cost of material on the acre would not be over half a dollar. That is very cheap cleaning. A question I think we should ask the Doctor is how long it can be kept up without injuring the soil. We use two or three pounds of soda ordinarily.

Mr. Cooke: Can a man spray an acre in a day?

Mr. Turner: I think he can go over two acres in a day on ground of the roughest possible description.

Mr. Anderson: Mr. Turner asks how long the spraying can be done without injuring the trees. We have done it for years. We have used this spray for two years.

Mr. Lindsay: How many applications did you make in that two years?

Mr. Anderson: We had one field that we sprayed about once in every three months. We gave it eight or ten sprayings, and the trees looked thoroughly healthy, and there is a marked difference in the appearance of the soil. When the grass grows up on the soil it improves considerably in appearance.

Mr. Turner: It kills out some and does not kill out others.

Mr. Anderson: It is the same thing; I have tried the iron sulphate, but it is not as effective as the arsenic.

PAPER BY MR. C. J. AUSTIN.

Owing to the absence of Mr. C. J. Austin of Nahiku, his paper on "Pests that have been found in Rubber Trees in Hawaii" was read by Mr. Lindsay. It was as follows:—

"When the rubber industry was started in this Territory, it was stated by many people that the rubber tree had no pests, so that those that were investing their hard-earned capital in the rubber business need have no fear of later disastrous developments along that line. But, unfortunately, those who made such statements had not taken into consideration the great scheme of universal life which is hemmed on all sides with enemies of one kind or another.

"And when large numbers of individuals are gathered together these enemies also seem to congregate and carry on a war for existence, and we find that the rubber plant is no exception to the general rule. In the early stages of the rubber planting a small nocturnal marauder, the cut-worm, did considerable damage to the young plants as they were set out, but as the plants grow rapidly, and those who had the work in charge learned the habits of this nightly visitor, it soon became of little importance, and now it is hardly considered a pest, as it also has a parasite which keeps it in partial check.

"Following the cut-worm, rats commenced their depredations, and with an appetite that one might fear would be dangerous to well-equipped digestive organs, they peeled the bark that contains this most valuable gum we call rubber, and in some instances have been known to climb trees that were six or eight feet high and destroy the more tender shoots either killing the tree or materially setting it back. But their depredations were soon stopped when clean cultivation removed their hiding places, and with the use of dogs and poison their homes were destroyed, so that injuries caused by this small animal at present, for they are so slight, hardly noticed.

"At the present time there are one or too small pests that are still with us in the form of sucking insects. One of these is a small brown scale that usually infests the under part of the leaves and congregates along the mid-rib and the soft bark of the young and tender twigs. This insect is generally known here as the brown or shell scale, and has been determined by Mr. Ehrhorn, Superintendent of Entomology of the Board of Agriculture and Forestry, and others, as being *Saissetia nigra*, The injuries that are caused by this do not come so much from what they take out of the tree, as by a black fungus that grows on the honey-dew exuded by this scale. This fungus covers the leaves and branches of the tree, and materially checks the respiratory organs, and to a certain extent weakens the tree. The other of these sucking insects is what is generally called the Miali Bug (*Dactylopius*). This also exudes a honey-dew which supplies the growing fungus with the material, and also has a tendency to curl up the leaves, which are all injurious to the tree to some extent.

However, through the assistance of the Board of Agriculture and Forestry, parasites for these insects have been introduced in the Nahiku district, and we trust that these insects will soon be a thing of the past, or be under such control that their injurious effects will not be felt, as the scale has already shown signs of diminishing.

"Since tapping has commenced, a few slight injuries by boring beetles have been noticed, but at present we are unable to give any special information, nor do we know that it can be classed as one of the rubber pests; but will require close observation during the coming year to see that it does not get a start in our fields.

"There is still another pest that may possibly become a menace to our Heveas. This is a fungus disease which is closely allied to what is known as shot-hole fungus (*Phyllosticta prunicola*), but no fear need be felt from this fungus, as we know how to deal with it."

At the afternoon session of the Convention the following officers were elected to serve for the ensuing year:—

C. D. Lufkin, President.
William Williamson, Vice-President.
D. C. Lindsay, Secretary and Treasurer.
Bertram von Damm, Director.
Wade Warren Thyer, Director.

PAPER BY MR. WILLIAMSON.

"The Present Status of Rubber Growing in Hawaii" was then discussed by Mr. William Williamson as follows:—

"Gentlemen of the Convention:—A couple of weeks ago Mr. Waldron came to me and asked me if I would talk, and I told him that I would be very glad to. He wanted me to talk about marketing, or something else. I told him I would talk about marketing, but mostly about something else. All I can say about marketing is that we accumulated about 40 pounds of rubber, of which 18 pounds was scrap. We did not feel like giving this away, so we sent it on through Alexander & Baldwin, through their New York agents, as it was sufficient to make up what the companies back there seemed to want—that is, a good working sample. We expect within a week or two to get a report on that rubber. In order to get something to talk about, and as I had not been in Nahiku for two years, but previous to that had been over there three or four times each year, and had seen the various companies plant their lands, I thought it would be a good idea to go to Nahiku and try to give you here a general idea of the condition of things over there on Maui.

"When the first rubber companies were organized to plant rubber trees at Nahiku, some six years ago, it was thought that all that would be necessary would be to cut down the virgin forest, dig holes 3 or 4 feet in diameter, and plant the seedlings there. During the first year the trees grew remarkably well, but as the roots struck the edge of the hole, instead of striking through into the virgin sod, in many cases they turned back and formed a tangle within the original hole. The natural result was that during the second and third years they failed to respond to hoeing and became backward in their growth.

"During 1908 a few acres to be planted to Hevea from choice seeds were ploughed in preparation, and the trees planted in this area showed such thriftiness that at the beginning of the next year three of the companies operating in the district decided to clear the Ceara fields of all stumps and grass, and stir the soil of all the space between the trees. Of the 800 acres planted by these three companies, 550 are now clean cultivated, and the balance will be within a few months. The trees have responded readily, showing an average growth of 4 inches in circumference per year, from which it is evident that had the first plantings been in ploughed ground, the Nahiku product would have made its appearance in the market last year when rubber reached $3·00 per pound. These lands, once cleaned up, are kept in condition by an occasional spraying with arsenate of soda. The writer was doubtful of the wisdom of applying a powerful poison over any considerable area when it was first recommended, but in so far as he can see it kills the grass and weed growth, but has had no injurious effect whatsoever upon the trees. Some of the lands so treated for about a year where the branches interlace to shade the ground are now so free from grass and weeds that they will require no more attention. Acreage that has not been cleaned up is backward, and it is evident that the longer the trees are neglected the longer will be the wait for returns, while many thousands of trees will never reach tappable size, while they must share the life-sustaining properties of the soil with the grasses and weeds that grow between.

"Throughout the fields are a few thousand trees that have attained a circumference of 20 inches, and a few hundred will measure as much as 30 inches. The average run of the 1905-1906 plantings is 12 to 18 inches.

"Eight men who have become fairly adept at handling the tapping knife are now tapping under the direct supervision of the several managers. These will form the nucleus of a much larger force that will be required next year, when at least 20,000 trees will have attained tappable size.

"From the results obtained by these men, explained in detail by another paper to be read here to-day, the rubber industry, young as it is, offers great promise of a reasonable return on capital invested, if conducted as it now is by men of intelligence, ingenuity and adaptability.

"As the time for tapping over a large area is at hand, one plantation has already ordered machinery for a factory which will be running within a few months.

"A movement is now on foot to unite the companies now operating at Nahiku, and if successful this factory will be enlarged to handle the product of the whole district. Additional advantages to be gained by this move are the establishment of a standard product to be known as Hawaiian Rubber and doing away with competition for labour among the various companies.

"Noticeable in the district is the planting that has been done by homesteaders. With a factory at hand to handle the product as it comes from the trees, the writer sees for the individual planter a profitable use for his land."

DISCUSSION.

Just two years ago when I went over there, the Plantation was considering putting the lands under cultivation. About two acres had been cleaned up, and some 30 or 40 hevea trees had been planted there. Then there were very few trees that would run 8 inches. To-day under clean cultivation, with many of the smallest trees thinned out; the average size of the trees that I mentioned is now about 12 to 18 inches, with many 20 inches, and some even as high as thirty. The growth of older trees under clean cultivation is not as rapid as that of the later plantings, and it is evident from this that if you plant a tree in ploughed land it will grow faster than a tree that has been growing for several years in unploughed land, and is clean cultivated later on. Trees of later planting in most cases have caught up with the other trees. You can find there acres and acres of trees that will average twelve to eighteen inches.

Mr. Lindsay: How about the Hevea trees?

Mr. Williamson: The Hevea in some lots seems to be doing nicely. I think it was in June, 1907, that the first lot was set out up there, and those I have measurements of. They average about 10 inches at the base, and the bark will average a fourth of an inch in thickness 22 inches from the ground. The hevea trees throughout the Plantation seem to be growing very slowly as compared with the ceara.

Mr. Thayer: Will it be a long time before any of those hevea trees produce?

Mr. Williamson: I am inclined to think it will be a year or two. If you wait until they are 20 inches in circumference, it will be a couple of years at least.

Dr. Clark: Are they injured by the heavy winds—do the leaves fall off?

Mr. Williamson: The hevea leaves do not stand the wind. The leaves seem to curl up in the wind and get brown on the edges and blow off. The trees in our nursery average about 10 inches. A few ceara trees on our Plantation that were given garden cultivation from the first measure a little over 40 inches, and the average is 30 inches. That is a very good growth. They have grown so fast that the wind has not damaged them a particle.

ADDRESS BY DR. E. V. WILCOX.

The Chairman then introduced Dr. E. V. Wilcox, Director of the United States Agricultural Experiment Station at Honolulu, who spoke as follows:—

One of the things that strikes one in looking into the history of the rubber industry in Hawaii, is the fact that the men who have borne the burden of the finances of the rubber here have had a very good, steady nerve all the time. When we stop to think that at the start nothing was known as to whether rubber would succeed here or not, that the expense of managing the rubber was not understood, that it was not known what the yield would be, and, furthermore, the whole proposition of managing ceara rubber as a plantation business rather than wild trees, was almost entirely new, and we had next to no information on it at all. I say it required good business enterprise to start in and plant as has been done in Hawaii and keep the business going.

When we first began work on the rubber here, the first tapping and experiments were carried on by Mr. Smith, and they indicated that satisfactory yields could be obtained, that the trees were actually producing quantities which were promising, and immediately we began on the methods of tapping. I was impressed, while listening to Mr. Anderson's paper this morning, with the idea of the necessity of varying the tapping methods as the trees became larger, and I have no doubt that other modifications may be found very desirable when the bark becomes a little thicker and the trees become larger. When we started in tapping. the cut was made in only one direction, and it was necessary to use the upright cut in order to get a sufficient area or surface of the bark, but it soon became evident that when the rainfall was heavy there was a high pressure, and that the trees had actually popped and split open. Under those circumstances, it may relieve the pressure so that the flow will not be so extensive.

The manner of cultivation of rubber trees is one of the most important things in the industry. Like Mr. Williamson, I went over all the plantings of all the companies last May, and I think it was shortly after that I went over to Puna Plantation, too, and was able to observe very carefully the growth of trees with cultivation and without it. It is a very serious proposition on account of the very rough nature of the land. It simply means promptly getting rid of the weeds and giving the sun a chance to get at the soil. In my opinion, it is not necessary in rubber cultivation to stir the soil very much after the trees have once got a start, if you keep the ground clear so that the sun can get it. Any statement that you may make regarding the cultivation of soils in Hawaii will have to be taken with some reservation, as this statement will apply only to the particular lands in question. In soils which can be puddled, one of the prime requisites in getting a crop from anything, is to keep off the land when it is too wet. In some of the districts in Nahiku, it will be seen that the manager would have a very easy job, because it would be raining most of the time, and yet something must be done. The weeds could not be annihilated because it is so wet that they, after being hoed, would again grow up. No plant can grow without air any more than an animal can, and if you shut out the oxygen it would die in a short time, and it will show the effects of the lack of oxygen very quickly.

One of the most striking things to me on looking over all the plantings and comparing them with about a year before, was the great changes that had taken place in the physical appearance of the soil where this weed eradication had been carried on. In some places the soil was mud and the horse went along in the mire. After the weeds were removed, the superficial water ran off, and many of those places were actually more or less dry. There was a very noticeable difference, and the air was going into the soil and the trees were growing.

Now, from the results that have been had so far in growing rubber in Nahiku, it seems to me that we may be sure that a tree large enough for tapping can be got inside of five years. I do not think that unreasonable. Inside of three years we could get them, with the best cultivation, but five years is plenty of time to allow to get a plantation of good size for convenient tapping. It is not possible by any means to get ceara without cultivation. You can go about the plantation and see trees three years old with cultivation that are larger than trees five years old without cultivation in similar conditions. That saving of two years is, of course, of immense advantage. It might make all the difference between succeeding and not succeeding, keeping the stock-holders encouraged and having them discouraged, and having the question of financial backing trembling in the balance all the time.

Of course I have heard some expressions of slight disappointment from time to time at the results of tapping experiments which have been carried on here. I think we have been unduly enthusiastic about the yields which we are going to get, and particularly in Hawaii we are always looking for too large profits. But the results indicate, as Mr. Anderson said this morning, very clearly that a reasonable profit can be obtained from the rubber trees as they stand, and this is the time to settle the matter, so far as we can tell now, as to whether the rubber is an industry here or not. If you can take trees that were planted five years ago with no special knowledge as to what ought to be done to rubber here, starting in on an industry of which there was absolutely nothing known to us, and, after making some mistakes, still get trees which will yield a profit in five years, it seems that would settle the point as to whether there is a reasonable profit in carrying for rubber trees, for every man who has charge of rubber work on every plantation is now armed with a whole arsenal of information.

The yields, as I look at them, are very encouraging. We are dealing with young trees that are more or less lacking in uniformity because they did not receive the same line of treatment. We have had different methods of tapping, and while there may be a hesitation on the part of some as to the foundation of getting enormous profits, there must be big profit in the business when we can take it out at 50 cents a pound and sell for $1·40, with the unskilled labour here.

One thing that appears interesting to me in the experiments of the Nakiku Rubber Co. under Mr. Anderson is the fact that boys do the work very well. It is not a heavy class of work; it does not require much brute force. It merely requires a little manual skill and dexterity. They are very quick in collecting the rubber. It is all light work, and they can easily carry a bucket, perhaps faster than a grown person, and do the work just as well. That indicates that in that cheap labour we can find a solution of the problem of reducing the expense, provided the price of rubber should fall below where the rubber growers might wish it to fall.

In the matter of diseases and the insects and pests of rubber I do not believe they are very serious so far. It may be that some will develop of which we know nothing now, and there are but few instances of trees which have been seriously affected by the shot-hole fungus or even with rats as soon as the ground in between the trees has been cleared up.

Another point is the matter of altitude. I don't know whether it would be wise, it never is commercially, to try to find the limit of altitude in which rubber can be grown, but in going over the plantations last May I was enabled to note that the rubber grew as well at 1,400 feet as it did at some lower elevations where it received the attention that it deserved. However, an altitude up to 1,300 or 1,400 feet does not seem to affect the rapidity of the growth.

The question of the kind of rubber to be grown here is somewhat left open yet, but the decidedly more rapid growth of ceara seems to indicate that that is the one upon which we can depend at present. There is also the hevea and the castilloa, which have been discussed. There have been at times a number who have been enthusiastic about the growth of hevea, but it is so slow as compared with ceara, and is affected so much more by the winds and altitude, for it seems to dwindle out at 1,000 or 1,100 feet, that it seems that the ceara tree is the one to grow here. And as to the rapidity of growth, we may say that the ceara does remarkably well here, and is perfectly satisfactory as to the rate of growth, and in the most part in the shape of the trees.

Referring again to the tapping experiments which Mr. Anderson has been carrying on, I would suggest that a device might be gotten up which would hold several knives at the same time. That might be possible if we had several trees the same size in trunk; one knife might not cut as deep as the other knife, and in straight cuts a device something like the instrument that was submitted to Mr. Hosmer from a Mexican rubber expert might be modified in such a manner as to carry several knives, but the device itself would have to be worked outright on the plantation. As a matter of fact all of the actual, practical details of how to make rubber economically have to be worked out by the man who has charge of the plantation. We cannot depend upon any man who has other things to bother about, and is looking at it from a different standpoint from the man who is interested in it. He cannot work at the practical details. I am always glad to do whatever I can do toward the encouragement of any industry which really promises to give rewards which warrant one in being encouraged, and I have been impressed with the management of industries which are more or less new, and on which we have only limited local experience.

One of the things in gaining success is not to be too enthusiastic at first, not to expect three or four hundred per cent., not to expect that the crops are going to grow without attention, and not to expect that there is going to be no trouble. The plants require attention. It requires not only money, but brains and industry joined together and applied to the business at all times in order to make a success of it, and I honestly believe that the results which we have gotten so far from rubber show that not only have there been men with the courage to put their money into it, but that the work which has been done by the men who have had practically to manage this business, has been conscientious and has brought about results which are all that any reasonable man can expect, and so, gentlemen, it seems to me that these results are very encouraging at the present time. If you can get profit from the trees you have now, I do not see that there should be any worry about the methods. In looking after the little details which may improve the business from your standpoint, the proposition to unite the companies together I believe would be a very fine scheme indeed. It would accomplish just what Mr. Williamson said it would. It would be more economical. You need to have a large plant in order to manage the thing economically. If you are going to have such a thing on the market as Hawaiian rubber, it should be always of the same quality, so that the market can be kept up, so it seems to me that the rubber situation would be greatly improved if the companies were united on an equitable basis.

Gentlemen, I thank you for your attention.

Mr. Anderson: At the last Convention we asked Dr. Wilcox about the spray. As we have only used this material for about a year, he might be able to tell us what he thinks about it.

Dr. Wilcox: As I said this morning, I have used several formulas at the Station. I believe you found that 1 to 20-24 is about right; about a hundred gallons covers an acre. At that rate, only 5 pounds of arsenic were used per acre. It is in a very soluble form. The most of it is held upon the plant and finally falls down when the plant falls down, or if you burn it up, it is burned up in that way. Five pounds per acre is actually less than has been applied for 20, 30 and 40 years on the same ground in orchards on the mainland without causing any injurious effects on the soil. The presence of arsenic, even in a soluble form, would not cause a burning effect on the roots, because they are too thickly covered with bark, and the mere presence of it at that rate does not cause any harmful effect on plants. I don't see any reason why we should worry about that. If it is to be kept up for years and years and years, you might think there might be an accumulation. The soluble salts are continually washed out of the soil, and I do not believe it could accumulate beyond a certain limit. I doubt whether it will ever accumulate.

Mr. Turner: I may say that in spraying our trees the barrel was placed between two trees, and in dipping out from the tin there was a certain amount of dripping, and the exact amount that was wasted I do not know, but it was merely dripping. The bark burst open and bled all the way through and the tree was defoliated.

Dr. Wilcox: How much was poured in there?

Mr. Turner: I was not along with them at the time. The trees are not dead, but they have not recovered yet.

Mr. Cooke: I would like to offer a suggestion to the Convention at this time. It seems to me that we are about getting to a position where the rubber will be placed on the market. It might be a good idea to have a Committee to look into the marketing conditions and make suggestions at the next Convention. It seems to me that if a certain standard of rubber can be produced, possibly a unique form of putting it upon the market might give the Hawaiian planter a certain advantage. I don't believe there is much call for a report, but just offer this as a suggestion.

Chairman Lufkin: It seems to me eminently in order that such a Committee should be appointed.

Mr. Cooke: I make it as a suggestion, and as a motion also. Dr. Wilcox said that in all shipments we should maintain a certain standard, and that in my experience is most essential, and it is very essential that the bulk of the product should come up to the standard.

Chairman Lufkin: The motion is duly seconded that a Committee of three be appointed to investigate the rubber market, looking foward to future marketing of the rubber crop on several plantations. Of course, in the present condition of the rubber business, we are all acting for this individually, and it would hardly be practicable, but in view of the fact that combinations are likely to be made, I think we are good business men enough to see the advantage of it, where the marketing can be done by one concern or agency.

Mr. Turner: There are no two plantations that bring the same rubber; they do not bring the same price.

Chairman Lufkin: The object is to investigate the market, ascertaining the best form in which to place the rubber on the market, pancakes or whatever it is, and at the next meeting of this Convention to make a report which will put us in the right way of marketing the rubber at that time. I understand this Committee is to make merely preliminary investigations. Motion carried.

Mr. von Damm: I would like to say that some time ago I got a small sample of Nahiku rubber from Mr. Williamson and sent it to London, where a friend of mine in turn took it to experts, and he wrote me and said that they had not seen rubber in that shape before, but that these experts, after analyzing the sample, had said that it would fall not very far short from the top price of Para, and they were very anxious to find out whether it came from the hevea or ceara trees. I had written him that we were principally growing ceara on these Islands. The experts had the impression that it might have come from the hevea tree.

Mr. Anderson: We were told by manufacturers in New York that most of the ceara rubber they get is not properly washed and dried that they had imported ceara rubber from abroad and had been unable to use or dispose of it and had sent it back. They said that all they needed was working samples in order to give us a definite price for our rubber.

MR. R. S. HOSMER'S REMARKS.

Chairman Lufkin: My predecessor has very wisely obtained the consent of Mr. Hosmer to address the Association.

Mr. Hosmer: I did not come here to make any speech; I only came as an individual member to show my interest in this Convention, and, indeed, I have not anything technically of interest to contribute. Unfortunately, the appropriations of our Board have not been sufficient for us to branch out except for our regular routine work, so I have not gone into this investigation from a technical standpoint.

There are two things I would like to say, however. The Board of Agriculture and Forestry is always willing to do all it can in helping on any of the so-called "allied industries," and rubber naturally appeals very strongly to us as an industry in which we are especially interested. At this time we can help, possibly, by opening the columns of our monthly magazine, the *Hawaiian Forester and Agriculturist,* if you desire to publish the reports of this meeting. Even if you publish them again as a separate report, it could well appear as a special number of the *Forester.* I think that the papers which have been read here to-day ought to be made of permanent record and given wide distribution. They ought to go on record for future reference.

One other matter, and that is the suggestion made by Mr. Anderson at the end of this talk, that someone from this Association should be present at the Rubber Growers' Meeting in London next spring. I don't know much about that meeting, but I do know that there is going to be a big meeting there, and I know from my own personal experience that it is a mighty good thing for the man himself, for anyone occasionally to go to such meetings. He gets a great deal out of it, and the information brought back is of value to the industry. I strongly recommend that one of the technical rubber men be sent on behalf of the Association, or in some other way to represent the Association there; to be on hand to bring back as much information as he can.

If at any time or in any way the Board of Agriculture and Forestry can be of assistance to the members of this Association, we are there to be called upon.

REMARKS BY MR. E. M. EHRHORN.

Mr. Ehrhorn, Territorial Entomologist: I don't know that I can tell you very much about the pests that affect the rubber. I have just read Mr. Austin's paper, and there is just one thing I can say, and that is that the rubber growers can be congratulated because they have very few pests attacking the trees. Since last year I have looked into the matter, and in fact have kept in very close touch with the rubber growers, and I can say that we know of only two scale insects, that those are insects that are found in forests, generally speaking, but they are kept in check by the parasites that are already here. I forwarded to Mr. Austin at Nahiku some of these parasites because he was complaining about the black scale pest. The mealy bug which attacks the rubber tree is one common kind, but I do not think that you are in danger from the pest or that pest, or that it will injure the rubber tree. The cut worms have, of course, attacked the rubber tree, but that when they were only very small and the trees were protected by the grass. I think that hereafter there will be very little trouble with the cut worm.

There is one thing that we should all be prepared for, and that is the importation of any rubber varieties. We have here all the kinds that we want now, and the only danger in the importation of more is the bringing in of new pests through importing trees. There is very little danger from the seeds, yet someone might find some new species of pests, and there is where the danger is, because in Ceylon there are several root diseases which are very serious pests. They have also the white ant which attacks the green timber of the rubber tree, and it is known that in Ceylon this species attacks the timber of the rubber tree. In shipments of plants from Manila we find all kinds of pests, and of course we are always very careful to see that they are killed before being landed. There is one pest that Mr. Austin speaks of in his letter, and he sent me specimens of it. They are two small beetles which he found in the root of the rubber tree. They are a common native species, and I told him that as far as my conclusions at that time were concerned, the beetles had appeared on account of some sap remaining on the tree after the tree was cut, and that always draws beetles. I do not think that that pest really would be considered as a pest of the rubber tree. Evidently it was not very alarming, because I have not heard anything more about it.

The rubber growers are very fortunate in having so few pests, and I think it will be possible to keep out any others.

President Lufkin appointed Messrs. F. L. Waldron and George P. Cooke to take up the matter of sending a representative of the Association to attend the London Rubber Exhibition in June.

Messrs. Wade Warren Thayer, Albert Waterhouse, and A. L. Castle were appointed as members of the Publicity Committee.

Messrs. George P. Cooke, F.L. Waldron and William Williamson were named as the Committee on Markets and Marketing.

After tendering votes of thanks to Dr. Wilcox, Mr. Hosmer and Mr. Ehrhorn for their able addresses, the Convention adjourned.

INDIA-RUBBER IN DUTCH GUIANA.

By the EDITOR of "The Rubber World."

(From the *India Rubber World*, Vol. XLIII., No. 6, March 1, 1911.)

THIRD LETTER.

A Morning Ride to the Balata Pier.—Dutch Negro Workmen.—Government Balata Concessions.—Bush Negroes.—Balata Trees 400 Years Old.—Locating the Trees.—Balata Crews.—Tapping.—Coagulating.—Bringing the Gum to Market.

Very early morning the Balata Man came around in a stylish little trap drawn by the liveliest horse that I had yet observed, and invited us to go out and inspect a shipment of balata that had just arrived from the interior. Our acceptance was prompt and grateful. We whirled down Keizerstraat, which was crowded with men and women on their way to work, down by the huge market sheds where sat scores of country negroes with baskets of fruit, eggs, poultry and every variety of tropical edible, animate and inanimate, which could possibly find sale in the city. Then out through the suburbs and up to the balata warehouses.

Balata arrives in bales weighing about 250 pounds each, the sheets folded together, piled up and then bound with bushrope. One of the first things down on the receipt of a shipment is the inspection. The sheets are cut apart, partly to allow of further drying, and partly to detect foreign material, particularly sand. It is then baled again and weighed, the Government Royalty paid, and it is ready for shipment abroad. It is here also that boats are outfitted for balata gathering and for the gold fields. One boat was loading while we were there. It lay some eight to ten feet below the pier, and one negro and four coolies were trying to induce a mule to step up on a narrow plank and then descend into the boat. The mule knew that the plank was so awkwardly placed that it would slide off, and wisely refused, so they blindfolded her with a piece of burlap so loosely woven that she could see right through it. Then with a man down in the boat, pulling at the halter and four pushing from behind she suddenly jumped and landed safely in the bottom of the boat, incidentally catching the man below by surprise, and knocking him heels over head under one of the seats, and that is about the way the workmen do everything. They are slow, clumsy, and lack mechanical ability. It does not do to be too impatient or to try to hurry them, for then they hasten but always do the wrong thing, and their misdirected energy and ingenuity in accomplishing what you do not want done is appalling. They are willing workers and also exceedingly willing loafers.

The Balata Man told of being far up the river at one time with a lot of balata awaiting shipment. This, some negro boatman agreed to take to Paramaribo for twenty guilders. It was seven days' journey, and they had been four days rowing when they were overtaken by a steam launch. This they hired to tow them the rest of the way, contentedly paying twenty guilders for the service.

The balata lands are almost wholly owned by the Crown, but are exploited only by individuals or companies under Government concessions. The *concessionaires* pay half cent per hectare (2·471 acres) for prospecting. Then they pay 4 cents per hectare for ground rent. Added to this is 4 cents per kilogram export tax which must be paid within eight days of its receipt. The only other export tax in Dutch Guiana is a small one on gold. It is probable that when cultivated rubber is produced in quantity it will be required to bear its *pro rata* of the State burdens. The policy of the Government has never been to embarass the planters; on the contrary it has helped in many enterprises, even going so far as to loan money at a low rate of interest to many of the planters whose estates suffered through disease.

Speaking of Crown lands and the wilds, one at once remembers the bush negroes. They were once servants, perhaps slaves, gone into the hinterland and made little settlements where they live by hunting, fishing, and as little farming as possible. In some respects they have lapsed into savagery. They speak a mixture of Dutch and Indian, a language of their own which is analogous perhaps to the pigeon English of the Chinese. They are tractable and friendly if treated well, and are sometimes used by planters with excellent results. They are very honest, and while they often borrow, a debt with them is a sacred obligation. Incidents are cited where a man has travelled miles to town with a little money accumulated penny by penny for a long time to pay a debt contracted by his grandfather years before.

I think it was Jenman who estimated that many of the mature balata trees that he saw in the Guianas were at least 400 years old. Whether he hit it within a century or so does not matter. Certain it is that the tree is of slow growth, and as an ordinary planting proposition is not to be considered for a moment. The tree which is locally known as the "bully" or "boela," is botanically the *Mimusops globosa.* It is found in French, Dutch, and British Guiana, in Venezuela, and indeed in various parts of Brazil. It is very common in the Guianas, growing on sandy reefs that run in all directions through the lower country, and also along the margins of streams in the uplands.

The beginning of gathering is the exploration party that locates the trees. This consists of eight or ten men at 60 cents a day, under a foreman at 80 cents a day, who go out into the bush in September, October and November, and stay for weeks at a time, until they have located a section where the trees are thick enough to make gathering worth while. A report is made to the Government concerning the location, and the right to gather balata is obtained. The laws are very strict concerning tapping and destruction of the tree, or over-tapping, is expressly prohibited. Only one-half of the bark area is tapped in one year, and that area is rarely tapped again. The reason is that the bark grows over the wounds in irregular forms, making it almost impossible to secure a surface that can be bled in a satisfactory manner.

The gathering or tapping begins in January. Bush negroes are not used in this work, nor are the coolies. The labourers are invariably town negroes who have been contracted for before the holidays. They have also secured advances of money of which they invariably spend every cent in Christmas and New Year's festivities. It is quite a task to round up these contract labourers, and very often the police are forced to lend a hand in getting the expedition started. The food supply which the foreman looks after consists of flour, split peas, molasses, salt, fish, beef and pork, tobacco and matches, while each man carries *calabashes*, a 5-gallon tin can, a cutlass and a queer tin canister for a trunk. They go by boat up one of the many rivers which may take a week or two to the place they have picked out for the central camp. Here twenty-five or thirty men make their headquarters. As soon as the shelters are built, and they are erected very quickly, the tanks for coagulating are made. They are built on log foundation, the bottom being about 3 feet from the ground, and are shallow wooden pans 10 to 12 feet long and 6 to 8 inches deep. They are made from boards split from palm tree trunks, and the cracks are carefully stopped up with balata until watertight. A cover is also made to keep out the rain and to prevent insects, twigs, etc., from falling in.

The collectors after breakfast spend a short time discussing the weather probabilities, and if it bids fair to be a day free from rain they scatter for the parts of the forest where they have located untapped trees. In addition to cutlass, calabashes and collecting can, each workman constructs a rough ladder of poles and bush rope.

Tapping is begun at the foot of the tree, where great gashes are cut in the tough bark, under which a *calabash* is placed. Then on up the tree worker goes cutting deep grooves two inches wide, crisscrossing them so that the milk will flow down a main channel into the *calabash.* Eight or ten trees is a day's work for one man and from them he should fill the 5-gallon tin. This should give about 20 pounds of balata. The gatherer starts back to camp about 2 in the afternoon empties the latex into his tank and spends the rest of the day far into the night in eating, smoking and story-telling of the weirdest sort.

The gathering being done at the beginning of the rainy season, as the milk flows best then, great care must be exercised to avoid the frequent showers, as water injures the product and often stops coagulation. The drying or coagulation is very simple. The tank is set out in the sunlight for several hours, and a thin skin soon forms on the surface of the milk. After a time when this is thick enough it is peeled off and hung up to dry. This film looks like raw hide and is of a dark red colour. The dishonest gatherer will fold the wet sides of the sheet together before it has thoroughly dried out, and by so doing gets greater weight. Normally, the drying continues for about a week, but the product shrinks for a month or more. The average gatherer brings in from 400 to 500 pounds, while experts in good sections have been known to gather as much as 1,000 pounds in a season. When the work is finished camp is broken and the balata is taken to Paramaribo; the men are paid whatever balance is due them, and they promptly and joyously spend it all in a single night.

The sheet balata from Surinam is the standard, and is worth much more than block, which latter is never as dry, and often contains impurities. Sheet balata costs to collect from 40 to 45 cents a pound; 20 cents of this goes to the labourer who is paid only for the gum he turns in. The other costs are a small commission to the foreman, general outfitting expenses, Government tax, and so on.

Balata has been much slower in coming into use than has almost any rubber or gutta. For a long time it was classed among the intractable gums. In 1890 the world could find a use for only 200 tons of it. Little by little, however, it found uses chiefly as a substitute for gutta-percha, until in 1900 400 tons were needed.

(*To be continued.*)

FIBRES.

PAPER INDUSTRY IN CEYLON.

[*Special to the "Morning Leader.*"]

In response to many inquiries made about the possibility of a Paper Industry in Ceylon, I should like to say a few words, and leave my enterprising and industrially inclined countrymen to take them for what they are worth.

There are many points to be considered before a mill is established, and the most important of these is

THE SUPPLY OF RAW MATERIAL.

Till about the middle of the 19th Century, Linen and Cotton Rags were exclusively used as "raw" materials for paper-making. As time advanced, the demand for paper increased and the supply of rags in large quantities to meet the demand of the Paper-maker was disappointing; he was forced to go in quest of cheaper and more inexhaustible raw material. This was found in some varieties of wood, like the Pine, Fir, &c. The art of paper making consists of uniting or felting together any fibrous material so as to form a continuous sheet. As such paper could be made out of any fibre, it is for the expert to select the one that requires the easiest and least expensive treatment.

Dr. Little, the leading Paper-chemist of America, says :—

"WOOD AS A RAW MATERIAL"

has proved so available, convenient, compact, easily handled and heretofore so cheap, that we have been led to overlook or ignore the immense sources of other and better paper stocks which lie easily within our reach."

The demand for paper is steadily increasing by leaps and bounds, and as it was feared that there would come a famine in the pulp wood, those concerned were on the look-out for suitable provision in other directions. Mr. Thomas Routledge, the famous Sutherland Paper-maker, who first introduced *Esparto Grass* into England as a paper stock, found in the Bamboo an excellent material for the manufacture of paper. Ever since then investigations have been going on, and now experts like Sindall, Raitt, Richmond and others agree that

THE BAMBOO

would be the future mainstay of Paper-makers. Dr. Arthur D. Little says in the *American Exporter* :—

"Especially noteworthy in the developments of the year is the serious and general revival of interest in bamboo as a source of paper stock. Its superlative value for this purpose was urged, it will be recalled, by Routledge in 1875. The very favourable conclusions as to bamboo, reached by R. W. Sindall, in his report to the British Government on available sources of Paper Stock in British Colonies, are now amply confirmed by Raitt."

In the bamboo Paper-makers have found a really

INEXHAUSTIBLE RAW MATERIAL,

and Mr. William Raitt, of Bangalore. recommends the establishment of Bamboo Plantations so arranged, that one-third of the whole plantation shall be cut over every year. This will secure absolute permanence of growth, and in fact such systematic cropping will increase productions.

Mr. R. W. Sindall in his booklet *Bamboo for Paper-making* (the book is printed on Bamboo-paper, a copy of which the author was kind enough to send me) has the following :—

"In the summer of 1908 the Government of Burma supplied several tons of bamboo, and this was converted into paper by Messrs. Thomas and Green, Soho Mills, Woodburn, Berks, who found that the material yielded readily to treatment. . . . . This firm reports that the material

WORKED EXCEEDINGLY WELL

on the Paper Machine and produced a very good sheet of paper.

The manager of the North of Ireland Paper Mill Co., who tried this stuff, says :—

"We found no difficulty whatever in working the stuff. . . . . The paper was put through the mill just the same as if we had been treating wood pulp, and came on the machine in the usual way. We had no difficulty whatever, nor had we to alter anything on the machine."

The extreme rapidity with which the bamboo grows and the easier treatment it requires in comparison with wood, makes it very valuable. According to Mr. Raitt the yield is 45 per cent. as such, to make a ton of paper 2¼ tons of bamboo are required. I think from the results (which were satisfactory and encouraging) of the experiments I have been carrying on, while I was in charge of the Lunmi Paper Mills, the yield should be a little more than 45 per cent. —very near 50 per cent.

I HAVE MADE PAPER OUT OF REEDS,

Beesha Travancorica, a sort of plant belonging to the same family as the bamboo, and the yield was much higher, about 66 per cent. This reed paper has been very well commented on by experts both in India and England. A beautiful cream coloured paper which looks like parchment is produced from the reed.

I am afraid I am digressing from the main point. If I have said too much about the bamboo, it is because this would be the main raw material,

IF EVER CEYLON HAD A PAPER MILL.

The beautiful forests of Ceylon have an inexhaustible supply of this wood, specially the kind known as "Bata," *Ochlanda stridula*, which is found in profusion in the low lands. There are rivers that would form splendid water courses, allowing easy transport over long distances. It is my belief that "there are many localities capable of providing for ever for a paper mill making about ten thousand tons of paper per annum."

In addition to the bamboo there are other kinds of fibrous plants in our forests that could be advantageously utilized for the manufacture of paper. The particular kind of

SUGAR CANE

known as *Rambuk* would be an excellent paper stock, and I believe this could be had in any quantity. The fibre of this, I understand, is now used for twine. Murukku (*Moringa pterygosperma*), Kat Amanakku (*Jalropha curcas*), Tirukukalli (*Euphorbia tirucalli*), Elakalli (*Euphorbia nerifolia*). Plantain fibre and many of the aloes would be excellent paper-stocks, and I have experimented on most of these. As I said at the beginning of this article, we have to select only those that would give profitable results.

Jute fibre is an excellent material for brown-paper, and this is got by collecting old and torn gunny-bags. I have been getting the whole stock of this required for the Lunmi Paper Mills from Ceylon through a contractor.

So much for the raw materials. I think that a paper mill in Ceylon would never fail for want of "paper-stock," which is the most important factor. In short, all refuses and all that now goes to waste could be profitably used in a paper mill.

THE OTHER CONDITIONS

that have to be considered are (1) Source of power—either steam or water. (2) Labour. (3) Water for manufacturing purposes.

If water power could be had, it would certainly be a very great advantage, but in this case there would be the item of transport. If steam power is used a supply of coal would be necessary and the refuse of the raw materials also could be used.

Paper industry, unlike other industries, requires a very large quantity of

WATER

for manufacturing purposes. The mill should be situated in a place where plenty of clean water could be had, and there is not the least difficulty in this in Ceylon.

As for Labour in Ceylon it is much cheaper than in other paper-making countries except India, and so this also will not be an obstacle.

Taking all these into consideration we see that

CEYLON IS SITUATED MOST ADVANTAGEOUSLY

for the establishment of a paper mill, and it is my firm belief that such an undertaking will give a very decent return as profit, and I shall endeavour to establish this by facts and figures.

A paper mill in Ceylon should have the

SUPPORT AND SYMPATHY OF THE GOVERNMENT,

without which such a concern cannot become a success. The Government of Burma has promised to give many concessions to any one proposing to start either a pulp or paper mill in Burma. With Government support, a Ceylon paper-mill should be able to get a ton of air-dry bamboo for about Rs. 10 (Mr. Sindall's estimate is Rs. 9 18 (12*s.* 3*d.*)

A mill capable of turning out about six tons of paper a day would be just the thing for Ceylon. The necessary plant has to be imported, and from an estimate I was supplied with by a leading British engineering firm I find the estimated

	Rs.
Approximate cost of plant ...	250,000
Buildings, &c.	100,000
Contingencies	50,000
Total cost about Rs.	400,000

To this amount should be added another hundred thousand, which would be the working capital. So

A JOINT STOCK COMPANY

with a capital of about Five Lakhs of rupees would be required to start a Paper Mill of the capacity above mentioned. The figure may look a big one (I don't think it is so for a place like Ceylon), but when divided into fifty thousand

SHARES OF TEN RUPEES EACH,

the amount could be easily collected; but then again, as an esteemed friend of mine, who is very much in sympathy with such undertakings, told me, "it is not who *could* but who *would*."

I will now try to give an approximate

COST OF WORKING

this mill—the cost per day. Presuming that bamboo is the raw material used, and this could be had at Rs. 10 per ton at the mills, the quantity required per day to make 6 tons of paper at 2¼ tons of air-dry bamboo for every ton of paper would be 14 tons or say 15 tons.

	Rs.
Bamboo	150
Chemicals	600
Fuel	200
Establishment	150
Contingencies and wear and tear of machinery	100
Total cost of 6 tons ... Rs.	1,200

The market value of such paper at present would be Rs. 350 a ton, but say Rs. 300. Then, the selling price of 6 tons would be R1,800, and

THE DAILY PROFIT

Rs. 600, and this amount would give a profit of 36 % per annum on a capital of 5 lakhs, there being twenty-five working days in the month.

I will leave this bluntly here and let the reader form his own opinion. It is my belief that such a concern should give a return of about 24 % per annum. If any of my countrymen want any more information on this subject, I am at their disposal.

I am enclosing samples of reed and brown paper manufactured by me, and leave the Editor of the *Morning Leader* to have his say on the quality and get up. I am also enclosing a small bit of bamboo paper.

T. P. MASILAMANY.

Jaffna, June 3.

[This article must arrest general attention. It arouses our sympathy and enlists our support. The idea is well stated in a thoroughly practical form. We leave the reader to digest the suggestion, and propose to deal with the matter editorially.—ED., *M. L.*]

SUITABILITY OF VARIOUS WOODS, BAMBOOS AND GRASSES FOR PAPER-MAKING.

(From the *Indian Forester*, Vol. XXXVII., No. 7, July, 1911.)

We mentioned in a previous issue that Mr. Raitt had been deputed to the Research Institute at Dehra Dun to test the suitability of various materials for paper pulp. Below we print a memorandum drawn up by Mr. Raitt which contains definite instructions for the selection and collection of materials. This memorandum has, we understand, been circulated to Local Governments by the Government of India.

Copy of a Memorandum drawn up by Mr. Raitt.

PAPER FIBRE TESTING AT THE FOREST RESEARCH INSTITUTE.

1. It is recommended that before selecting and collecting any material proposed, enquiry be first made of the President, Imperial Forest Research Institute and College, as to whether such material has already been tested, or if samples of it are already available in the Institute.

2. Samples should be accompanied by a memorandum giving the scientific and local name and place of origin.

3. *Woods*—

(*a*) Trees of rare occurrence are not admissible, nor those of which the average girth is under 2 ft.

(*b*) They should be fairly cylindrical and regular in outline so as to facilitate barking. Deeply fissured outlines in trees under 5 ft. girth are not suitable, but they may be passed if they exceed that measurement, as the larger bulk compensates for the additional cost of clearing bark out of fissures and crevices.

(*c*) Dry seasoned weight should not exceed 45 lbs. per c. ft. and preferably under 40.

(*d*) Samples should consist of cross-cut sections, with bark left on, of not less than 20 or more than 40 lbs. in weight. In the case of large trees the section may be split and a quarter or half of it sent.

(*e*) Samples of woods which remain sound during seasoning may be sent green. Those liable to rapid decomposition, and which do not season well in the log should be split into wedges and dried in the sun, or artificially before sending.

4. *Grasses*—

(*a*) Only those which are sufficiently gregarious to permit of cheap collection are suitable.

(*b*) Samples should preferably be cut just before or during flowering *and prior to formation of seed.* If cut after seed production, the fact should be stated on the accompanying memorandum, so that due allowance may be made for it.

(*c*) Samples should consist of the whole grass stem and leaf, and should be well dried before packing—not less than 20 or more than 40 lbs. may be sent.

EDIBLE PRODUCTS.

HICKORY KING MAIZE.

The illustration on the frontispiece represents a plot of Hickory King Maize 63' × 15' grown by a Tamil cultivator at Valluveddi, north of Jaffna, under the supervision of Mr. S. Chelliah, Agricultural Instructor of the Northern Province. The seed, which was planted on May 16, germinated on the fourth day and eared on the 24th June. There are altogether about 300 plants on the plot, and, taking an average of two cobs per plant, the value of the produce is more than that of the produce of a similar plot of the Italian millet (*Setaria italica*), a common grain of the district. The latter is invariably the third and last crop in the native farmer's cultivation for the year, which ends with July. Maize would appear to be in every way preferable to Italian millet, and might well replace it.

C. DRIEBERG.

HICKORY KING MAIZE AT VELVETIDURAI.

PHILIPPINE TOBACCO.

PRICES OF LEAF MORE REASONABLE—NEW AREAS DEVOTED TO TOBACCO PLANTING—PLEA FOR AMERICAN PATRONAGE.

(From the *Manila Bulletin*, August 9, 1911.)

Late trade news from the Philippines regarding the tobacco situation and the trade in Manila cigars is the subject of an article appearing in the "Tobacco Leaf," dated Manila, and signed by "Maniletto."

The situation here is well summed up, and the writer gives statistics regarding the shipments of Manilas to the United States since the passage of the Payne Bill.

With the exception of the monthly statistics the letter is as follows :—

The prices of tobacco leaf 1910 crop are now more reasonable. The better parcels have been bought up by the big factories. There is very good wrapper tobacco among the Isabela and Cagayan leaf. Nearly the whole of the 1909 crop, as well as that of 1908, has been taken up by the large factories and are fairly selected parcels. These parcels are to be used in the manufacture of cigars and cigarettes, which are sure to be of excellent quality.

The prospects for the 1911 crop have also a fair outlook. It is predicted, however, that it will turn out to be of a rather gummy character, but really it is too early to form any definite conclusion in this connection. The 1910 crops of the other Provinces like Union and Cebu have found a ready exportation to Europe. This kind of tobacco is not fit for cigars, and has never been used for such.

No new areas have been devoted to tobacco planting except in Cagayan and Isabella, comprising the Cagayan Valley, because there is no other island among the Philippine group where the climatic and soil conditions are favourable enough for the growing of tobacco suitable for making good cigars. This had always been maintained since the discussion in Washington about free trade relations with the United States, and it is actually a fact, with the possible single exception of the island of Mindanao; and there is little hope in the tobacco line in that island for the next twenty, thirty or fifty years, owing to the lack of necessary labour. As an instance we may cite Davao, where abaca (Manila hemp) is grown. Several Americans, some years ago went into the planting of hemp with much zeal and enthusiasm, but their ardour soon vanished in consequence of their inability to secure a sufficient number of labourers. The hemp grown in this district is of superior grade and worth double the amount of that grown in the Camarines and Albay Provinces.

It is incomprehensible why the opposition continues among the tobacco people in the United States against the Manila product. We have a first-class cigar over here, and considering the fact that for the next ten, twenty or more years we shall not be able to ship more than 150,000,000 cigars to the United States annually, which is the limit prescribed in the Payne Bill, it seems hardly fair to oppose the Manila article in participating to the extent of one to two per cent. in the cigar sales in the United States.

A good Manila cigar is well worth five to seven and one-half cents, which we claim for it as the retail price. In the long run the cigars must sell because they offer an agreeable smoke (although it is an acquired taste), and gives to the importer, jobber and dealer a sufficient margin. It seems to us that it would be entirely to their interest to give the Manila cigar a fair test rather than continuing in their opposition. It would really be advantageous, as some wide-awake firms have already done, to secure the representation of some reliable brands.

The factories of importance in the export trade to the United States are in a perfectly sanitary condition and their operatives are clean. This must be so, as the rules laid down by the Bureau of Health are stringent in this regard, and inspections are made periodically to see that they are complied with.

Much has been said of the total production of tobacco in the Philippine Islands, which is about 50,000,000 pounds annually, but if you really come down to actual figures, you will find that about ninety per cent. of this amount must necessarily be exported and be used for cigarettes for local consumption, partly because of the fat, gummy character of that percentage.

The Manila cigar will eventually find a market to a greater extent than is now enjoyed in the United States, because the consumer will have a word to say about the matter; and the sooner the importers and dealers take a kinder view toward the Manila product, the better it will be for them.

There are fairly good-sized orders coming from the United States for cigars, and the situation is strenghening after nearly all of the old and inferior stocks of Manila cigars, which were sent by the less scrupulous merchants to the United States have been disposed of. It is only a matter of a short time now when we shall deservedly enjoy a steady sale of our product. It seems strange but one of Manila's leading firms is responsible for glutting the market.

PHYSIOLOGY OF THE COCONUT.

BY E. B. COPELAND.

(From the *Philippine Agriculturist and Forester*, Vol. I., No. 3, March, 1911,)

The entire course of study of the College of Agriculture is planned with the understanding that any science of crop production must be built on a knowledge of the physiology and pathology of the crops, and that without such knowledge there can be no science of agriculture. As the course is now organized, students entering the coconut class have had successively a year of general botany, a year of plant physiology, and a year of general agronomy, with special attention to the grains; they have also had one year of chemistry, and take a second year while studying the coconut. They are obviously well prepared to study effectively so much of the physiology of a crop as does not require distinctly organic chemistry. And there is no crop, at any rate in this part of the world, which is so well known that such work as they are called upon to do will not add materially and practically to our knowledge of it.

The best general and easily used index to the condition of a plant is its rate of growth. It is certainly possible to develop such a knowledge of the growth of any plant, and of the reaction of the growth to outside conditions, that it shall be possible to make roughly such allowances as are necessary for temporary conditions (the weather), and to decide from one day's measurement of the growth that the plant's condition is poor, fair or good; that is, that the more fixed conditions (soil, climate, state of cultivation, freedom from living enemies) are or are not what they should be. The great value of such knowledge must be clear.

The only past study of the physiology of the vegetative coconut was published by the writer in the first number of the *Philippine Journal of Science* (1906, pp. 6-57). That study was made in one place, San Ramon near Zamboanga, and during a single exceptionally dry season. Even though it was done with reasonable thoroughness at the time and place, it by no means furnished the data necessary for the establishment of standards by which the activity of coconuts in general can be judged. Neither do the data reported here suffice, but they are a very material contribution. For this place and season they can be accepted with entire confidence, for they are selected representatives from a large mass of tables of results,

The coconuts of the college are none of them on land well suited to this crop. The soil, varying from forty centimeters to hardly more than a meter in depth, is everywhere too shallow. The depth mentioned includes the clayey, not sharply distinguished subsoil, which in turn rests on a succession of thin layers of volcanic stuff, such as occurring in thick strata, is known as Meycauayan stone or "dobe stone." These groves are moreover so suited that they receive no ground drainage from Mount Maquiling. As Los Banos has a decidedly dry season, usually of several months' duration, this soil becomes dry to a degree incompatible with very successful coconut culture without irrigation.

THE ROOT.

In my work at San Ramon, the most rapid growth observed for any root was 3·5 mm. per diem; but this was transitory, and greatest growth per mensem was less than 5 cm. The growth was usually very irregular. This has been the experience here as well; but some roots have come under observation which were growing more regularly fast. For example, the following table shows the growth of two roots measured by F. Cevallos. The figures in each case represent the growth during the preceding period, usually of one week.

Table I.

		A.	B.
October	20	13·0	15·55
	28	16·5	19·80
November	5	23·2	19·10
	13	24·0	22·20
	20	26·9	16·70
	27	23·0	24·90
December	4	26·2	24·80
	11	29·5	26·95
	18	25·7	24·55

It happens that the first of these roots grew in fertilized ground, and the second did not. The fertilizer was applied during the second week of September.

There is a very slight difference in favour of the fertilized tree. However, the difference observed was not always in this direction; and, considering the general irregularity in the rate of growth of roots, we are not at present justified in drawing any conclusions as to the influence of fertilization on their growth.

As the dry season advances, the growth of roots becomes slower, just as was the case at San Ramon; but the checking is up to this time nothing like so complete as was observed there. It naturally occurs first where the soil is thinnest. The row of trees under observation by A. Lejano is on shallower soil than that of Cevallos. The average daily growth of the roots of Lejano's trees during the fall months was more than 2 mm.; but the average daily growth of four roots from February 2 to February 16 was only 1·25 mm. The average daily growth of two roots measured by Cevallos from January 14 to February 18 was still 3 mm.

The most rapid steady growth reported for any root was 108 mm. from October 31 to November 26, covering eight measurements. This was one of T. Vibar's. During the first nineteen days of February, his most active roots grew 31 and 30 mm. respectively; his trees are intermediate between those of Cevallos and Lejano. This relation between the depth of the soil and the ability of the tree to resist the evil influence of drought is very instructive.

It is a good general rule, but naturally not without exception, that the larger the root the more rapid its growth. In the saturated atmosphere of a buried bottle, roots grow at about the same rate as in the soil; but the roots growing in free air, where the new roots of grown trees frequently emerge from the trunk, grow very slowly until they enter the ground.

THE LEAF.

My work on the growth of leaves at San Ramon was very inadequate, because undertaken some time after the beginning of a severe drought and confined to young trees. As the growth of the leaves is the most convenient criterion by which the activity of a tree can be determined at any one time, and as it stands in a double direct relation to the prospective productivity of the tree, we have here studied it with special care and thoroughness. The following tabulation of the determinations of the growth of four of the trees measured by Vibar will give a good idea of the general rate. These trees are about ten years old and are coming into bearing. The figures in each case represent millimeters of growth since the preceding measurement.

Measurements can, of course, be made only of the growth of the visible leaves. The method employed was as follows: A horizontal straight line of India ink is drawn across the youngest leaf as low down as possible, and carried without a break into the next youngest leaf. On the lowest possible part of the latter a similar mark is made, and carried on to the next older. The same is done on the lowest visible part of the succeeding leaves. Where there is on no growth, these marks, each drawn on two leaves, will remain unbroken. This would also happen if the two leaves grew equally; but in normal growth the younger of any two visible leaves usually grows the more rapidly. The vertical distance between the two parts of the broken line is then the difference in growth. The break in the lowest broken line is the growth of the oldest growing leaf. The growth of the second oldest growing leaf is found by adding the break on the line at its base to the break in the line below. And the growth of each of the younger leaves is found by adding the break in the line of its base to the sum of the increments in length of the older leaves. Subsequent determinations are made by subtraction without the use of new marks, except when younger leaves make their appearance.

This general method is the only easy and accurate one possible in working on subjects of such size as the coconut tree. In detail it can be modified as convenience suggests: for instance, it is sometimes simpler to draw a horizontal line across several leaves. As the growth of the leaves is entirely basal, no error is introduced by marking one point rather than another, so long as the power to make accurate measurements is not interfered with.

Vibar's results shown in Table II show the most rapid growth observed at any time, 205 mm. in three days by tree D; but this rate was closely approached at the same time by many trees. The youngest leaf always grows the most rapidly, or is sometimes equalled in rate for a time by the next older. Independently of the environment the rate is decidedly irregular, as is unmistakably shown by comparing different leaves on the same tree. It happens fairly frequently that one leaf increases its rate while another decreases it; and this change is not rarely in the opposite direction to that which can be explained by a consideration of their grand periods of growth.

The real explanation, I believe, of most of these irregularities is to be found in the high tensions between the neighbouring leaves. The latter are packed closely together, and growing at unequal rates, must move along each other with considerable friction and set up tensions whose occasional release will make the growth evidently jerky. These tensions are probably responsible for the equal elongation usually exhibited for a longer or shorter time by the two youngest leaves. The tendency is certainly for the younger leaf to grow the more rapidly, but the difference is not great enough to prevent their holding fast, one to the other, sometimes for a term running into weeks.

Table II.—GROWTH OF LEAVES, BEGINNING OCTOBER 11.

		Tree A.							Tree B.					
Leaf		1	0	1	2	3	4	5	1	0	1	2	3	4
October	12	...	...	20	20	...	...	...	...	...	17	14	...	...
,,	15	...	...	66	59	7	2	...	...	...	60	46	3	...
,,	17	...	...	56	60	2	1	...	...	...	39	26	1	...
,,	19	...	...	62	49	5	4	...	...	...	49	28	1	...
,,	23	...	...	84	47	6	3	...	...	...	72	43	2	...
,,	26	...	...	80	55	12	2	2	...	...	60	35	5	3
,,	31	...	...	122	120	14	4	4	...	...	100	56	6	3
November	4	...	...	80	68	4	4	...	...	...	90	22	6	4
,,	7	...	...	80	35	3	7	...	...	...	73	18	6	2
,,	10	...	...	86	15	5	2	...	...	...	50	14	3	1
,,	13	...	...	90	16	6	2	...	...	...	78	15	4	1
,,	16	...	...	86	15	7	1	...	...	shows	79	17	3	2
,,	19	...	...	76	12	2	...	...	...	78	78	16	5	...
,,	22	...	...	80	15	6	1	...	...	66	66	17	4	...
,,	26	...	...	82	15	4	1	...	...	69	69	20	6	...
,,	30	...	shows	87	28	3	2	...	..	71	71	30	5	...
December	4	...	96	96	31	4	...	...	...	103	83	29	4	...
,,	11	...	232	175	66	8	...	...	...	180	160	63	12	...
,,	24	...	117	92	42	6	...	...	shows	140	122	42	8	...
January...	3	shows	127	81	31	4	...	...	113	106	92	32	6	...
,, ...	10	146	146	56	29	...	...	...	123	118	68	12	11	...
,, ...	17	192	189	42	28	...	...	...	134	123	69	13	5	...
,, ...	22	139	135	30	30	...	...	...	132	126	40	16	...	...
,, ...	28	149	148	21	7	...	...	...	151	121	26	5	...	...
February	1	169	160	20	...	...	...	...	150	100	10	...	...	...
,, ...	4	182	175	20	...	...	...	...	166	110	10	...	...	...
,, ...	8	shows	186	160	21	...	...	...	shows	176	116	9	...	...
		Tree E.							Tree D.					
October ...	15	...	...	...	...	...	...	...	...	...	218	158	16	3
,, ...	17	...	...	...	...	...	...	...	...	...	56	28	4	2
,, ...	19	...	...	...	...	...	...	...	...	...	55	26	3	...
,, ...	23	...	...	leaves marked			...	...	...	...	104	57	6	...
,, ...	26	...	...	140	140	55	9	...	...	...	87	36	6	2
,, ...	31	...	...	235	230	59	13	3	...	...	140	135	15	5
November	4	...	...	200	106	60	12	1	...	...	101	90	7	8
,, ...	7	...	...	161	99	53	9	1	...	...	96	86	8	6
,, ...	10	...	...	102	81	43	10	1	...	...	90	80	7	5
,, ...	13	...	...	91	62	39	11	2	...	...	86	77	6	2
,, ..	16	...	...	92	61	40	10	2	..	...	81	69	9	...
,, ...	19	...	...	91	51	35	7	2	...	...	99	57	3	2
,, ...	22	...	shows	93	59	38	8	3	...	shows	93	58	8	...
,, ...	26	...	98	98	63	34	6	3	...	91	91	59	11	...
,, ...	30	...	100	100	76	38	6	8	...	116	93	36	23	...
December	4	...	96	96	71	34	7	6	...	102	99	46	29	...
,, ...	11	...	192	190	186	62	13	8	...	190	180	81	39	...
,, ...	24	...	190	182	162	51	8	...	shows	146	122	68	21	...
January	3	shows	186	91	81	47	8	...	157	157	96	56	11	...
,, ...	10	179	179	86	60	33	9	...	148	148	87	42	7	...
,, ...	17	168	168	57	40	21	6	...	129	124	68	51	3	...
,, ...	22	156	156	50	37	20	4	...	136	125	59	47	...	...
,, ...	28	186	186	59	27	5	2	...	198	180	44	20	2	...
February	1	189	189	66	18	9	2	...	200	160	33	12	...	...
,, ...	4	200	190	77	15	8	3	...	205	160	32	11	3	...
,, ...	8	201	196	82	14	5	1	...	206	181	36	12	...	...

The growth of stems and roots, if an accurate enough record is kept, is found never to be steady, and the true explanation of its irregularity is probably analogous to that just given for the greater irregularity of the growth of the coconut leaves. In the stems and roots, the cells and tissues, having unequal inherent power to enlarge, as we know they have, set up tensions, the accumulation and release of which are expressed by the observable irregularities of rate. In roots there is also the opportunity for tensions between cap and body, in spite of the fact that the most rapid enlargement is often back of the cap. In the coconut, the entire elongating region is usually enclosed, and must inevitably stretch with more or less of a jerk every time the hold between the back part of the cap and the enclosed body is overcome.

The rate of growth is also consequently a function of the weather. As an illustration, a severe storm began October 31, and the growth during the four day interval following was slower in most cases than it had been immediately before. Again, there was some rain February 5 and 6, and February 8 and 9 were stormy. Vibar's table shows a slower growth during the four days, February 4 to 8, than during the preceding three days. This is more clearly brought in Table III, containing the measurements of Lejano, of the youngest leaves only of six trees.

Table III.

Growth per diem of youngest leaves during the periods ending on the dates given. Beginning January 28 :—

Tree.	Jan. 31	Feb. 2	Feb. 7	Feb. 9	Feb. 16
I ...	30·7	32·2	26·5	15·5	22·3
II ..	34	32·5	31·4	12·	39·
III ...	16	18·5	25·	9·5	23·
Average ...	26·9	27·	727·6	16·3	29·4
IV ...	14·	25·	17·8	8·5	13·5
V ...	19·	17·8	16·2	15·5	12·
VI ...	32·	33·2	29·4	20·	25·3
Average ...	21·3	25·3	21·1	14·7	16·9

It has already been noted that Lejano's trees are on very shallow soil, which had become decidedly dry by the end of January. The growth of his trees was slower at the beginning of February than during the preceding September; while the students whose trees grow on deeper soil found the growth in February more rapid than at any previous time.

It will probably be a cause of surprise to many, as it was at first to me, that a few days of rainy weather have a decided deterrent effect upon the growth. Most plants growing in the Philippines whether herbs, vines or trees, and in whatever stage, show this more markedly than does the coconut. Several hundred species, records of the growth of which are in my hands, have shown this whenever the records were so timed as to bring it out.

The difference between the diurnal and the nocturnal growth appeared as conspicuously as possible in my San Ramon work; for not merely was there frequently no growth at all during the day, but there was sometimes an actual shortening. Working here with adult trees, and at a time when the water supply for the root was ample, the difference was still evident. It is shown by Table IV, compiled from the tables of Cevallos.

Table IV.

GROWTH OF LEAVES BY DAY AND BY NIGHT. 3 TREES.

BOLD-FACED TYPE, 5 P.M. TO 5 A.M.

	Leaf.	1	2	3	1	2	3	1	2	3
Aug. 6 ...	0·0	10·3	0·9	0·2	13·0	0·8	0·5	18·5	5·0	1·4
...	1·0	22·0	3·1	1·1	48·0	1·2	3·0	47·9	24·8	5·6
7 ...	0·6	23·8	2·0	0·4	14·4	1·0	1·0	11·0	7·0	1·0
...	2·4	41·0	6·2	0·9	41·6	3·C	3·2	52·0	18·0	4·0
8 ...	0·0	4·0	1·5	0·3	11·0	0·5	0·9	13·2	2·1	0·6
...	0·5	38·2	5·0	1·5	24·0	4·0	2·0	33·0	37·9	2·4
9 ...	0·0	6·0	2·2	0·6	18·0	1·3	0·8	7·2	5·0	1·6
...	1·1	27·0	4·5	4·0	54·0	5·1	1·0	29·0	32·0	4·0

All figures represent millimeters. The first column is growth in width; otherwise, all are increment in length.

The checking of the growth during the day is obviously a function of the decreased water supply of the crown of the tiee. The same is true, at least in large part, of the damage done by drought. On the other hand the checking of growth by prolonged rainy weather seems unintelligible, except as a result of the checking of photosynthesis. It is true that the temperature is usually lower during storms; but it is likewise true that February is a colder month than any from July to December, and yet it shows the most rapid growth except when dryness interferes. As a matter of fact, our differences in temperature from day to day, or from month to month, are less than the usual difference between day and night, and the fact the night is cold does not prevent rapid growth at that time.

Regarding the relation between the rate of growth and the age of the tree, it can be laid down as a general rule that from germination to maturity there is a gradual increase in the rate of growth of the most active leaves. The younger the tree, the slower the growth. This has been demonstrated on trees of various sizes; but as the exact ages of the trees are not known, it is not worth while to publish a tabulation of the measurements.

It has been emphasized, perhaps unnecessarily since it is necessarily so, that the measurements apply only to the visible leaves. When we state that the most rapid growth is shown by the youngest visible leaf, it means that when a leaf appears it is at near the stage where the cure representing its grand period would reach the highest point. There are also present numerous invisible leaves, the most of which are very small and growing very slowly. Dissection of a young tree, whose free trunk was as yet only 50 cm. high, showed the following leaves which had not yet reached the light, but were well enough formed to be separated with a pocket knife and without the use of a lens. These are numbered from the largest to the smallest.

Table V.

LENGTH OF CONCEALED LEAVES.

I	...	...	1·31 m.
II	...	...	0·43 m.
III	...	...	0·09 m.
	of which, 19 mm. sheath.		
IV	...	...	50· mm.
V	...	...	34· mm.
	of which, 16 mm. sheath.		
VI	...	...	21· mm.
VII	...	...	15· mm.
	of which, 0·7 mm. sheath.		
VIII	...	...	13· mm. (?)
IX	...	...	11·2 mm.
X	...	...	8·7 mm.
XI	...	...	7·1 mm.
XII	...	...	5·5 mm.

XIII and XIV separable, but too small to measure accurately.

The rate of growth at different ages can be calculated approximately by the differences in length. It is evident that the growth in length is at first exceedingly slow, less even than 2 mm. a month, and increases until the leaf reaches the light.

In our coconuts, the interval between the appearance of successive leaves is usually more than one month; so that fully eighteen months can be expected to elapse before the smallest leaf-rudiment recognizable with the naked eye would grow into the light. Any condition which controls the rate of formation of these leaf-rudiments must therefore have more or less influence on the rate of the appearance of new leaves a year and a half later, and on the crops the tree can bear a year and a half later still. And this influence is a direct one. In the case of the coconut, as of any other perennial, unfavourable conditions, by lowering the general vitality of the tree, have indirect effects, the duration of which is altogether indefinite.

The fact that leaves succeed each other at intervals of more than one month indicates that our coconuts are not in very good condition; for at San Ramon, until the drought became too severe, the succession was considerably more rapid. In consideration hereof it may be anticipated that better situated coconuts will under favourable conditions show a more rapid growth of the leaves than any we have been able to observe.

At the time these coconuts came into possession of the college the grove was infested with cogon (lalang) where fire had run through it, and grown up with brush and small trees elsewhere. During the following year it was not cleaned, except immediately around the trees, with a bolo. After a thorough cleaning out it was ploughed shallowly during the first week of last September; the ploughing reached at the most a depth of less than ten centimeters. As a result of the lack of previous cultivation, and of the shallowness of the soil, this ploughing cut many of the roots. This was of course immediately injurious to the trees. The number of leaves on them was at first from 21 to 27. During the succeeding two months the majority of the ploughed trees shed four leaves, while neighbouring trees shed on the average less than two leaves. There was also an evident and immediate checking in the rate of growth of the younger leaves, from which the trees gradually recovered in the course of about three months. After this interval the growth became more rapid than it had been before cultivation.

In spite of the temporary set-back it gives to trees hitherto neglected, there is no reasonable doubt as to the value of shallow cultivation. Six months after the act it seems clear that our trees are more vigorous as a result of it. Surface ploughing results in the development of a root system at a greater general depth; and assuming freedom from stagnant ground water this is an advantage, for it tends to secure immunity from drought. Moreover, some measure of surface cultivation is necessary for the controlled and rational use of fertilizers or of irrigation. The grove is now kept in decent condition by the occasional use of the disc harrow at very slight expense, and without even temporary bad effect on the trees.

EFFECT OF FERTILIZERS.

Half of the grove in charge of the class was fertilized Sepetember 9, each tree receiving 0·6 kilo of basic slag containing 20% P2 05, and 0·8 kilo of kainit containing 13·50% K2 0. These fertilizers were donated by Behn, Meyer and Company of Manila for this experiment. For reasons developed elsewhere in this paper, an application of fertilizer to the coconut is not likely to reach its maximum effect until at least eighteen months, and perhaps as much as three years after it is made. The fertilizer was scattered over ground already ploughed, and was then harrowed in. It must first enter the plant in appreciable quantities, and this takes some time before it can begin to have any influence. If it then hastens the building of leaf-rudiments, this effect can be seen only after a year and a half, or more; and the nuts borne in the axils of these leaves will not be ready to harvest within three years.

However, if the fertilizer is going to have much effect, this must appear more immediately in acceleration of the growth of the leaves. If it results in more rapidly growing and larger leaves, and so in increased photosynthesis and transpiration, the fertilizer is likely to have ultimate indirect influence on the production of nuts, more important perhaps than its direct effect can be. As a matter of fact, its influence on the growth of the leaves is already evident. During the first week in March I have had measurements made of the growth of the leaves of all the normal trees under observation, fertilized and unfertilized. Trees attacked by beetles, and a few trees younger than the others, have been left out of account for the sake of uniformity.

The following table shows some of the results of these measurements. The first part of it is compiled from measurements by M. B. Raymundo :—

Table VI.

AVERGAE DAILY GROWTH OF LEAVES, FERTILIZED TREES.

Leaf Tree	1	2	3	4	5	6
I	10·71	5·5	3·14	1·88	0·78	0·28
II	10·42	5·0	3·0	1·5	0·57	0·28
III	10·00	2·85	1·71	1·0	0·45	0·28
IV	10·28	6·14	broken ...		...	...
V	8·42	3·28	1·71	0·88	0·36	0·14
VI	5·00	2·28	1·28	0·61	0·7	0·14
VII	7·07	1·21	0·44	0·11	0·04	0·00
Average	8·84	3·74	1·88	1·00	0·41	0·19

UNFERTILIZED TREES.

I	3·07	2·0	0·8	0·17	not measured.
II	4·67	3·57	1·57	0·46	
III	3·64	2·17	0·6	0·04	
IV	5·35	3·71	2·21	0·71	
V	4·28	3·28	2·02	1·71	
VI	3·35	1·8	1·07	0·28	
VII	6·85	5·25	3·51	1·42	
Average	4·47	3·12	1·69	0·68	

Results of Cevallos, 6 trees each, fertilized and unfertilized.

Fert.	28·8	16·6	6·8	2·1
Nor Fert.	26·6	15·8	3·7	1·6

Lijano found the average growth of the youngest of his fertilized trees to be 27·9mm, and of the unfertilized trees 20·8mm.

Two general conclusions can be drawn from these determinations :—

1. The average growth of all leaves of fertilized trees is greater than that of unfertilized trees.

2. The greater difference is to be noted in the older leaves. This indicates that the leaves of fertilized trees continue to grow for a longer time. This may have as much as the more rapid growth to do with the ultimate greater size of the leaves, and so the greater vigour of the tree.

THE SPATHE.

The growth of the spathe is a matter of general interest as a part of the general growth of the tree, and of special interest to tuba producers since the spathe is the source of the crop. The spathe ceases to elongate shortly before it splits open. This is usually from 75 to 90 days after the first appearance of its tip. The total length of the visible part of the grown fertile branch is usually between seven and nine decimeters. The rate of growth of all spathes measured has risen at times more than 2 centimeters a day; but the average including periods of depression, and the final period of little or no elongation is only half of the maximum, The cure, or rather the part of it we can get the data to plot, is quite irregular.

TUBA.

Partly for the sake of investigation, partly to give practice, and in chief part because it is hoped that by using some of the trees for tuba, it will be possible to protect the entire grove against the attacks of beetles, a considerable number of trees have been operated on to produce tuba. It might be explained that this is the native name of the fresh or undistilled sap more widely known as toddy. As Mr. Gibbs, of the Bureau of Science, has in press a thorough study of this and other Philippine palm saps, I will here touch on only one point, and on this, the relative flow by day and by night, only because it seems to be in some dispute.

Table VI shows the flow from two spathes as reported by Cevallos. Prior to February 10 the removal of slices from the bleeding tips was performed three times daily, morning, noon, and night; from this date on it was performed only morning and evening. The extra slicing at noon would have a tendency to cause a more rapid flow during the day.

Table VII.

TUBA PRODUCTION, DAY AND NIGHT.

Night hours, bold-faced type.

Spathe.		1	2
February 5	...	123·0 cc.	56·0 cc.
		169·5	101·0
6	...	175·0	124·0
		205	132
7	...	235	112
		242	171
8	...	225	135
		235	206
9	...	210	185
		213	174
10	...	240	150
		250	240
11	...	167	160
		290	260
12	...	175	125
		304	209
13	...	115	185
		88	210
14	...	130	125
		191	162
15	...	117	117
		212	124

This production of tuba is less than would be obtained by any expert tuba gatherer, chiefly, I believe, because of the excessively thick slices removed by the students; but I cannot believe that there was anything in their manipulation which could cause any abnormal distribution through the day of the sap. Further, a greater flow during the night is to be expected *à priori* as a direct result of exactly the same factors which cause more rapid growth during the night.

CONCLUSIONS.

The most rapid observed growth of roots is at a rate of about 1·2 meters around each young tree, kept in good condition and devoted to the use of the coconut, have its radius extended at the rate of one meter a year, the tree will have as much ground as it can use. Only a few roots can grow farther.

The most rapid observed growth of the leaf is slightly over seven centimeters a day. This is likely to be exceeded by trees better situated, but is a fair standard of excellence. By making an allowance for the weather, if it is unfavourable, it is possible to estimate the state of thrift of a grove from a day's measurement of growth of several trees.

The growth is checked by wind, by prolonged rain, and by drought severe enough to lessen the water the roots can absorb.

The growth of uncultivated trees is checked by surface cultivation; but this check is temporary, and is followed by a more enduring acceleration.

Within six months after the application of fertilizers, the effect can be seen in accelerated growth of the leaves. This is a practically sure promise of future increase of crop.

There are leaf-primordia large enough to be recognized with the naked eye, which will still require one and a half years in which to grow to the light; another year and a half must pass before fruit matures in their axils. Therefore anything which can influence the rate of development of these youngest leaves will affect the crop three years later.

The growth of the leaves and the production of tuba are more rapid during the night than during the day.

I am under obligation to S. Asuncion, F. Cevallos, A. Lejano, A. Navarro, M. Raymundo, and T. Vibar for careful execution of the field work forming the basis of this report.

EXPERIMENTS BEARING ON THE CULTIVATION OF PADDY.

BY R. H. LOCK, M.A., SC.D.

(Paper read before the Board of Agriculture at its August Meeting.)

1. *On the Nature of Agricultural Experiments.*

The notes which I have the honour to submit to you this afternoon deal with the *method of experiment* as applied to a particular branch of *agriculture*. In order that there may be no mistake about my meaning, I should like, with your permission, to explain the sense in which I use these terms. *Agriculture*, I take it, is the cultivation of the soil for profit, and the best agriculture is that which results in the largest profit without exhausting the soil and so reducing its capacity for yielding further profit. An *experiment* is a test planned scientifically for the purpose of obtaining definite knowledge, and the best experiment is that which leads to the most accurate information. What I have said so far may seem at first sight to be in agreement with the opinion universally prevalent in Ceylon among all classes—the opinion that the objects of agriculture and those of science are totally opposed to one another. It is not so very long since we heard the opinion expressed in this room that a commercial experiment is a different thing from a scientific experiment. That view is not held in all agricultural countries, and it is not my view. One of my main objects to-day is to express as forcibly as I can the opinion that an experiment which is not a scientific experiment is not an experiment at all.

Two things only are essential in a scientific experiment, namely, common sense and accuracy, and any man who possesses these most uncommon qualifications has the right to call himself scientific. Without them no amount of labour and information can produce science. Let us see what science has to say on the subject of agricultural experiments.

We will take a simple case of an experiment designed to afford accurate information on some point important to agriculture, that is to say, affecting the question of profit. For example, we may wish to know whether a certain quantity of a particular manure applied to a particular crop will produce an increase in the yield, the value of which will be greater than the cost of the manure, the cost of transport to the field, and the cost of application, all added together. For this purpose we may mark out two plots of equal area; sow each with the same quantity of seed of the crop in question, and treat them in the same way in all other respects, except that we apply the manure to one of the plots and not to the other. If the plots or their treatment differ in any other way, it will be quite impossible to tell whether any difference which may be found between the yields from the two plots should be ascribed to the effect of the manure or to some other cause.

We will suppose that our two plots are each one-hundredth of an acre in extent; and further, that the crop from the unmanured plot weighs 100 lb., and that from the manured plot 110 lb. Are we therefore justified in assuming that the same amount of manure applied in the same way always cause an increased yield of 10 per cent.?

The answer to this question is "no." To come to such a conclusion would be to suppose that our work is perfectly accurate, and that natural conditions can be made perfectly uniform. In practice we can only make an approach to accuracy. Two plots in a field can never be made exactly alike, there will be slight differences in soil, aspect, drainage, and the like, and all these will affect the crop. It is therefore most important to know how close an approach to accuracy may be expected in an experiment like the present. In order to find this out it is necessary to know how much difference is to be expected between two plots which have been made as much alike as possible, and which have not been manured differently or otherwise differently treated.

How is this most important point to be ascertained? The method is to grow a large number of pairs of like plots and to observe to what extent the crops do actually differ from one another. We may take the average crop of all the plots as the amount which each plot ought to yield theoretically, and we shall find that the actual yield of each plot differs to some extent from this amount. From the data thus obtained it is possible to work out the odds that the crop of a single plot will differ from the average by more or less than a given quantity.

This has been done in a very interesting paper published by Professor Wood and Mr. Stratton in the last number of the "Journal of Agricultural Science." A brief summary of their conclusions may not be without interest.

These authors find that the size of the plot has little or no effect upon the result so long as the plot is more than one-hundredth of an acre in extent. They find that in the case of similar plots the odds against the yield of one plot being better than the average by more than 5 per cent. are 3 to 1.

The odds are	10 to 1	against a	difference of more than	10	per cent.
Do	44	do	do	15	,,
Do	290	do	do	20	,,
Do	2,700	do	do	25	,,

Now, odds of 10 to 1 do not by any means represent a certainty. If they were commonly so regarded, bookmakers would find it difficult to make a living; consequently the 10 per cent. increase obtained in our supposed experiment by no means proves that the manure is doing any good at all. The chances are only 10 to 1 that the whole difference observed is not entirely accidental, having nothing to do with the manure. Still less is it possible to deduce from such an experiment the amount of benefit which the manure is likely to produce. This information can only be obtained by repeating the experiment.

Wood and Stratton have therefore calculated the number of times an experiment must be repeated in order to give any desired degree of precision. They assume that odds of 30 to 1 represent a practical certainty, and their conclusions are given in the following table:—

Precision desired in Percentage Difference between Yields.		Required Number of Plots.
20 per cent.	...	1
15	...	2
10	...	4
8	...	6
6	...	10
4	...	23
2	...	91

That is to say, the yield of two experimental plots must differ by upwards of 20 per cent. before we can safely conclude from a single experiment that there is any real difference between them, whilst, in order to detect a real difference of 2 per cent., the experiment must be repeated almost a hundred times. With these facts in view, I think it may fairly be conceded that agricultural science does not fall much behind the other sciences in point of laboriousness. The man who deduces the value of a manure, or of transplanting, or some other point from a single experiment resulting in a difference of 10 per cent. may fairly be called unscientific, simply because his deduction is not necessarily true.

2. *The Transplanting of Paddy.*

I now propose to illustrate what has gone before by some actual experiments undertaken by the Botanic Gardens Department. Mr. D. Clouston, in a paper published in the "Agricultural Journal of India," has recorded the following results of transplanting in the Central Provinces on irrigated land. The figures given are pounds weight per acre, and a bushel of paddy weighs about 44 lb. :—

		Transplanted.		Broadcast.
1904-05	...	2,000	...	960
1905-06	...	1,940	...	1,190
1906-07	...	1,940	...	1,220
1907-08	...	1,550	...	1,180

This works out at an increase of 63 per cent. on the average of four years. Our degree of precision for four experiments being 10 per cent., we may say that under the conditions of the experiment transplanting may be expected to give an increase of not less than 53 per cent. and not more than 73 per cent. over the broadcasting method. Similar results have been obtained elsewhere, and we may take it as established that the transplanting of paddy leads to a greatly increased crop, although we may remark in passing that the results of Mr. Clouston's experiments differ from one another by an amount which cannot possibly be accounted for by the laws of chance.

Mr. Clouston's paper says nothing about the distance between the transplanted seedlings, but we understand that the recognized distance in India is about 9 inches. The question of distance is, however, a most important one. It is clear that there must be some particular distance which, other things being equal, will give the largest crop per acre; and that if we transplant more closely than this, we not only waste both seed and labour, but lose on the total crop as well. Moreover, it is better to plant too widely than too closely, since by the former method we save labour and seed, even at the expense of some reduction of crop.

The discovery of what is actually the best distance entails a very long series of carefully conducted experiments, and my own preliminary experiment in this direction by no means settles the point. I describe it here, partly in order to point out the precautions which must be taken and the sources of error which arise in experiments of this kind, and partly because it is doubtful whether the work will ever be carried to a definite conclusion.

On the paddy field at the Peradeniya Experiment Station an area was selected which was bounded by a single bund, and which might therefore be expected to be fairly uniform as regards soil composition. Here five plots were marked out, each 20 feet square, or rather less than a hundredth of an acre, and on these paddy seedlings were transplanted singly at different distances. Paddy was also transplanted close up to the edge of each plot all round—an important precaution for two reasons: first, because only in this way can the plots be regarded as fair samples of a larger area; and secondly, because birds and other enemies which always attack an experimental plot under the impression that some special delicacy must be growing there are in this way more or less circumvented. The remainder of the field was transplanted, according to what appears to be the local practice, in bunches of six to ten plants about 6 inches apart.

The plots with their yields were as follows:—

Distance.	Number of Plants per Acre.	Yield in Bushels per Acre.	Percentage of Increase over General Field.
Bunches 6 x 6	—	32	—
4 x 4	392,040	37	15 + x
6 x 6	174,240	60	87
8 x 8	98,010	60	87
10 x 10	62,726	52	62
12 x 12	43,560	18	—44 ?

Now, although our degree of precision in the case of a single experiment is only 20 per cent., we have here a certain amount of definite information. The transplanting of single plants at distances of 8 by 8 or even of 10 by 10 inches gives us something like double the crop yielded when transplanting is in bunches at 6 by 6. On the whole, therefore, the experiment supports the view that 9 by 9 inches is about the best distance between the plants under the circumstances of this particular crop. Unfortunately the plots planted 6 by 6, 8 by 8, and 10 by 10 were the only ones which could be regarded as giving a definite result, for about a quarter of the crop of the 4-by-4 plot was destroyed by pig or some other large animal, whilst the 12-by-12 plot was very sickly for some unexplained reason, which had nothing to do with the distance between the plants, but was provisionally put down to sourness of the soil.

With regard to the question of profit, transplanting 8 by 8 ought not to cost more than Rs. 4 per acre altogether, whilst the increased crop over bunch transplantation—28 bushels at Re. 1·50—is worth Rs. 42. The amount of seed required by the former method is perhaps a tenth of that required by the latter.

At my recommendation Mr. Harbord has carried out a similar experiment at Maha Iluppallama, and he has kindly furnished me with a summary of his result. The figures represent the average of the yields from two sets of plots, each plot being one-hundredth of an acre in extent:—

Distance apart.			Bushels per acre.
2 × 2	...	...	45
4 × 4	...	...	50
6 × 6	...	...	50·5
8 × 8	...	...	49
10 × 10	...	...	48
12 × 12	...	...	39

Here, again, we find that the distance of transplanting may be varied from 4 inches up to 10 inches with little effect upon the yield of grain, the recorded difference being insignificant compared with the probable error of the experiment. As transplanting 4 by 4 represents more than six times the labour and seed required to transplant at 10 by 10, the choice of a suitable distance should present no difficulty to the practical agriculturist.

3. *Manuring for Paddy.*

Although further experiments are required in order to decide what is exactly the most economical distance for transplanting paddy, there can be no doubt from the result of the experiments described above, as well as from many others carried out in different parts of India, that transplanting represents a paying proposition. In the Secretary's report for last year I find the complaint that the manuring of paddy "on scientific lines" makes slow progress, and cultivators are recommended to try a particular mixture prescribed by Mr. Kelway Bamber. This mixture has been on trial at the Experiment Station at Peradeniya during the two past seasons, with the following result:—

	Yield per Acre. Paddy. Bushels.		Straw. lb.
1910, Manured ...	27	...	1,450
1910, Unmanured	18	..	1,616
1911, Manured ..	32	...	2,223
1911, Unmanured	25	...	1,665

This works out an average increase of 8 bushels per acre for the two years, value Rs. 12 per acre. The increase is 37 per cent. of the unmanured crop, which as the result of two experiments we may regard as correct to within 15 per cent. So far so good, but what about the profits on the transaction?

The manure was applied at the rate of 5 cwt. per acre. The mixture costs Rs. 5·72 less 5 per cent. discount F. O. R. Colombo, and the freight from Colombo to Peradeniya is 56 cents per 100 lb. If we put the cost of application at only Re. 1·50 an acre, the total cost of the manure works out at Rs. 32 per acre. This represents a nett loss of Rs. 20 per acre, due solely to the application of the manure. From the result of this experiment I should think it in the highest degree unlikely that the use of this manure can ever be made profitable, no matter what the quantity applied may be.

4. *Selection.*

My own transplanted plots were intended in the first instance to provide material for the selection of seed. As a second generation has not yet been grown, I can give no information at present regarding the result of selection. But it may be worth while to give a brief statement of the range of differences which have been found between different plants, thus affording some idea of the material upon which selection may be based.

From each of the transplanted plots 100 plants were separately gathered, the number of tillers or fruiting stalks sent up by each plant was separately counted, and the grain from each plant was separately weighed. I have therefore 500 definite observations of weight to select from. The result of these operations were as follows:—

Number of Plants having different Weights of Grain in Grammes.

Plot.	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
4 × 4	21	24	25	15	10	4	1														
6 × 6	5	18	22	20	24	5	5	.	1												
8 × 8	.	3	9	10	12	20	16	15	7	4	1	1	.	1							
10 × 10	.	.	2	9	5	9	14	16	14	7	6	5	6	2	4	.	.	.	.	.	1
12 × 12	3	16	16	21	8	10	8	10	6	.	.	2	.	.	.						
Total	29	61	74	75	59	48	44	41	28	11	7	8	6	3	4	.	.	.	.	.	1

The weights in the above table are given, as they were recorded, in grammes, 28 of which go to an ounce.

Number of Tillers.

Plot.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4 × 4	2	19	33	18	20	6	1	.	1		.					
6 × 6	6	19	35	24	11	3	2									
8 × 8	.	4	9	28	21	14	18	5	.	1						
10 × 10	.	1	8	6	14	13	18	20	7	3	5	3	1	.	.	1
12 × 12	2	13	15	20	21	6	9	9	2	2	.	1				
Total	10	56	100	96	87	42	48	34	10	6	5	4	1	.	.	1

It will be seen at once that both the number of tillers and the weight of grain depend a good deal on the distance of transplanting. Each plot, however, generally contains one or two plants which are notably superior to the remainder, and by sowing separately the seed gathered from these we may hope to see some definite improvement in future generations. A similar result may be obtained with considerably less trouble if the best plants are simply selected by eye, and this could readily be done by the cultivator, whose object is simply improvement and not demonstration of improvement.

5. *Conclusions.*

Whilst there can be no question as to the value of transplanting in paddy cultivation, a process which invariably yields a large return in comparison with the labour expended, there is, on the other hand, no evidence that the use of artificial manures can be rendered profitable to the cultivator. There is a strong probability that green manuring would be found to pay, but at present we have no direct evidence bearing upon this process in Ceylon. The use of cattle manure, where it is available, may also yield a profit.

The range of variation in the weight of grain obtained from transplanted paddy plants makes it probable that selection will lead to improvement.

R. H. LOCK.

Royal Botanic Gardens,
Peradeniya, June 15, 1911.

PADDY CULTIVATION IN CEYLON DURING THE XIXTH CENTURY.

BY E. ELLIOTT.

INTRODUCTION.

Memories of absentees die out so rapidly in the tropics, it is possibly advisable, the more especially as now reigns a Pharaoh who knew not Joseph, that I should start by setting out my qualifications for venturing to undertake the task placed at the head of this paper, and explain that during my forty-three years' residence in the Island I had special opportunities of studying the subject in the successive offices I held as Assistant Agent, first at Matara (for seven years), and then Mannar, and subsequently Grain Commissioner and Government Agent in three different Provinces. Further, after my retirement from the Civil Service, as a practical cultivator, I brought under paddy over 600 acres; consequently I have, so to speak, seen both sides of the shield, and am therefore the more qualified to express an all-round opinion.

Before leaving Ceylon I partly compiled a history of Irrigation to assist Mr. White in the Manuals he was bringing out. I have only recently met with a copy of this work, and while admiring the able manner and the extensive sound information it contains, and Mr. White's industry and ability in the compilation, I was disappointed that it contained no notice of the development of paddy cultivation in the island. It was said by the natives that, with the abolition of the so-called grain tax, Government would lose all interest in the cultivation of paddy. *Absit omen*! but it is rather significant that even the word paddy does not find a place in the index of the official manual.*

I had at one time intended to follow up my contribution on irrigation with a similar review of the allied branch of agriculture; circumstances, however, prevented my doing so before leaving Ceylon. But, as I found a more recent edition of the Manual is equally devoid of any reference to the subject, I think it may not be inopportune if I venture to obtrude my views on the notice of the present authorities and public, especially as they, I fear, differ from those of some other agricultural authorities of the island.

Of course I undertake this task under considerable disadvantages, as I am unable to refer to various authorities and get original information from sources which would be open to me if in Ceylon; but I find I have considerable materials which will enable me, I think, to give a fair account of the subject; and during visits to London I have been able to obtain further information and verify figures from the records of the Colonial Office Library.

As applicable to the task I have undertaken, I borrow from an American author as follows: "In performing a study of this kind one feels the need of limiting the scope by reducing the denominator, as Arthur Help remarked: 'Even so limited, the subject is not without difficulties.' The forces to be studied do not lie on the surface, and some of them are not described in any document or found in any treatise. The effect of the various forces at work must be a matter of opinion in which well-informed people may differ, and the writer has to draw the picture as it appears to him."

It will be first convenient to review

THE GOVERNMENT POLICY AND PAST LEGISLATION

in regard to Paddy cultivation. When the British Government got possession of the maritime portion of the island in 1796, the Madras civilians first entrusted with its administration endeavoured unsuccessfully to introduce a general land tax such as prevailed in India. When they failed, the Dutch system was permitted to continue in operation, until the proclamations of May, 1800, and September, 1801, abolished the "accomodesans." Government then resumed the lands held on this tenure, and fixed the land tax as follows :—

On Paddy lands not held on Service terms and which had paid less than one-fourth, one-tenth in future.

On those which paid over one-fourth, in future one-fourth. On lands held by Service tenure one-fifth of the gross produce. In the Tamil districts the Tax in the Dutch time appears to have been one-tenth, and so it remained under the British.

Soon after the British Government obtained possession of the Kandyan Provinces in 1818, the rent on paddy fields was fixed at one-tenth of the produce (with a reduction to one-fourteenth for loyal conduct in certain specific cases).

An endeavour to commute the tithes in the low-country for a general rent payable in money was made in 1812, but failed. Originally the Government share was accepted in *aumani* (kind) and

* Under Rice the reference is to the imports and market price.

placed in stores and thence issued; but this gradually gave place to the farming and renting system which had become general in the low-country districts by 1829.

In the policy and system followed (to adopt Sir Edward Barnes' words) "the prominent feature was that of paying certain fixed proportions of the produce so that the more the agriculturist cultivated, the more he paid to Government. It had much to recommend it; it was simple, appeared equitable and was easy of comprehension to the natives."

This mode of collection by farming had never been followed in the Kandyan Provinces, where Mr. Turnour by agreement with the cultivators converted the Government share (one-tenth) into a payment of a fixed amount of grain per holding, and afterwards into a money payment. It was readily accepted by the Kandyans and immediately augmented the revenue.

In 1831 the Board of Revenue proposed the extension of this system to the Maritime Provinces, both Sinhalese and Tamil. This commutation was voluntary and was effected by means of written agreements between the Government Collectors and the land-owners. The only means of enforcing payment was by action in the Civil Courts, and in result large arrears accumulated, and the system broke down and was abandoned at different dates between 1841-53 in the Western and Southern Provinces, but reintroduced into Sabaragamuwa and Kegalle after the Ordinance of 1886 had rendered the collection of commuted revenue more practicable.

In 1835, at the suggestion of Sir W. Colebrooke, permission was granted to the land-owners in the Central Province to redeem the charge on their fields by a payment of ten years of the commuted tax, and this privilege was afterwards extended to the other Provinces, but it was not largely accepted, and the privilege was subsequently withdrawn.

In 1841 Ordinance No. 14 was passed regulating the collection of the Paddy rent,* and laying down the procedure to be followed by both renters and cultivators. Under this law until 1878 the tax was collected either by the system of voluntary commutation already explained; and when this could not be arrived at, by selling the Government share generally by public auction to the highest bidder, who "on payment of the amount of his bid became the renter of a village or a group of villages." The rent consisted of the right to recover from the land-holders the share of grain due to Government for the fields in the rented area. Undoubtedly under this system there was a great check on false assessments and estimation by the headmen, but on the other hand the renter was bound to get something more than he paid, to cover the expenses of collection and realisation. In some districts the relations between renters and cultivators were fairly satisfactory, but in others complaints were made of extortion on the part of renters, of inconvenience to the cultivators involved by this mode of collecting the tax, while the renters alleged evasion and delay on the part of their debtors.

As the only compulsory mode of settling such disputes was by prosecution in the Police Courts, such cases mounted to thousands, and were nearly all settled by the day fixed for hearing, only a very small number requiring adjudication. Finally an outcry was raised against the system as savouring too much of Turkish modes of administration and ill-suited to the British Standard, and though any change to a less elastic method was deprecated by many experienced civilians, the Grain Committee, which enquired into matters in 1877, recommended renting should be abolished in favour of compulsory commutation. In compliance with this view an Ordinance was passed in 1878, it was said, "in the interest of the holders of paddy lands with the view of relieving them of the exactions of the renters," and "affording encouragement in other ways to the cultivation of paddy."

Under this Ordinance Government was empowered to gradually introduce a system of compulsory commutation; and Grain Commissioners were appointed to investigate the circumstances of each separate holding and fix a money value for the Government share. This was carried out in the Western, Southern and Eastern Provinces and created great discontent, chiefly because a fixed sum had to be paid whether the crop was good or bad; a principle utterly opposed to the native idea of a sliding rate, proportionate to the capacity to pay—much when there was much in good years, and little when there was little in years of scarcity.*

* In this Ordinance the alternative term of "tax" was applied to the Government share of the crop, though this was ordinarily and generally known as the "paddy *rents*."

*The alternative of Crop Commutation payable only when a parcel was cultivated afforded no practical relief.

These measures practically sounded the knell of the grain tax. Complaints of the new procedure soon arose, and coupled with it, a movement for the total abolition of the impost, now come to be looked on not as a rent, but as a tax—a tax on food. The subject was fully enquired into by a Select Committee of the Legislative Council, composed of Messrs. O'Brien, Saunders, Moor and Williams (officials), and Senewiratna, Grinlinton and Panabokka (unofficials) with Mr. A. Ashmore as Secretary. Though this strong Committee reported against the abolition of the impost, and their opinion was strongly backed by the Governor, his successor came out, it was believed, instructed to carry out the abolition of the impost; and this was eventually carried out with effect from 1st January, 1893.

In concluding this part of my review, I must acknowledge my indebtedness to the Report of this Committee (which was, I believe, drawn up by the late Sir A. Ashmore as Secretary) and its annexures. Fortunately I had brought home my copy and have found it most useful.

All the foregoing

LEGISLATION SO FAR PROVIDED,

it will be observed, *solely* for the due collection of the Crown share of the crop as Lord of the soil. Indeed, during the final half of the XIXth Century, almost the only other important action taken, viz., the abolition of "Rajakariya" in 1882, though "actuated by the laudable desire to free the people from oppression," was simply ruinous to the interests of paddy cultivation.

In 1846 Sir Emerson Tennent, the Colonial Secretary, recognised the unsatisfactory condition of the industry and endeavoured to awaken an interest in the matter. But he again raised the bogie of 'oppression,' that of the 'renter.' He succeeded in obtaining a recommendation from a Committee for the repair of tanks, etc, to share in the proposed 'Ordinance Labour.' I rather think this was included in the first Ordinance passed, but it was disallowed by Lord Grey, who laid down the principles on which he was willing to give help. So nothing was done, and matters went from bad to worse.

THE TURNING POINT.

In 1856 came the turning point in the tide of the affairs of this branch of agriculture, when, under Sir H. Ward's energetic rule, the first Paddy Cultivation Ordinance was passed. The cardinal provision of this important measure was the revival of the ancient village customs relating to cultivation—whenever two-thirds majority of the proprietors in any district so desired, their incorporation in written rules and the restoration to the village councils of power to compel their observance by fine. This Ordinance was tentative in character and its duration limited to five years from January, 1857.

In 1861 it was renewed for another five years, but the necessity of obtaining the consent of so large a proportion of those interested prevented its adoption in some districts. In 1867 this Magna Charta of the paddy cultivator was permanently added to the Statute book, with the proviso that the approval of a simple majority of those interested should be sufficient to secure its introduction in any division; its general acceptance followed.

As I will presently show, the development and progress of paddy production has been ever since most satisfactory, and been of course furthered and advanced by expenditure on irrigation initiated by Sir Henry Ward.

THE HISTORY OF IRRIGATION

per se has been already so fully written in the official manual, and the policy so admirably reviewed in Sir West Ridgeway's farewell address in 1903, that it is unnecessary for me to go over the same ground in detail, but to complete this record it will be well to include a short notice of the action taken by each Governor.

Sir Henry Ward (1857-8) spent money in restoring irrigation works, without requiring any special repayment or water rate, depending on the increase in the value of the Government share of the crops and the sale of Crown land for a return.

Sir Hercules Robinson (1867) provided for repayment in ten annual instalments without interest, of all expenditure on irrigation.

Sir W. Gregory (1873) offered, as an alternative, a payment of Re. 1 per annum in perpetuity. He also in backward districts authorised a limited expenditure on the necessary masonry, when the cultivators did the earth, work required to restore a village tank.

Sir Arthur Gordon (now Lord Stanmore) provided by Ordinance for the setting apart of one-fourth of the "grain tax" for expenditure on irrigation, under the supervision of a Central Irrigation Board.

Sir Arthur Havelock (in 1892) abolished the "grain tax," and in lieu of it charged a sum of Rs. 200,000 on the general revenue to be placed at the disposal of the Central Irrigation Board.

Sir West Ridgeway (1900) arranged for the expenditure of five millions of rupees within a limited number of years, and created a separate Irrigation Department to carry out (what he himself called) "an ambitious programme" of large works. He also increased the maximum irrigation rate to Rs. 2 per acre, and the maintenance rate from 10 to 50 cents per acre.

THE HISTORY OF PADDY CULTIVATION IN CEYLON

may, I think, be appropriately divided and conveniently dealt with in five periods as follows :—

(1) From the arrival of the British in 1796 to 1830-2, when Rajakariya was abolished,and a new system of collecting the Government share was introduced.

(2) From 1830 to 1856, when the Colonial Legislature passed the first Irrigation Ordinance, which has had such an important bearing on the industry, and the first irrigation works of modern times were initiated.

(3) From 1856 to 1869, when there was a further advance in the irrigation policy of Government, and a correspondingly larger outlay on works.

(4) From 1870 to 1892, when the share of produce due to Government as rent was remitted altogether.

(5) From 1893 onwards, during which there has been a still further outlay on works, both from the general revenue and a loan specially raised for the purpose, during the enlightened administration of Sir West Ridgeway.

Fortunately the Sessional paper No. XVII of 1890 contains a mass of most useful but ill-digested information regarding the first three periods, and from it I have culled the facts and figures I will now present in, I trust, a more intelligible and interesting form.

FIRST PERIOD, 1796-1830.

Under the administration already noticed in the earliest days of the British occupation, the cultivation of paddy declined very considerably. At Batticaloa, Captain Kingstone (an early Collector) records the Government share of one district in 1798 was 2,000 avonams equal to 15,000 bushels, and not so much in any year since the capture by the British, while the average of years preceding that was 5,000 avonams (37,500 bushels) to the Dutch. In the Wanny Manual, Mr. Lewis gives figures, which show that in the portion now included in the Vavoniya and Mulletivu districts, the cultivation, which in Wannian's time had been about 11,000 acres, had increased under the Dutch to 11,700, but had declined in 1807 to 3,400 under the British.

A Committee which sat in the early days of the occupation enquired into the matter, and Government in 1800 deputed Capt. Schneider, their chief Scientific Officer, to inspect the maritime districts and report fully on their capabilities for grain production and to advise how best to improve this industry. This officer in 1808 made a very exhaustive report, a portion only of which has been published in the *Literary Register* for 1856.

According to the Dutch records at the time of the British occupation the extent of paddy land in the Colombo Division (which included the Colombo, Kalutara and Negombo districts) was 10,347 amunams, say 26,000 acres.

In 1798 Ceylon was declared a Crown Colony, and the Hon. Mr. North appointed Governor, but it was not transferred to the superintendence of the Colonial Department until 1802. It is said "His administration partook more of a temporary military occupation than of any settled plan of civil policy."

In 1805 Sir Thomas Maitland, G.C.B., succeeded; though his "Government was not distinguished by any political event of importance," a suspension of hostilities with the Kandyans enabled him to devote his attention to developing the resources of the British territory; and the decadence of paddy cultivation received his marked attention.

On the 8th December, 1808, a code of general instructions to heads of departments was passed and subsequently published, signed by Mr. R. Plasket, Secretary of the Council, who afterwards became as Sir R. Plasket, Civil Auditor-General, and retired on pension in August, 1814.

These were incorporated in an old volume of minutes, a copy of which forms one of my "relics," from which I cull some interesting particulars. The first Chief Secretary was Mr. Robert Arbuthnot, doubtless one of the Madras civilians, and who soon left and was succeeded by the Hon. John Rodney from 1809 till June, 1832. The Revenue Commissioner, Sir A. Wood, who ranked next to the Chief Secretary, was the officer charged with the supervision of the interests I am discussing...... He was in 1811 succeeded by Mr. R. Boyd who held the office until his retirement in 1836.

In an excellent code of instructions issued in 1808 to Collectors of Districts, they were assured "the most ample means would be furnished to every Collector of making advances of various kinds with a view to increase cultivation." . . . They were urged to make at least one circuit each year, and, if possible two, so as to settle disputes in the villages and to make arrangements with the cultivators for supplying them with seed, grain, "clothing" and agricultural tools, and, as far as may be possible, relieving them from the vexations of a tax gatherer by letting to the cultivators the tithes of their villages. The advances were of course to be repaid in grain or money after the crops were reaped. Mr. Swettenham, writing in 1888, records that "though under this system losses were incurred, they were amply covered by the insurance of 20 % charged upon the loan by the Executive Council." He adds :

"The happiest consequences of this liberal policy which Government anticipated, appear to have followed, Mr. George Turnour senior being specially successful in the Wanny, where he so increased cultivation that the Government share of the crops rose to 40 thousand parahs in 1810 as against 9,000 in 1806." Mr. Sawer's administration of Batticaloa up to 1817 (says Mr. Swettenham) was equally successful, and in the districts which now constitute the Northern and Eastern Provinces, the Government share had increased to 191,000 bushels, "indicating a gross crop of say two millions."

Under this policy the total revenue raised from paddy, according to Bertolacci, who was at the time Civil Auditor-General, was as under—

	1811.	1812.
Collected direct by officers of Government, R. Dollars ...	172,401	230,178
Farmed out to renters ,, ...	259,744	238,491
	432,145.	468,669
Annual average, say	£33,756.	

A portion of this high revenue was doubtless due to the great increase in the price of rice which the same authority states doubled in price between 1800 and 1812. But from his remarks there appears to have been a good time all round, "an increase in the population as evidenced by the number of children that are now seen in the families of the Ceylonese," and "no rise in the price of labour." But considering the tax was drawn only from the maritime districts and when paddy was much cheaper, these figures point to crops which were unequalled until towards the end of the Century.*

* General Maitland is said to have made a fortune of £100,000 as Commander-in-Chief in Ceylon. General Brownrigg, who succeeded him, has given up a situation of more power at home for one of more emolument abroad." (*Morning Post* of 1811, recently reproduced.)

Sir Thomas Maitland just stayed long enough to see the success of his policy and was succeeded by another General, Sir Robert Brownrigg, Bart., G.C.B., in March, 1812. Shortly after which there arose much distress, especially in the "Northern parts of the island and Matara" (which the map in Bertolacci shows included the Hambantota district) at the end of 1812 and continued throughout 1813 and 1814, "consequent on repeated drought at the seasons when rain might naturally be expected, which is indispensable to the cultivation of Rice." (B.p. 70.) So . . . . grain had to be imported from India, while "a very large supply was derived from the Candian Country which produced large supplies."

Considering the large contribution to the general revenue from grain, it is under these circumstances not surprising the new Governor of the Colony found the finances of the Colony in a most deplorable state. For some years the revenue had decreased considerably and not covered the expenditure, necessitating application to the Home Government for assistance, which appears to have been given from the "secret service funds."

No figures are available for some years, nor is their absence material for purpose of comparison, as a very considerable area of paddy land was added to the British possessions by the annexation of the Kandyan Provinces during General Brownrigg's tenure of office (1812-20). The administration of this newly-acquired territory was for all purposes vested in a Board consisting of a Resident, the Officer Commanding the Troops, and two other Commissioners for Revenue and Judicial business. Sir John D'Oyly was the first Resident and held the position until his death on 24th May, 1824. Mr. Simon Sawers was the first Revenue and then Judicial Commissioner from 1816-27.

In 1828 Mr. George Turnour, who entered the Civil Service in November, 1820, and was for some years in charge of Sabaragamuwa was appointed to the Board as Revenue Commissioner. There were also two Secretaries, one at Colombo (Mr. James Sutherland) to the Government and another (Mr. George Lusignan) to the Board. Subordinate to the Board, there were at first Agents of Government only in Uva (Mr. Wilson who was killed in a rising in 1827,) Sabaragamuwa and the Three Korales, and the civil authority was exercised as before by the native Disavas and Ratemahatmayas. "But after the rising in 1818 with a view of destroying the paramount influence of the Chiefs, British

Civilians or military officers were placed in authority over them as the accredited Agents of the Government to collect the revenue and administer justice, and vested with the selection of the inferior headmen" —as follows:--

Lower Ouvah (Capt. Richie), Seven Korles (Major J. Andain), Pahaladolos Korles (Lieut. Felix O'Hara), Matella (Capt. J. Amthill) and Four Korles (————————). Nuwera Kalawiya was divided between Seven Korles and Matella.

Apparently it was not the rule at this time for officers to reside in their districts, for Pridham remarks:—"The aspect of European society in Ceylon underwent a considerable change during the latter part of Sir R. Brownrigg's rule, by the dispersion over the interior of the island of the civil and military servants, who had hitherto been concentrated at the Chief towns of the maritime provinces. This measure, though depriving the places referred to of their great charm, in a social point of view, was politically necessary, and whatever improvements have since been effected are in a great measure to be ascribed to the new field thus opened to the activity of men, who in addition to their ordinary civil duties, found it expedient to devote the remainder of their time to agricultural pursuits." But notwithstanding this drastic measure of discipline and the alleged devotion to agriculture, paddy cultivation does not appear to have flourished in the early days of Sir Edward Barnes' tenure of office (1821-31). Bertolacci's remarks that there was earlier in the century a large surplus in the Kandyan country, which was imported to the maritime districts, would lead to the expectation of a substantial addition to the total grain revenue after the annexation of the interior; but the figure for the whole island for 1822 was only £34,760. Rainfall returns for this period are not available, but it is recorded in the Sabaragamuwa, Matara and Galle Provinces, "owing to heavy falls of rain, and the loss in cattle, grain and the destruction of habitations were of an unprecedented nature."

Indeed at this time the gross income from some of the backward districts was small, thus in Nuwera Kalawiya in 1825 it amounted to the handsome sum of £11-13-5½, and from that time till 1833 it seems to have only averaged £129-13-5." (A. O. Brodie's paper in R. A. S. C. B. Journal, 1855.)

Though between 1824-27 the Kirema Dam was constructed by Sir Edward Barnes' order, it is well known his energies were more especially devoted to the formation of roads to Kandy and through the interior, and for which he fully availed himself of the system of Rajakariya, judging by the following extract from Col. Colebrooke's report: "In some districts through which the main road to Kandy has been carried, the people called out have been constantly employed for several years, and no correct account of the numbers can be procured. They have been usually relieved at certain periods of the year and for short intervals to enable them to cultivate their lands. The authority to return to their homes has on application been granted by the Governor, and in certain districts has not extended beyond a few weeks in the year."

Though probably this account is exaggerated, it is not surprising that the paddy crops during the twenties were very short, as shown by the statement made by Sir W. Colebrooke that the grain revenue from all parts of Ceylon *gradually* diminished from the figures given above, £34,766 for 1822 to £19,688 in 1826, and the average for the next three years (1827-29) was only £20,941 per annum.

On the 24th May, 1825, died Sir John D'Oyley, Bart., who had held the chief administrative office in the Kandyan districts since the annexation. He was undoubtedly an able administrator and won the confidence of the Kandyans largely, I believe, by making himself accessible to all classes. Regarding this I was told the following story (by I rather think Mr. J. A. Dunuville, Deputy Queen's Advocate, Kandy, at one time, and who was a grandson of Dunuville Disawe). Emerging late one afternoon from his office, Sir John found an old Kandyan who evidently wanted to make some complaint, but hesitated to address the great man; so the latter, as was his wont, said "Mokada?" The Kandyan had been waiting about all day, and whether through anger or ignorance shouted out "Sokade" and bolted. Sir John could not understand this word, though he had a good acquaintance with Sinhalese, and proceeded to make enquiries as to the meaning, but without success at first, but did not rest until he discovered that—though literally it was the name of the wooden bell put on buffaloes when turned out to graze, it was used as a vulgar retort, and which accounted for the rapid disappearance of the irate old Kandyan.

No successor was appointed to the Residency, but the leading member of the administration after this was Mr. George Turnour who was shortly after promoted to be Revenue Commissioner of the Kandyan Provinces, after serving under Sir John D'Oyley in Sabaragamuwa.

Mr. Turnour is described as having early acquired a profound knowledge of the language "and an indefatigable spirit of enquiry," qualifications which led to his undertaking an examination of the Sinhalese annals, and resulted in the publishing (in 1837) of the first part of a translation of the Mahavanso.

It may be here noted, in view of the important services rendered to the Colony by this able civilian and his father, that the latter, the Hon. George Turnour, was a son of Earl Winterton (an Irish peer) born in Feb., 1768, and married to Emilie de Beaussett, niece of Cardinal Duc de Beaussett. He was the officer whose service in the Wanny district in the early days of British rule have been already referred to as a most successful administrator, as more fully detailed and acknowledged by Mr. Lewis (in his Wanny manual), and whose methods for pushing paddy cultivation in particular, deservedly received high commendation from Sir A. Swettenham, K.C.M.G. The father's life seems to have been sacrificed to his duty, and he died at Jaffna, in January, 1813, at the early age of 45, leaving a widow (who lived till 1846), and a son George born in 1799, who happily joined the Ceylon Civil Service in 1820, and in a few years rose to the important office already mentioned of Revenue Commissioner. In this capacity he seems to have gained the confidence of the Kandyans and quietly perfected a new departure for the encouragement of paddy cultivation, the details of which more properly come into the history of the next period.

As it is fraught with important results to agricultural interests, mention should be made at this stage that the affairs of the Colony occupied the attention of the English House of Commons, and led to the appointment, on the 27th May, 1830, of a "Select Committee to enquire into the Revenue, Expenditure and Commerce of Ceylon." This action was taken at the instigation of a Mr. John Stewart, M.P., whose knowledge of the island was in his own words as follows:—

"I was shipwrecked in the island in 1805 where I remained for some months, and I frequently visited the Colony after that period, and was engaged for many years in commercial intercourse with it. I passed several months there in 1822, which was the last time I visited it."

Limited as was his experience in the island, he succeeded in raising the cry of "Slavery" and made other serious charges against the administration.

Actual slavery existed at the time in the island, and was not finally abolished till December, 1844; but apparently the denunciation was rather directed against what was locally known as *Rajakariya.* This was the system which had existed for centuries in Ceylon, under which the old Sinhalese kings had carried out and maintained extensive public works, irrigation and others, which existed in all parts of the island. Though mistranslated as "forced labour," it was based on the principle "that all land was held from the Sovereign for a registered rent, such rent being payable either in labour or in kind or both." The British found a considerable area still held as private property on the tenure of personal service direct to the Sovereign, but in the low-country taken over from the Dutch, tenure by service was abolished on May 1st, 1802. (For details see Sessional Paper XVII of 1890.)

In the Kandyan districts "rajakariya" still existed after the British occupation in a complicated form, and, besides the service due to the Government, covered those rendered by tenants of lands assigned to Chiefs, Temples and others by the Sovereign. In consequence of abuses which had arisen owing (according to Turnour) to "the absence of the despotic power of the Sovereign by which the undefined power of the chiefs was kept in check," a new system was adopted by the Proclamation of 18th November, 1818. By this the payment of a tenth of the produce of paddy lands was declared the substitute of all former gratuitous services due to Government, except for "the construction and repair of roads and bridges," but all other persons were declared liable to "perform services to Government on payment."

By a further notification of 16th October, 1819, the Agents of Government in the Kandyan districts were directed to restrict their requirements "for a term not exceeding *ten* days without previous reference to superior authority." During the administration of Sir Edward Barnes this limit was, however, greatly exceeded, as stated in the extract from the report already given. This was possibly overdrawn, and sufficient allowance was not made for the exigency of the political situation, which required the opening up of the recently conquered districts; or, the possibility considered of preventing such extreme application of the right to exact labour from a population, not in a position to contribute in money to the development of their country, and accustomed from time immemorial to this mode of discharging their liability to the State.

The Parliamentary Commissioners (Col. Colebrooke and Mr. Cameron) deputed to visit the island and make enquiry, took a strong view of the subject, and *inter alia* recommended the immediate and unconditional abolition of "rajakariya" without any commutation of that labour either by additional assessment in land or by personal or capitation taxes." This, however, only applied to the liability to Government and left untouched the services due by occupiers (tenants) to Temples and other holders of grants from the native sovereigns prior to the British occupation.

The special measures already referred to for the encouragement of paddy cultivation appear to have been gradually dropped and more attention paid to encourage other crops, regarding which I found notices such as Hemp in 1812 and Coffee in 1817. In 1824 a Minute by Sir Edward Barnes exempted crops of coffee, cotton and pepper from the general tax of one-tenth they were otherwise liable to, but specially notified this was not to extend "to any low land applied to the cultivation of paddy." The cultivation of Cinnamon, it may be remarked in this connection, was looked after by a special Department which was, however, abolished in 1832, and the officers (who were colloquially referred to as the gardeners) were incorporated in the *new* Civil Service, one of whom Mr. James Caulfield (appointed to the Department in 1823) eventually rose to be Treasurer of the Colony and *ex officio* "a Deputy Paymaster-General to the Queen's forces," which entitled him to military honours at his funeral in May, 1861.

(*To be continued.*)

RICE EXPORTS FROM SIAM.

(From the *Manila Bulletin.*)

HEAVY BUYING ON PART OF JAPAN—MATERIAL ADVANCE IN PRICE IS REPORTED.

An interesting report on rice shipments from Siam comes from the pen of Consul G. Cornell Tarler, Bangkok, who gives some interesting figures and statements regarding the shipments of rice and the advance in prices.

Consul Tarler says:—

Exports of rice from Bangkok for the first three months of 1910 amounted to 80,404 coyans to Hongkong and 70,020 coyans to Singapore. (The coyan equals about 2,977 pounds.) Shipments for the first quarter of 1911 totaled 77,984 coyans to Hongkong and 60,397 coyans to Singapore. This shows a well-sustained exportation in view of the 40 per cent. shortage of the rice crop for the past season.

I have been unable to discover any advance purchases except through a few firms exporting rice to Europe, and these firms have yearly contracts. The Chinese merchants here are following the Hongkong market, where the price of rice has increased as it has here. For white rice the price has advanced from about $2·04 a picul (133⅓ pounds) in November, 1910, to about $2·50 in the middle of February; it is now about $2·31. In 1909 the same rice paid $2·04 in October; in the following February it advanced to about $2·17.

Local merchants have received telegraphic information from their agents that Japan has been buying heavily from Saigon and Burma, the rice in the latter instance coming through Moulmein and Rangoon. Siam rice is not popular with the Japanese on account of the fear of beri beri.

GLUCOSE AS A FOOD STUFF.

(From the *Louisiana Planter and Sugar Manufacturer*, Vol. XLVII., No. 26, July 1, 1911.)

In a recent article concerning glucose, published in the "New England Grocer," the editor of that ordinarily very sound journal and always excellent, from its general points of view, makes the statement that glucose is not an inferior product, but a pure, healthful article. He then goes on to describe corn glucose as constituting perhaps a silver syrup in contradistinction to the ordinary golden syrups which are the residual part secured in refining cane sugars. Our friend, the editor of the "New England Grocer," commits, or permits, this serious error, that is to compare glucose, artificially prepared by boiling starch in dilute sulphuric or hydrochloric acid, with that material known as grape sugar, which actually exudes from grapes and figs as they become dry, forming as is frequently seen on raisins, a white incrustation. That kind of glucose, or more properly grape sugar, is formed in nature's laboratory. This is done to a greater or less extent in the sugar cane, wherein the glucose content is higher in immature canes than in the mature ones. In Nature's laboratory the translation from glucose to sucrose is made by the enzyms or ferments that constitute the active factors in the vital principles of the life of the sugar cane. The glucose is changed into sucrose, and there we have a natural and doubtless a healthful kind of sugar.

Whenever, however, our skilful chemists seek the transmutation of copper and silver into gold, as was done by the alchemists of old, or seek to convert rags and woody fibre into sugar, as is possible along certain chemical lines, they leave Nature's processes and Nature's enzyms or ferments, and utilize ordinary chemical reactions in order to bring about the desired results. Those familiar with the dyeing industry know that madder has been superseded throughout the world practically by anthracine, alizarin, or synthetic madder. Synthetic indigo has also been produced, and glucose is synthetic grape sugar, produced by a chemical process without the natural ferments that make up the genuine article.

The daily press brings the news that Secretary Wilson has issued his pronunciamento against the use of saccharin, the investigations of his department having shown that saccharin is injurious to the public health, and should not be used in this country, or at least in interstate trade, as is now so generally done. Saccharin is not sugar at all, and yet it has a sweetening power similar to that of sugar, but five hundred times greater, and was discovered by Fahlberg when he was proceeding with coal-oil analyses under the direction of Dr. Remsen, now President of the John Hopkin's University. Saccharin is now under the ban and a contraband article over nearly all of Europe. Its sale is forbidden in some of the States of Europe, and in others is held under the severest control. In this country, on the other hand, we use muriatic acid diluted with water in which to boil starch, and to thus turn out a heavy white syrup, comparatively tasteless, yet sweetish in taste, a product of these chemical reactions which has none of the characteristics of the reactions in our own physical mechanism.

It is to be regretted that a journal of the high standing of the "New England Grocer" should come out in defence of this synthetic sugar, when every effort should be made to show its defective and chemical ancestry. Some years back, in discussing this matter, we referred to the fact of glucose being made by boiling starch in dilute solutions of sulphuric acid. Our article was copied by the "Literary Digest," and that brought out from Prof. Chandler, of Columbia University, an attack upon our statements, which he said were untrue. An investigation led to the conclusion that our statements were practically true, and that the denial of their accuracy made by Prof. Chandler was in the nature of a subterfuge, to conceal the method now adopted in this country in the manufacture of glucose. In some of our lexicons glucose is defined as being produced from corn starch with sulphuric acid, but in the United States there has been a change from sulphuric to hydrochloric acid, probably because of the more brilliant and clearer syrup that can be got with that acid than with sulphuric acid. On the other hand, the sulphuric acid is reported to be still used in Germany, where immense quantities of glucose are manufactured from potatoes, and we are led to infer that the results there are sufficiently satisfactory to the Germans to permit them to maintain the use of sulphuric acid, while our more enterprising chemists have gone over to hydrochloric acid. In the use of sulphuric acid for the conversion of starch into glucose an excess of acid must be used, which must be neutralized by the addition of lime. With the use of sulphuric acid this lime then becomes a sulphate of lime, or our ordinary land plaster, and this is very difficult of sedimentation or of filtration, thus leaving the syrups produced with it more or less cloudy. Presumably the hydrochloric acid gives bright and clearer syrups, and a man of the distinguished attainments and high standing of Prof. Chandler, of the Columbia School of Mines, in New York, would have done better not to have simply denied the accuracy of our statement, but to have gone further and told the whole truth. Some times a part of the truth is very misleading.

We are afraid that the able editor of the "New England Grocer" has been misled in some similar way, as in this article he praises "nature's glucose" very highly, and leaves it to be inferred that the manufactured glucose is equally meritorious, whereas it lacks that link that binds it to organic matter, the enzym or ferment that effects the translation from starch to glucose and from glucose to sucrose in the natural way. Glucose as now sold on the markets under whatever fanciful name may be attached to it, is a compound brought about by the action of mineral acids on starchy substances, and as such its use is deleterious to the public health and ought to be earnestly condemned.

THE SUGAR-PALM OF THE EAST INDIES.

By J. C. K.

(From the *Louisiana Planter and Sugar Manufacturer*, Vol. XLVII., No. 26, July 1, 1911.)

The sugar-palm (*Arenga saccharitera* of botanists) grows abundantly in all the Dutch East Indian islands, and provides the natives not only with a fermented beverage termed *sagueiro*, but with sugar, cordage for the rigging of praus and material for caulking them, and brooms for sweeping. The palm is called *pokko gamutu* by the Malays, and plenty of the trees are always found in the neighbourhood of the villages. One of the commonest daily sights in a Malay village is the bringing home, slung over the shoulder, of the large bark buckets full to the brim of sagueiro, the liquid frothing on the top and of a milk-white colour, its fluidity also resembling that of milk. The palm itself is a fine though rather rough-looking tree, bearing huge bunches of fruit composed of large orange-coloured berries, the male inflorescence being then over, but the withered remains form similar large bunches of what at first sight look like strings of small dark purple or black berries. It is the stalk of the male inflorescence only which is tapped for the sap, and as the bunch is very heavy and also bears the weight of the sagueiro bucket, it is generally supported against the trunk by a stout prop. The palms produce fruit more or less throughout the year.

When about to tap the tree, the native usually climbs up by means of a long bamboo lashed against the trunk of the palm, just the bases of the bamboo boughs being left to form rungs or steps. He then bruises the flower-stalk with a heavy wooden pestle on all sides and from end to end, likewise swaying and twisting the bunch to loosen and disintegrate the fibres of the stem, or "make the sap flow," as the native says. Then a small nick is cut on the underside of the stem and a bucket is slung below, the tapping is done in the evening as a rule, and the sap trickles into the bucket all night, sometimes producing fifteen litres, or a little over three gallons by the time the native fetches the bucket in the early morning. During the day (say the natives) the sap practically ceases to flow, and when the bucket is taken away a leaf is tied around the wound in the stem to prevent the sap from dripping. Sometimes if there is not much sagueiro in the bucket it is left for another night on the palm, and a mass of bast from the leaf-sheaths is put over its mouth during the day to keep out the sun, rain and insects, for there is always some slight drip from the buckets, and these and the jungle beneath are usually swarming with insects, all eager to lick up the sweet juice. Flies, bees, and wasps are the most numerous, but many beetles and butterflies are attracted; it is in the sagueiro buckets that the large beetle with extraordinary long forelegs (*Euchirus longimanus*) is frequently found by the natives of Ceram and Ambon, having fallen in whilst drinking the sap. One flower-stalk will often give sap for two to six months, and as one stalk fails another comes to maturity; the life of a palm being tapped regularly is said to be fifteen to twenty years. Occasionally one may observe a wasted and blackened palm which has been bled to death by tapping. The sagueiro is either drunk fresh, when it has a sweetish taste, or more often small pieces cut from the living roots of a large tree, heavy and very bitter wood of a brightish yellow colour, are put into the liquid. This makes a very refreshing drink on a hot day, and is sold very cheaply at all the wayside huts and villages. It is quite possible to become inebriated with fermented saguerio or "palm-wine" if large potations are indulged in, though one but rarely sees a tipsy native. Nor does it produce the fighting and quarrelling that beer and spirits provoke, and these intoxicants are strictly prohibited by the Dutch Government from being supplied to the natives.

The sagueiro buckets are large, about eighteen inches deep, and roughly about ten in diameter, and are made of the inner part of the leaf-sheath of the ever-useful sago-palm. A long rectangular piece of sufficient length to form the two sides and the bottom of the bucket, and broad enough to make the desired diameter is shaved down till it is about an eighth of an inch thick, and is softened by soaking in water; four slight cuts, forming a lozenge or diamond, are made at mid-length, the two ends are bent up to form the sides of the bucket, and their edges are thrust into two pieces of bamboo, which each have a slot cut from the top to within a few inches of the bottom. Then a long wooden rod or wedge is driven down the interior of each bamboo, between the edges of the bucket sides. To keep the shape better, four or five rings of "gaba-gaba" or split leaf rib of the sago-palm are often put at intervals in the interior of the bucket, and a handle of the same material completes the article, though the joints are usually caulked with "chunam," a mixture of lime and oil, like putty. The inner polished and siliceous skin of the leaf-sheaf forms the interior of the bucket, the exterior being left rough from the thinning-down process.

When the palm-sap is destined for sugar-making it is boiled in primitive fashion in some convenient clearing in the forest, in large, shallow iron pans set in the top of a dome-shaped clay or mud furnace. This is fired with chopped wood, a quantity of which is always piled on a rack near the furnace to dry. The empty sagueiro buckets, too, are generally suspended mouth downwards in a rack over the furnace, to clean and dry, for they cannot be left empty on the ground long without swarming with ants. A piece of the mid-rib of the sugar-palm leaf, beaten at one end to separate the fibres and make a sort of broom, is used to stir up the boiling liquor, and a rough iron ladle to test the syrup; whilst a primitive table of "gaba-gaba" and stakes, holding a supply of empty coconut shells in halves, completes the sugar-maker's stock-in-trade. The whole apparatus is more or less protected from the weather by the usual attap-thatched open shed. The syrup is constantly stirred up with the broom to prevent burning, and from time to time a little is ladled out into a coconut shell to try its condition; as soon as a sample sets properly, the contents of the boiling-pan are ladled into the coconuts. The product forms dark-brown cakes resembling toffee in taste, and is either broken up and powdered to use like ordinary brown sugar, or melted down with a little water to make a syrup which is much eaten with sago; the broken pieces are also used as a sweetmeat.

This native manufacture of palm-sugar was still an important native industry in 1909, when Mr. F. Muir and the writer stayed some months in the Malay islands, but ordinary cane and beet-sugar were displacing it by degrees, and doubtless before very long the making of palm-sugar by the natives will belong to past history. Yet this palm-sugar has a peculiar and rich flavour, and, as the supply of firewood for boiling is free, and, at present, unlimited, it is manufactured by the Malays at a very trifling cost.

The coarse black bast or fibre which covers the bases of the leaf-sheaths of the sugar-palm is made into cordage for rigging praus and other uses, and is known as *gamulu*. A peculiarly soft, dark snuff-brown material is scraped off the exterior of the trunk and employed both for caulking boats as already mentioned, and also for tinder. Nearly all the natives in Ceram carry a little tinder box full of this stuff.

Wallace was, we believe, the first to notice at any length and at first hand the manufacture of palm-wine and sugar from *Arenga saccharifera* in his "Malay Archipelago." Since he lived so many years in the fifties and sixties of the last century in these islands, they have certainly changed much. The area of actual forest on most of the islands has been greatly reduced, not so much formerly by the operations of Europeans as the natives' habit of clearing patches of forest to enable them to grow bananas and vegetables, and after one crop was gathered, forsaking this ground and clearing another plot to save the labour of properly tilling the soil. But of recent years Europeans have felled and burned off much valuable timber to make room for rubber and coconut and other plantations; much land in some parts has been disafforested and then deserted, and is now covered with low second growth jungle, or, worse still, with the tall and harsh "Kusu-Kusu" grass which is difficult to force one's way through, and cuts like knives. Ceram is at the present time almost the only island in the Dutch Indies which is practically untouched, and already forest is here being cleared for growing coconuts for copra,

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COPRA TRADE IN PHILIPPINES.

SECOND LARGEST ELEMENT IN FOREIGN TRADE--IMPORTANCE OF CROP AND GROWTH OF TRADE WITH UNITED STATES.

(From the *Manila Bulletin*, 26th July, 1911.)

An interesting review of the copra trade in the Philippines has been published by the Department of Commerce and Labour, Washington, giving the exports from the islands to foreign countries and the growth of the trade in copra with the United States.

The article contains some interesting reading for those engaged in the copra trade, and the review of the copra situation as given is in part as follows:—

The Philippine Islands shipped abroad 116,374 metric tons of copra in the calendar year 1910, and the average price for the year was about $3\frac{1}{2}$ cents gold per pound. The price increased during the year from about 3 cents to about 4 cents gold per pound in the last quarter.

The steady growth of the trade is indicated by the fact that shipments increased from 168,473,499 pounds valued at $5,461,680 in 1908, to 232,728,116 pounds valued at $6,657,740 in 1909, and to 254,156,982 pounds valued at $9,153,951 in 1910 (fiscal years in each case), and that there was an increase from 113,463 metric tons in the fiscal year to 116,374 metric tons in the calendar year of 1910.

Because of the high price, due chiefly to the extraordinary demand for vegetable oils, and because of the strong demand generally, there is something of a boom in the coconut business in the islands, and the increase in trade is having a marked effect, not only on the islands themselves, but upon shipping in the Far East and other lines of business.

In the Philippines the export of copra is now the second largest element in the foreign trade, comprising almost a fourth (23 per cent.) of the whole and being exceeded only by hemp. Coconut planting is being carried on more extensively than ever before. Six years ago there was a period of high prices, during which time extensive plantings were made, and these trees will come into production this year. Indications are that the export of the product during 1911 will exceed all previous years in volume, while, owing to the shortage of other oil-producing crops, the prevailing high prices may continue for some time.

Naturally, such conditions are leading to a general expansion of business in all lines connected with coconut planting and plantation supplies.

Exports of copra from the Philippines to the United States have more than kept pace with the increased imports into the latter country due to the demand for coconut oil. The total imports of copra into the United States during the fiscal years 1908, 1909, and 1910 were P481,232, P666,820, and P762,560 respectively, and the imports thereof from the Philippines were P213,999, P273,497, and P416,074 respectively.

The increase in imports of copra into the United States during the three years was about 58 per cent., while the increase in imports from the Philippines was about 90 per cent. Nevertheless, most of the product went to France, mostly to Marseilles, where the great coconut-oil factories are largely dependent upon the Philippines for their copra supplies. France took $6,114,324 worth of the product in the last fiscal year; Germany, particularly Mannheim, takes an increasing quantity, while Spain maintains a trade long established.

PLANT SANITATION.

PROPOSED INSECTICIDE CONTROL LAW IN CALIFORNIA.

BY C. W. WOODWORTH.

The preceding article by Professor Colby* has shown very conclusively the necessity of some legal regulation of the sale of insecticides in this State. This is in the interest both of the honest dealer and of the grower.

The present law is intended to regulate the sale of but a single insecticide, Paris green, and this substance is becoming less and less important, being now so largely replaced by lead arsenate.

The writer wishes, therefore, to present the following proposed bill for consideration, and solicits comments, suggestions, and expressions of opinion of all parties interested in this measure. The bill is based on that now in operation for the control of commercial fertilizers, and is indeed the same bill with only the verbal changes necessary to make it applicable to insecticides:

AN ACT

TO REGULATE THE SALE OF INSECTICIDES, OR MATERIALS USED FOR INSECTICIDAL PURPOSES, AND TO PROVIDE PENALTIES FOR THE INFRACTION THEREOF, AND MEANS FOR THE ENFORCEMENT OF THE ACT.

The People of the State of California, represented in Senate and Assembly, do enact as follows:—

SECTION 1. Every lot, parcel, or package of commercial insecticides, or materials to be used for insecticidal purposes, sold, offered, or exposed for sale, within this State, shall be accompanied by a plainly printed label, stating the name, brand, and trade mark, if any there be, under which the insecticide is sold, the

* On analyses of Paris Green and Lead Arsenate.

name and address of the manufacturer, importer, or dealer, the place of manufacture, and a chemical analysis, stating the percentages claimed to be therein, of the substance or substances alleged to have insecticidal properties, specifying the form or forms in which each is present, and the materials from which all constituents of the insecticides are derived. All analyses of substances for which methods have been agreed upon by the American Association of Official Agricultural Chemists, are to be made by such official methods. In the case of those insecticides, the selling price of which is less than one cent per pound, said label need only give a correct general statement of the nature and composition of the insecticide it accompanies.

Sec. 2. The manufacturer, importer, agent of, or dealer in any, commercial insecticide, or materials used for insecticidal purposes, the selling price of which to the consumer is one cent (1 cent) per pound, shall, before the same is offered for sale, obtain a certificate of registration from the Secretary of the Board of Regents of the University of California, countersigned by the said university, authorizing the sale of insecticides in this State, and shall securely fix to each lot, parcel, or package of insecticide the word "registered," with the number of registry. The manufacturer, importer, agent, or dealer obtaining such registry shall pay to the said Secretary the sum of fifty (50) dollars, to be applied as provided in section eight of this Act; such registration shall expire on the thirtieth day of June of the fiscal year for which it was given; *provided*, the provisions of this section shall not apply to any agent whose principals shall have obtained a certificate of registration as herein provided. Every such manufacturer, importer, agent, or dealer, who makes or sells, or offers for sale, any such substances, under a name or brand, shall file, on or before the first day of July, in each year, a statement, under oath, with the Director of the Agricultural Experiment Station of the University of California, stating such name or brand, and stating the component parts, in accordance with the provisions of section one of this Act, of the substances to be sold, or offered for sale, or manufactured under each such name or brand.

Sec. 3. The said Director shall annually, on or before the first day of September, take samples in accordance with the provisions of section five hereof, of the substance made, sold, or offered for sale, under every such name or brand, and cause analyses to be made thereof in accordance with the provisions of section one hereof, and said analyses may include such other determinations as said Director may at any time deem advisable. Dealers in or manufacturers of insecticides must give free access to the Director of the Agricultural Experiment Station, or his duly authorized deputy, to all the materials which they may place on the market for sale in California. Whenever the analysis certified by the said Director shall show a deficiency of not more than five per cent. of the substance alleged to have insecticidal properties, the statement of the manufacturer or importer, as required in section one of this Act, shall not be deemed to be false in the meaning of this Act; *provided*, that this Act shall not apply to sales of insecticidal materials made to a registered manufacturer of insecticides or to sales for export outside of this State; *provided further*, that the said Director of the Agricultural Experiment Station of the University of California shall, upon the receipt of a sample of insecticide, accompanied with a nominal fee of two (2) dollars, furnish to the user of said commercial insecticide such examination or analysis of the sample as will substantially establish the conformity or non-conformity of the said insecticide to the guarantee under which it was sold.

Sec. 4. The Director of the Agricultural Experiment Station of the University of California, in person or by deputy, is hereby authorized to take a sample not exceeding two pounds in weight, for analysis by the said director or his deputies, from any lot, parcel, or package of insecticide or material, or mixture of materials, used for insecticidal purposes, which may be in the possession of any manufacturer, importer, agent, or dealer; but said sample shall be drawn in the presence of said party or parties in interest, or their representatives. In lots of five tons or less, samples shall be drawn from at least ten packages, or, if less than ten packages are present, all shall be sampled; in lots of over five tons not less than twenty packages shall be sampled. The samples so drawn shall be thoroughly mixed, and from it two equal samples shall be drawn and placed in glass vessels, carefully sealed, and a label placed on each, stating the name or brand of the insecticide or material sampled, the name of the party from whose stock the sample was drawn, and the time and place of drawing; and said label shall also be signed by the said director or his deputy making such inspection, and by the party or parties in interest, or their representatives present at the drawing and sealing of said samples. One of said duplicate samples shall be retained by the party whose stock was sampled, and the other by the Director of the Agricultural Experiment Station of the University of California.

SEC. 5. The Director of the Agricultural Experiment Station of the University of California shall publish, in bulletin form, from time to time, at least annually, the results of the analyses hereinbefore provided, with such additional information as circumstances may advise.

SEC. 6. There is hereby appropriated for the use of the Agricultural Experiment Station of the University of California at Berkeley, Alameda County, as set forth in this Act, out of any moneys in the treasury not otherwise appropriated, the sum of eighteen hundred (1,800) dollars for the equipment of a laboratory, with the chemicals and apparatus, and other incidentals necessary to the successful prosecution of the work.

SEC. 7. In order to further provide for the necessary expenses of this work, there shall be paid by the manufacturer, importer, agent, or dealer, ten cents for every hundred pounds of insecticides sold, the selling price of which to the consumer is one cent (1 c.) or more per pound. A statement, sworn to by the manufacturer, importer, agent, or dealer, of such sales shall be rendered quarterly to the Secretary of the Board of Regents of the University of California, accompanied by the corresponding amount of the special license fee, as above specified; *provided*, that whenever the manufacturer or importer shall have paid the special license fee, herein required, for any person acting as agent or seller for such manufacturer or dealer, such agent or seller shall not be required to pay the special license fee named in this section. On receipt of said special license fee and statement, the said Secretary shall issue to the manufacturer, importer, agent, or dealer, a certificate of compliance with this section.

SEC. 8. All moneys, whether received from registry and analytical fees or special license fees, shall be paid to the Secretary of the Board of Regents of the University of California, for the use of said Board in carrying out the provisions of this Act.

SEC. 9. Any party selling, offering, or exposing for sale any commercial insecticide, without the statement required by section one of this Act, or with a label stating that said insecticide contains a larger percentage of any one or more of the constituents claimed as having insecticidal properties than is actually contained therein, except as provided for in section three, or respecting the sale of which all the provisions of this Act have not been fully complied with, shall be deemed guilty of a misdemeanour, and upon conviction thereof, before any court of competent jurisdiction, shall be fined in a sum not less than fifty (50) dollars and costs of action for the first offence, and one hundred (100) dollars and costs of the action for each subsequent offence. Said fines to be paid into the school fund of the county in which conviction is had.

SEC. 10. In any action, civil or criminal, in any court in this State, a certificate, under the hand of said director and the seal of said university, stating the results of any analysis purporting to have been made under provisions of this Act, shall be *prima facie* evidence of the fact that the sample or samples mentioned in said analysis or certificate were properly analyzed as in this Act provided; that such samples were taken as in this Act provided; that the substances analyzed contained the component parts stated in such certificate and analysis; and that the samples were taken from the parcels or packages or lots mentioned or described in said certificate.

SEC. 11. This Act shall take effect and be in force from and after July first, nineteen hundred and seven.

INJURIOUS INSECTS AND PLANT DISEASES.

(From the *Gardeners' Chronicle*, No. 1,281, Vol. L., July 15, 1911.)

LEGISLATION IN CANADA.

The Department of Agriculture of Canada is empowered by the Destructive Insect and Pest Act of 1910 to take such action as may be deemed necessary to prevent the introduction or spreading of injurious insects, pests, and plant diseases. All plants, with the exception of certain classes, such as greenhouse grown plants, herbaceous perennials, and bulbs may be imported at certain seasons of the year only and through certain ports as specified in the Regulations. The Department of Agriculture has power to inspect plants liable to be infested with certain insects and plant diseases, to destroy the same, if necessary, or to prohibit their importation into Canada.

At six of the ports of entry (see Section 3 of the Regulation) fumigation stations are established where plants from countries and states infested or liable to be infested with the San Jose Scale are fumigated with hydrocyanic acid gas by special officers in charge.

Plants from Europe, Japan and the States of Vermont, Maine, Massachusetts, New Hampshire, Connecticut, and Rhode Island, six of the United States of America, are inspected by officers of the Department for the Browntail moth and Gipsy moth. In some cases this inspection is made at the port of entry, in other cases at the destination of the stock. In the latter case the plants may not be unpacked except in the presence of an inspector.

It is necessary for all persons and transportation companies importing or bringing plants into Canada to notify the Dominion Entomologist, Ottawa, of the fact, and through the co-operation of the Department of Customs, the Customs officers at the ports of entry also send advices of the arrival of shipments of plants at the various ports through which plants may enter.

In addition to the inspection and fumigation of imported plants, field officers are employed in inspecting orchards and in carrying out eradicative measures against the Brown-tail moth in those regions in Nova Scotia and New Brunswick infested with the insect. This eradicative work is carried out in co-operation with the respective provincial governments. The fumigation and inspection of imported plants and infested regions and all measures for eradication work are carried out under the direction of the Dominion Entomologist.

The Minister of Agriculture has power to prohibit the importation of plants from any given region should it be deemed necessary, owing to the presence of serious insect pests or diseases in such a region. This has been done in the case of Potatoes from Newfoundland and the neighbouring islands, to prevent the introduction of Potato canker (*Chrysophlyctis endobiotica*).

The Destructive Insect and Pest Act, and the Regulations issued under the Act are given below.

In addition to the legislation of the Federal Government, certain of the provincial governments have instituted legislative measures in reference to plant diseases and pests.

The Province of British Columbia inspects all plants and fruit entering the province, and any plant or fruit found to be infested with insect pests is either subjected to treatment or destroyed.

The province of Ontario has legislation chiefly relating to the inspection of nurseries and nursery plants.

The province of Nova Scotia has recently enacted legislation under which the Department of Agriculture for the province will have power to inspect orchards and take such steps as are necessary for the eradication or control of the more serious insect pests and plant diseases.

The Destructive Insect and Pest Act.

An Act to prevent the introduction or spreading of insects, pests and diseases destructive to vegetation.

(9—10 Edward VII., Chap. 31.)

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follow:—

1. This Act may be cited as the Destructive Insect and Pest Act.

2. In this Act, unless the context otherwise requires, "the Minister" means "the Minister of Agriculture."

3. The Governor in Council may make such regulations as are deemed expedient to prevent the introduction or admission into Canada, or the spreading therein, of any insect, pest or disease destructive to vegetation.

4. Such regulations may provide:—

(*a*) For the prohibition generally, or for any particular country or place, of the introduction or admission into Canada of any vegetable or other matter likely to introduce any such insect, pest, or disease;

(*b*) The terms or conditions upon, and the places at which any such vegetable or other matter may be introduced or admitted into Canada;

(*c*) For the treatment and manner of treatment to be given to any vegetation, vegetable matter or premises in order to prevent the spreading of any such insect, pest or disease, and may prescribe whether such treatment shall be given by the owner or by a person appointed for such purpose;

(*d*) For the destruction of any crop, tree, bush or other vegetation or vegetable matter or containers thereof infested or suspected to be infested with any such insect, pest or disease;

(*e*) For the granting of compensation for any such crop, tree, bush or other vegetation or containers thereof so destroyed, such compensation not to exceed two-thirds of the value of the matter destroyed and to be granted only by the Governor in Council upon the recommendation of the Minister;

(*f*) For the prohibition of the sale of any vegetable matter infected with any such insect, pest or disease;

(*g*) That the occupier of the premises on which is discovered any such insect, pest or disease shall forthwith notify the Minister, and shall also send specimens of such insect, pest or disease;

(*h*) For the confiscation of any vegetable matter and the container thereof, if any, in respect of which a breach of this Act, or any regulation made thereunder is committed and generally for any other purpose which may be deemed expedient for carrying out this Act, whether such other regulations are of the kind enumerated in this section or not.

5. The Minister may appoint inspectors and other officers for carrying out this Act and the Regulations made thereunder. Such appointments, if not confirmed by the Governor in Council within thirty days of the date thereof, shall lapse and cease to be valid.

6. Any inspector or other officer so appointed may enter any place or premises in which he has reason to believe there exists any such insect, pest or disease, and may take specimens thereof, and also of any vegetable matter infested or suspected of being infested therewith.

7. The Minister upon the report of any inspector setting forth a reasonable belief of the existence of any such insect, pest or disease in any area defined in such report, may prohibit the removal from such area or the movement therein of any vegetation, vegetable or other matter which, in his opinion, is likely to result in the spread of such insect, pest or disease.

8. Every person who contravenes any provision of this Act, or any regulation made thereunder, shall be liable upon summary conviction to a fine not exceeding 100 dollars, or to imprisonment for a term not exceeding six months, or to both fine and imprisonment. Any vegetable or other matter imported or brought into Canada contrary to this Act, or to any regulation made thereunder, shall be forfeited to the Crown.

FRUIT AND PUMPKIN FLIES.
(*Illustrated*).

BY E. ERNEST GREEN, F.E.S, etc.,
Government Entomologist.

Fruit Flies of the family *Trypetidæ* occur commonly throughout the tropical and subtropical regions of both Hemispheres, spreading to southern Europe in the North, and to South Africa and the Australasian continents.

I have found six species in Ceylon, namely:—

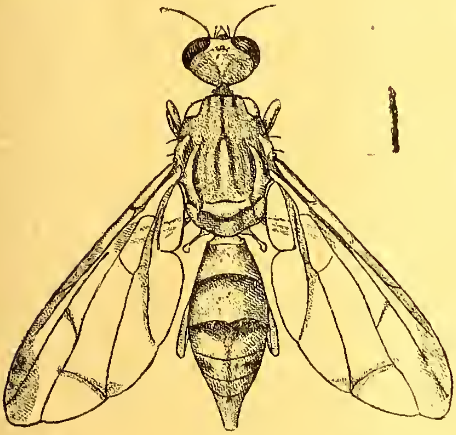
1. *Dacus ferrugineus*, Fabr., breeding in the fruits of oranges, mangoes and 'star apple,' (*Chrysophyllum cainito*).
2. *Dacus garciniæ*, Bezzi, in the fruits of 'Cochin Goraka' (*Garcinia xanthochymus*).
3. *Dacus cucurbitæ*, Coq., in Pumpkins, Cucumbers, Vegetable Marrows and Melons.
4. *Dacus caudatus*, Fabr., in Pumpkins.
5. *Dacus zonatus*, Saund., food plant unknown.
6. *Ceratitis striata*, Frogg., breeding in the young shoots of the 'Giant Bamboo' (*Dendrocalamus giganteus*).

Probably other species will be found breeding in Guavas and wild fruits of various kinds.

Perhaps the most troublesome of our local species is *Dacus ferrugineus*, which is responsible for so many 'wormy' oranges and mangoes. But *Dacus cucurbitæ* runs it very close in destructiveness. Many a promising crop of cucumbers and vegetable-marrows has been ruined, and the largest pumpkins reduced to a mass of putrid pulp by the maggots of this fly.

All the species of *Dacus* bear a general resemblance to each other, and many of them can be distinguished only by minute microscopical characters. Their bodies are usually of a tawny yellow colour, the front part striped longitudinally and the hinder parts banded with dark brown. The wings are often blotched or banded with smoky gray.

The adult flies puncture the fruit by means of a horny ovipositor and deposit their eggs just within the rind. The resulting maggots bore their way into the fruit and feed upon the pulp. They spoil more than they actually consume, for decay sets in and spreads through the whole fruit. Even a single maggot will taint a whole orange and make it uneatable. The maggots are of a creamy white colour, tapering to a point in front, and blunt at the hinder extremity, When extracted from the fruit, they are capable of leaping to a considerable distance.



'Cucumber Fly' *(Dacus cucurbitæ.)*
Enlarged by 6½ diameters.

Very little attention seems to be paid to the ravages of these flies in Ceylon. Though quantities of good fruit is spoiled, year by year, no systematic attempts have been undertaken to mitigate the pest. This apathy is due principally to the fact that fruit growing is not a commercial industry in the Island. Private growers appear to accept the damage as inevitable, or as part of the 'Curse of Adam.' The maggoty fruit is allowed to rot on the ground, permitting the full-fed grubs to emerge and pupate in the soil, whence fresh swarms of the destructive flies are produced.

The systematic collection and destruction of the infested fruit is of the greatest importance in combating the pest. Wormy fruit usually falls prematurely, and should be collected regularly, day by day. With regard to the disposal of the damaged fruit, Mr. W. W. Frogatt—in a comprehensive report on the fruit fly pest—says that "it is preferable to destroy the fruit by burning, but it may be disposed of by burial, and when buried it should be covered with at least 20 inches of soil." Another method of disposal, which may be convenient in some cases, is to sink the fruit in water and leave it there. This plan was adopted in Bermuda, where the infested fruit was enclosed in sacks, weighted with stones and dumped in the sea. Where fallen fruit has been permitted to remain long enough for the maggots to escape, the soil should be forked and fowls allowed the run of the orchard.

Infested cucumbers and marrows do not fall off, but rot on the stem. The presence of eggs or maggots may be detected by a gummy excretion from the punctures. All such wounded fruit should be removed and destroyed at once.

In a vegetable garden, cucumbers and marrows may be preserved from attack by enclosing them in muslin bags. It should be remembered that the flies will attack the fruit when still quite small, so the bags should be applied immediately after the flower has withered, taking care that they are of sufficient size to permit of the full development of the fruit. The bags should be tied round the stalk of the fruit, but not so tightly as to interfere with the circulation of sap. This may be prevented by inserting some cotton-wool in the mouth of the bag.

Besides the flies of the genus *Dacus*, we have a species of *Ceratitis* which has a different habit. For many years it was observed that a large proportion of the new shoots of the Giant Bamboos—in the Peradeniya Gardens—failed to develop, but rotted off when only from two to three feet high. This has now been proved to be the work of the fly *Ceratitis striata* which breeds in enormous numbers in the succulent shoots. The only practical means of combating this pest is to remove and destroy every shoot as soon as it is found to be infested. This is not difficult to determine; as such shoots decay very rapidly and will break off with a slight push. Where bamboos are growing on river banks, the damaged shoots could be merely thrown into the water. They are heavier than water and do not require any weighting to sink them.

Several methods have been employed for the destruction of the adult flies. Froggatt mentions that certain species of fruit flies are strongly attracted by the scent of citronella oil, and that kerosene even has some attractions; but that the cucumber fly is unsusceptible to this odour. By exposing shallow trays of kerosene in the vicinity of fruit trees large numbers of the insects have been trapped. A mixture of kerosene and citronella should be still more effective. The flies fall into the mixture and are drowned.

It has also been observed that all fruit flies are fond of sweets and may be killed by exposing poisoned baits. Mr. C. W. Mally has perfected this treatment in South Africa, and claims to have completely protected orchards (at a cost of 4*d.* per tree) by repeatedly spraying them with a mixture of $\frac{1}{4}$ lb. Arsenate of Lead and 3 lbs. sugar in five gallons of water. The spray is made to fall in fine drops on to the foliage, where it is quickly discovered by the flies. Spray pumps are necessary for the treatment of orchards, but single trees can be effectively sprinkled by means of an ordinary garden syringe. The spray from the syringe should be directed up into the air and allowed to fall—like fine rain—upon the foliage.

Attempts have been made to combat the pest by means of natural parasites, and Mr. Compere (of West Australia) claims to have discovered various useful insects of this kind. But Froggatt, who has studied the question very closely, throws some doubt upon the reliability of Compere's observations. Lounsbury and Fuller (of South Africa) have also investigated the subject very thoroughly, and came to the conclusion that the supposed natural enemies afford no appreciable check to the pest.

Various species of the Fruit Fly are troublesome in other countries. Amongst these, the following are the more notorious :—*Dacus oleæ*, Rossi, destructive to Olives along the Mediterranean shores of Europe; *Dacus tryoni*, Frogg., attacking peaches, nectarines, etc., in Queensland, Australia; *Dacus persicæ*, Bigot, bred from peaches in India; *Ceratitis capitata*, Wied., a serious pest of oranges in Southern Europe, Australia and New Zealand; *Ceratitis punctata*, Wied., breeding in Cacao pods in Uganda: *Trypeta ludens*, Loew, damaging oranges, mangoes, etc. in Mexico; *Trypeta pomonella*, Walsh, an apple pest in the United States; *Trypeta musæ*, Frogg, in bananas from the New Hebrides. We may congratulate ourselves that neither the cacao nor the banana species are known in Ceylon.

LIVE STOCK.

ERADICATING RINDERPEST IN DAVAO DISTRICT.

The last issue of the *Philippine Agricultural Review* to hand contains the report of C. G. Thompson, D. V. M., of the Bureau of Agriculture, on the recent oubreak of rinderpest in Davao District and the means taken to eradicate it. The report, which is a chronicle of work well done, follows :—

In accordance with travel orders dated December 3, 1910, I sailed from Manila with Mr. R. E. Burris on the United States Army transport *Seward* on December 4, and arrived at Zamboanga on December 7. I immediately presented my letter of introduction to Brigadier-General John J. Pershing, governor of the Moro Province, and in conference with him and Colonel Richard, the provincial health officer, discussed the Davao situation at some length. Very little was known in Zamboanga at that time as to the nature or extent of the outbreak, but both Brigadier-General Pershing and Colonel Richard realize the menace presented by the existence of rinderpest infection in the Moro Province, and assured me that they would support us in any reasonable measures which we might recommend, providing such measures offered some hope of success.

With Brigadier-General Pershing we sailed on the U. S. Army cutter *Samar* on December 10, arriving at Davao December 14. After several days spent in studying local conditions as to the extent of the infection, distribution of susceptible animals, avenues of animal travel, and the distribution of Scouts and Constabulary for quarantine work, I submitted a letter to the governor of the Moro Province recommending that the sum of $7,500 be made available for transportation and indemnification of owners for slaughtered animals. In response I was informed that no funds could be made available at that time for the purpose of indemnification, but authorization was made for reasonable expenditure for transportation. I secured a small launch and used it almost constantly during my stay in Davao.

In the letter to the governor of the Moro Province, above mentioned, I submitted copies of ordinances covering certain quarantine provisions necessitated by local conditions and not anticipated in Act No. 1760 or the acts of the Moro Province. Emergency health ordinance No. 1, passed by the provincial board of health on January 1, 1911, covered the desired points.

After a very careful study of the situation, I became convinced that only by the most drastic measures could the eradication of the infection be accomplished. The outbreak had already encompassed an area of over 150 square miles. The infection was of the most virulent type, and the rugged nature of the country made operations difficult in the extreme. Accordingly, fortified with the Insular and provincial laws, we proceeded to institute and enforce the most rigid restriction of the movement of all classes of domestic animals, to kill all animals found infected, and other susceptible animals considered as being directly exposed to infection. My first concern was to guard against further spread of the disease. This was accomplished by establishing a series of Scouts patrols well beyond the most remote known infections, to prevent the escape of any animal from within the infected zone. Detachments of Scouts were then stationed in the barrios within the infected area to tie up or corral every carabao, head of cattle, horse, pig, goat, and dog. Before taking stations, the quarantine detachments were given brief instructions as to the nature of the disease, conditions tending toward its spread, and the nature of their duties, which consisted, briefly, in taking an accurate census of all classes of domestic animals in their districts, securing them in corrals or by ropes, and inspections twice daily to insure against their movement and detect infection. From certain barrios detachments were sent morning and afternoon to patrol the trails running from the coast to the mountains in order to prevent the movement of animals north or south. Written reports were submitted at my office in Davao every Wednesday and Saturday, and an immediate report was made of new developments of any nature.

The quarantine regulations provided for the absolute restriction of the movement of animals within the infected area excepting in the town of Davao, where horses and dogs were permitted in the streets. It was desirable to permit the use of horses, because practically all of the shipping interests are centered in Davao, it was therefore necessary to make some provision for the transportation of merchandise. Very little hardship or inconvenience was caused by rigid quarantine in the outlying districts, as most of the towns and plantations are located on the shores of the Gulf of Davao, and transportation is mostly by launch or native boat. The *hacenderos* did not suffer through the enforced idleness of their carabaos and cattle, as very little land is cultivated. I considered it best to tie up horses and dogs outside of the town of Davao, because they present some little danger as infection carriers, and in view of the drastic measures taken, we could not afford to overlook even such agents of infection.

I made inspections of the detachments in the infected area nearly every day, and of the more remote posts as often as possible to stimulate interest in the work, to further instruct the soldiers, and to keep in touch with the changing conditions. On all of these trips of inspection I was accompanied by a ranking Scout sergeant, through whom I issued all orders, also by a Constabulary private, who arrested the men whom it was occasionally necessary to prosecute.

The infected area was limited on the north by a creek near the barrio of Ylang, on the south by the Taloma River, on the east by the sea, and on the west by the Apo mountain range. Many of the animals in the barrio of Taloma were infected, and this condition presented a grave danger to the large herds to the south; therefore, our first efforts were directed toward cleaning up this district. In all of the work, the scheme of daily inspection, the absolute prohibition of the movement of all classes of domestic animals, the immediate slaughter of all sick and directly exposed animals with a thorough chemical disinfection of contaminated corrals and wallows, was carried out as thoroughly as possible.

The enforcement of the quarantine of carabaos and cattle in the town of Davao proper interfered seriously with business, so it was desirable to hasten the accomplishment of the task there. Accordingly, I had Mr. Burris remain in Davao much of the time for the first few weeks. No soldiers were used in the town of Davao, as two efficient native policemen were detailed for the service by the municipal president, Lieutenant W. H. Dade. The infection in Davao yielded readily to the measures initiated, so that during the last week in January it was possible to relieve a few work carabaos and cattle on pass and under guard from quarantine during the days just preceding and following the arrival of boats. The quarantine provisions against horses and dogs were, of course, never enforced in the town of Davao for obvious reasons.

No animals were slaughtered except under my personal direction with the exception of a few suspected cases which I directed Mr. Burris to destroy whenever unmistakable symptoms developed. In almost every case the owners readily consented to the slaughter, and there were but few exceptions. I recorded the names of owners, the class of animals, estimated the value of all animals slaughtered, and in accordance with the laws of the province submitted this list to the district governor. No provision has been made for the indemnification of these owners. In my report to Brigadier-General Pershing I recommended that payment be made for part of the value of these animals. The provincial authorities fully realize the justice of such payments, but in view of its revenue available the province is not able to reimburse the owners.

As a result of the methods instituted no cases of rinderpest developed in the town of Davao after January 16 and none in Taloma after January 12. The cases in Taloma were the last discovered south of the Davao River, so from the middle of January we were able to concentrate our efforts on the district north of the river. Considerable losses were sustained in this district during the latter half of January due to infection occurring among animals at Sasa and at Panacan. The disease persisted in these two barrios until February 2, but offered no danger to other animals as they were secured under guard and subject to daily inspection.

The last case appeared on February 2 and the quarantine was maintained in full force until March 2 in accordance with the plan decided upon during the inspection trip of the Director of Agriculture to Davao on February 17.

Realizing that some danger remains through undiscovered cases and contamination of wallows and swamp lands, we have closed the heavily infected trail between Taloma and Davao against use by carabaos and cattle, and by municipal ordinances have warned the people not to pasture their susceptible animals in certain sections.

Lieutenant Dade, president and district health officer of Davao, has consented, at my request, to maintain Constabulary patrols who will inspect the cattle of the infected area twice weekly to make sure of prompt detection if the disease reappears, and to enforce the quarantine on this trail.

To the best of my knowledge the total loss sustained by the district of Davao during this epizoötic was 2,535 cattle and 133 carabaos, a total of 2,668 animals. Of these 372 died after our arrival on December 14, 1910, and about 200 of the 372 died during the first week before I was familiar with the conditions. Of the 372 only 82 were slaughtered as "exposed" or "infected." The term "exposed" signifies that the animals were considered as being in the incubation stage of the disease.

The success attending this work may be attributed principally to three factors:—

(*a*) Adequate laws and ordinances of the province, which coupled with the influence of the officials, enabled us to maintain the necessary rigid quarantine and to accomplish the slaughter of infected and exposed animals.

(*b*) The satisfactory transportation which permitted constant inspection of suspects, thus rendering their slaughter possible in the incubation period before they became highly infectious.

(*c*) The use of the Philippine Scouts, who proved to be a most efficient arm for effective quarantine service.

The work of the Scouts cannot be commended too highly. They followed instructions implicitly and intelligently, took a keen interest in the work and refrained from abusing their authority. I feel confident that the situation could not have been handled successfully if their services had not been available.

I received the most cordial support and co-operation from all of the officials with whom I came in contact, and I am especially indebted to Lieutenant Dade who, as municipal president, exerted an invaluable influence.

Efforts to trace the source from which the infection entered the district were unsuccessful. The original supposition that it was carried down from Surigao by deer or wild hogs as hosts, was not supported by fact, as no infection was discovered among wild animals. I tried to secure deer for exposure to infection that their susceptibility might be demonstrated conclusively, but did not succeed in obtaining subjects until the infection had subsided. I am of the opinion that the infection was introduced into the town of Davao through importation from Cebu, and that it smouldered there several months before enough animals had succumbed to provoke its recognition as an epizoötic. The first case was observed by Lieutenant Dade on October, 8, 1910, in the town of Davao. Later it spread across the river into the large herds in the adjacent fields.

While in Davao, the Director of Agriculture directed that I investigate the eastern coast of Mindanao as to the existence of rinderpest, provided I could make the trip within a reasonable period of time. The conditions were such that I considered it inadvisable to leave Davao for this purpose. Lieut. H. H. Smith consented to perform this task, and his report shows that no disease exists within the region.

AGRICULTURAL FINANCE AND CO-OPERATION.

THE EDUCATED CLASSES AND CO-OPERATIVE CREDIT.

(From the *Indian Agriculturist*, Vol. XXXVI., March 1, 1911, No. 3.)

The ignorance of movements for the elevation of the ryot which prevails among a class of Bengali publicists is well illustrated by the violent contradiction by a local newspaper of our statement that the educated classes have displayed a lack of interest in the formation of co-operative credit societies. This apathy is a matter of common knowledge, and it has been repeatedly referred to in the annual reports of the Registrars as well as in the resolutions issued by the Government. In the latest of these Resolutions, published in September of last year, Sir Edward Baker made pointed reference to the subject. "The Lieutenant-Governor," it was stated, "regrets to note that the number of non-official workers is still small, and that men with influence in the districts are, on the whole, apathetic. While cordially expressing his obligation to the small band of non-officials who are furthering the movement, and without whose assistance no progress would have been possible, His Honour desires again to emphasise the increasing need of non-official organisers." In his annual report for the year 1909-10, moreover, Mr. J. M. Mitra, Officiating Registrar of Co-operative Credit Societies, pointed out that while the villagers had shown readiness to combine, and marked capacity for united action, a lack of support from the educated classes checked the progress of co-operation, "Although," wrote Mr. Mitra; "there is evidence that the public is giving greater attention to the movement than before, it is very discouraging that on the whole the leaders of the Indian community should be so slow to realise the immense potentialities and power for good which the movement possesses." A striking indication of the apathy complained of is furnished by the fact that out of the nine honorary organisers in Bengal at the period of the publication of the report, no fewer than six bore European names. Where Indians of standing have come forward to assist, the result has proved highly beneficial. Mr. Mitra observes, for example, that the rural societies in the vicinity of Ranchi, as well as the Ranchi Union of societies, owe their origin to the energy and enthusiasm of Babu Radha Govinda Chowdhuri of the Ranchi Bar, and he adds, "if we could get a sincere worker like him in every district, the movement would rapidly extend. This is the crux of the question, and it is to be hoped that after the praiseworthy appeal to his countrymen by Mr. Saroda Charan Mitter at Midnapore, there will now be a disposition on the part of the educated classes to assist a movement which promises to bring economic salvation to the ryot. In spite of the indifference which has prevailed among the more favoured members of the community, co-operation has made considerable progress, and its fruits are in many cases of a most remarkable character. The primary object of the Co-operative Credit Society is to relieve the cultivator of the burden of usury, but it is not merely accomplishing this desirable object. In the report to which we have alluded Mr. Mitra cited many cases where arbitration by societies was taking the place of costly litigation, and he also quoted an instance where a village society was contributing to the maintenance of a Middle English school. "In Khulna," wrote the Officiating Registrar, "one of the effects of the societies is a growing demand for night and vernacular schools. In several districts the societies have risen to arbitration of village disputes. In one or two cases they have taken up successfully the question of the village sanitation. One can see in these institutions the beginnings of the revival of the old village communities, the disappearance of which as a factor in the political organisation of the country everyone deplores." We have here a glimpse of the possibilities of co-operative credit which is calculated to appeal with eloquent force to every patriotic Indian. But in order to make the picture a living reality, intelligent work and persistent application will be required. Lip service and vague and grandiloquent expressions of sympathy with "the people" are worthless offerings which will not contribute one iota towards improving the lot of the ryot. We hope and believe that full recognition will be given to these considerations by an increasing proportion of educated men who possess the time and ability requisite for advancing this beneficent movement.

BELGIUM.

HOUSEKEEPERS' CLUBS.

We reproduce the following information from the *Bulletin of Economic and Social Intelligence* (31st. May, 1911) published by the International Institute of Agriculture.

The beneficent influence women may exercise in the field of rural economics is now universally recognised; but up to the present their participation in agricultural concerns has only been exemplified in individual cases, without there being any special organ uniting these new forces for definite and continuous action.

Belgium, a land very fruitful in social experiments, has been among the first to give us an example of what may be effected by the organization of the farm women. Side by side with the very numerous agricultural associations, the large majority composed of men, in the last five years there have appeared in this country, where they have rapidly extended themselves, also the so-called housekeepers' clubs of which Canada furnished the first example.

The principal motive for the foundation of such institutions was the desire of arresting the exodus from the country that is continually assuming more alarming proportions, and now has extended to the women.

It was thought that one of the most effective means for combatting this movement would be to appeal directly to the women, to the mothers, and induce them to appreciate the advantages of country life, and warn them against the dangers and disappointments of the city, as well as to supply them with professional education, by means of which they may become better fitted for the occupations specially entrusted to them, such as the work of the dairies, farm yards, gardens, etc.

The *itinerant housekeeping schools* that have now been many years at work, have already in part provided for this need; but it was necessary that their work should not be lost.

For this purpose, the farm women had to be united in permanent associations. Thus, there arose in 1906 the first *farm womens' clubs*, which rapidly extending themselves throughout the whole of Belgium, and especially through the efforts of the Catholic party, now have reached the number of 75 and contain 7,000 members.

Their organization is simple. Members are recruited among the housekeepers of the neighbourhood, during the term of the agricultural womens' school, with the help of the pupils themselves, and so the club is formed. The club is managed by a President, two Vice-Presidents, three Councillors and a Secretary and Treasurer. The contribution to the club is 50c. Out of the fund so formed the needs of the club are provided for and articles of domestic utility, selected seeds, etc., are purchased.

At the time of the meetings which are held four or five times a year, lectures are given, agricultural competitions are held, and practical lessons are also given. Almost all these clubs possess libraries composed of books on domestic economy --hygiene, agriculture, dairy work, cattle, rearing, etc. Two papers, the *Fermière* (Farm woman) for the Wallon districts and the *Boerin* for the Flemish districts, are the most widely diffused organs for the extension of this movement.

The results attained by these interesting womens' organizations have been very happy: the housekeepers attend the meetings most assiduously, take a lively interest in the lectures and derive great profit from them: as appears in no doubtful manner in the remarkable progress already observed in the rearing of fowls, in cheesemaking, gardening, manufacture of preserves, in every department, finally, in which women's influence is sensibly exercised.

(Summarised from the *Bulletin of Economic and Social Intelligence of the I.I. of A*. Year II., No. 5, 31st May, 1911.)

BULGARIA.

THE WORK OF AGRICULTURAL CREDIT.

There are three institutions in Bulgaria which more particularly provide for agricultural credit: the *National Bank* of Bulgaria, the *Agricultural Bank* and the *Co-operative Society for Agricultural Credit*. The National Bank, which is a State institution founded in 1870 under the provisional Russian Government, grants loans to farmers, either directly or indirectly, through the Agricultural Bank; in fact, in 1908, it received in deposit or discounted 2,217 bills for farmers for 1,459,962·54 Fr., and granted loans to the Agricultural Bank to the amount of 1,116,916·26 Fr.

The real institution for agricultural credit, however, is the "Bulgarian Agricultural Bank," which has branches throughout the Kingdom in the chief towns of 85 districts, and agencies in 75 of the principal villages. It was instituted by a law passed on January 15th, 1904, which arranged for the amalgamation of the old *urban banks* founded in 1863 at the time of the Turkish domination and transformed into *agricultural banks* in 1878 by the Russian Government.

Thus, in the course of a few decades this institution has passed from a collection of primitive institutions into a bank of a modern type, which, while it has adopted the principles of other banks operating in the remainder of Europe, is distinguished from them by some special characteristics, thus constituting a type by itself. This makes it especially worthy of study, and we therefore refer our readers to a long article on the Bulgarian Agricultural Bank which appeared in the June number of the *Bulletin of Economic and Social Intelligence* published by the International Institute of Agriculture.

A few figures will be sufficient to demonstrate the importance of the Bulgarian Bank. In 1908 it had a capital of 40,241,159·41 Fr., 3,731,509·64 Fr. of which was represented by the reserve fund. In spite of the heavy losses caused by debtors who failed during the year, it realised a gross profit of 11,129,057·22 Fr. and a net profit of 3,134,850·64 Fr. There were 793,232 operations carried out during the year for a sum total of 1,161,951,569·18 Fr.

The greater number of the loans granted were for small sums, in conformity with the law of 1904; in fact, most of them ranged between 100 and 500 Fr., which shows the enormous benefit of the bank to the small farmer class.

We must give a few words to the third form of agricultural credit institution: the small co-operative society. These institutions began to arise in 1896 and developed so rapidly that there were already 493 in 1908, most of them being of the Raiffeisen type.

Their growth is more particularly due to the action of the Agricultural Bank, which at once realised the great importance of these local Banks and worked assiduously to encourage their development, founding new banks, aiding those already in existence, organising them and supervising their working. In 1908 there were in Bulgaria 384 rural banks of the Raiffeisen type supervised and accredited by the Bulgarian Agricultural Bank; their members numbered 28,744, and they had granted loans to the sum of 8,150,537 Fr., receiving in their turn 1,517,593 Fr. in loans from the Agricultural Banks.

These local credit co-operative societies, distributed about in the smaller centres, have been successful in ridding their districts of the scourge of usury which was weighing so heavily on the peasants and small farmers of Bulgaria.

(Summarised from the *Bulletin of the Bureau of Economic and Social Intelligence* of the International Institute of Agriculture, 2nd Year, No. 6.)

FRANCE.

THE OIL CO-OPERATIVE SOCIETIES IN FRANCE.

During the last decade the associations for the production and sale of olive oil have developed considerably in the oil regions of Provence and Languedoc.

For some time past there had been a serious crisis in the olive-growing industry, which was primarily due to the competition of foreign oils from oil seeds. On the other hand, as the olive growers had no suitable machinery at disposal—they were able at most to count on rough wooden presses—they found themselves at the mercy of speculators and the proprietors of more or less improved oil-works, whose whole interest lay in keeping back as much oil as possible in the olive husks, which became their property after the oil had been expressed. The natural result was that the growers received but a small quantity of oil of a poor quality from their olives, which was unequal to the competition on the market.

The June number of the *Bulletin of Economic and Social Intelligence*, published by the International Institute of Agriculture, contains an interesting study on the first steps made in this field by co-operation, on its development and its future. We give the following summary of the main points dealt with in the article:—

In 1900, the first group of olive growers was formed at Codoux (Bouches-du-Rhône), and gave the happiest results. This example was soon followed by the growers of Cabris and Gilette (Maritime Alps), who set up some model oil-works. The movement spread rapidly, encouraged by the Government, and at the end of 1910 there were no less than 20 co-operative oil-works in the South of France.

The Government aids the movement in various ways, by spreading the principles of co-operation and technical instruction, granting fiscal immunities or subsidies, and granting loans at a low interest through the Mutual Agricultural

Credit Banks of the various districts, in accordance with the law of December 29th, 1906. These loans are granted for a maximum period of 25 years up to double the amount of the paid-up capital, at an interest not exceeding 2 %.

In 1910 as many as eleven co-operative oil-works had received low-interest loans for sums varying from 4,000 to 45,000 fr., the total sum advanced being 170,000 fr.

The co-operative oil-works have as a rule an average of about a hundred members, each extract annually from 40 to 150 double decalitres of olive oil. Several systems of plant are used: some societies buy or rent an old olive mill and bring it up-to-date, others buy suitable premises or have them built, and furnish them with a complete plant, while others have the necessary premises presented to them by the Commune, an association or some private benefactor.

In the first case, it is estimated that the sum required for the installation and working of a small model oil-works varies between 20,000 and 30,000 fr., that is, 12,000 fr. for the building, from 8,000 to 10,000 for the machinery, and from 300 to 5,000 for the various expenses and the initial circulation fund.

The Co-operative Oil-works of Grasse (Maritime Alps), which has at the present day a capital of 18,700 fr., has acquired a large oil-works furnished with the apparatus for the extraction of the oil from the husks and worked by hydraulic power; the entire plant cost 47,000 fr. In order to meet this expenditure, the society obtained a loan of 30,000 fr. from the Regional Bank of Mentone at the rate of 2 % and repayable in twenty years.

Among the more important co-operative oil-works we may mention the "Travailleuse" of Cotignac (Var), which has a capital of 10,625 fr. divided in 25 fr. shares yielding an interest of 3·60 %. This society had a loan of 25,250 fr. for twenty years at the rate of 1·50 %. Its steam plant cost 45,350 fr. and can treat sixty double decalitres of olives per hour.

According to recent information, the movement appears to be extending to Algiers.

Considerable advantage has already been obtained from co-operation in this branch of industry, both from the technical and economic point of view. The double decalitre of olives which now produces an average of 2·3 to 2·6 litres of oil, that is, from 3 fr. to 3·25 fr., gives a return of from 50 centimes to 75 centimes more than formerly, and by utilising the secondary products it has been found possible not only to cover the expenses of manufacture, but also to pay the interest on the loan.

We are not wrong therefore in feeling sure that co-operation will contribute largely to the resuscitation of the oil industry on the Mediterranean coast of France.

(Summarised from the *Bulletin of the Bureau of Economic and Social Intelligences* of the International Institute of Agriculture, 2nd Year, No. 6.)

ITALY.

Facilities Accorded to the Co-operative Distributive Societies.

The Italian Government, rightly thinking that the co-operative distributive societies might do much to lessen the increasing rise in the price of food, presented a Bill to the Chamber of Deputies on March 9th, 1911, which contains special provisions for the benefit of these co-operative societies.

The principal provision of this Bill (which was examined in the last number of the *Bulletin of Economic and Social Intelligence*, published in June, 1911, by the International Institute of Agriculture) is that exempting the dividends which the co-operative distributive societies pay to their customers in proportion to the purchases made from the tax on personal property, these dividends being considered as the customers' automatic savings.

The dividends relinquished by the persons who have a right to them, that is, the sums which are not withdrawn or left on deposit with the society for the purchase of new shares, and which therefore become the property of the society, do not benefit by this provision.

Another important concession is the reduction of the stamp duty to two-thirds of the present amount, that is, to 20 centimes for each share certificate or other document representing value issued by the society for an amount not exceeding 100 fr.

The first provision satisfies an old desire of the co-operative society, whose body of members and customers will undoubtedly increase as a result of this benefit, thus enabling the society to give larger dividends or to sell at a lower price.

(Summarised from the *Bulletin of the Bureau of Economic and Social Intelligence* of the International Institute of Agriculture, 2nd Year, No. 6.)

GIRLS' SCHOOL GARDEN, BALANGODA.

Vide page 249.

AUSTRALIAN STATE LOANS TO SETTLERS.

INTERESTING DATA ON THE SYSTEM IN VOGUE THERE FOR ASSISTING AGRICULTURAL AND PASTORAL SETTLERS.

(From the *Manila Bulletin*, June 7, 1911.)

With the establishment of an Agricultural Bank in the Philippines and the small amount of business that has been done by the same since its inauguration four years ago, the system in vogue in Australia for state loans to settlers, for assisting agricultural and pastoral settlers will prove of special interest.

In 1899 the Government of New South Wales, recognizing that some assistance was needed to restore prosperity to the large section of the farming community, which had suffered serious loss by drought, inaugurated a system of advances to settlers on lines similar to those followed by the Credit Foncier of France. The Act providing for this project, passed in 1899, was frequently amended, until in 1906 the powers of the Board, which until then had managed the whole undertaking of advances to settlers, were transferred to the Commissioners of the Government Savings Bank of the State, and the maximum and minimum advances were then fixed, and have since so remained at £2,000 ($9,733) and £50,000 ($243,325) respectively.

The popularity and success of this scheme can well be gauged by the fact that up to December 31, 1909, 8,456 advances, totaling £1,362,854 ($6,632,329) were made to settlers, averaging £161 ($784) per loan. Of this total, 4,833 advances, representing £566,102 ($2,754,935), had been repaid at the date mentioned, leaving 3,623 advances current. The average balance of principal was £220 ($1,070) per loan.

In explanation of the real purpose of these advances, and the terms of their granting, the Commissioners are empowered to make advances upon mortgages of land in fee simple or of land held under conditional purchase or lease, settlement purchase or lease, or homestead grant or selection. The advances are made for repaying existing encumbrances, purchasing land, or to effect improvements, develop resources, or build homes.

The conditions under which loans are repayable vary according to the circumstances of the individual case ; the maximum loan to any one person is £2,000 ($9,733), the rate of interest ranging between 4½ and 5 per cent.; and the maximum period for repayment is 31 years.

It is clear that the system is intended to confer and does afford material assistance to men who contemplate settling on the land, as well as to those already engaged in agriculture, but necessarily this system was not initiated to meet every instance in which farmers might require credit, usually in relatively small amounts, and for a comparatively short period. To effect this object it is felt by certain responsible local authorities that a system should be established in New South Wales, on the lines of a co-operative bank or borrowers' association, with the sole object of obtaining credit at low cost for its members, with adequate protection of their security on the plan of the co-operative loan organizations which have been introduced satisfactorily in Europe, and of which the best example is said to exist in the Raiffeisen banks of Germany.

EDUCATION.

GARDENING AT GIRLS' SCHOOLS.

It is satisfactory to find that the School Garden movement is gradually spreading to the Government Girls' Vernacular Schools of the Island. One of the first to take it up was the Kumbaloluwa girls' school, since when a number of others have followed suit, *e.g.*, Mugurugampola, Kirinidiwela, Handapangoda, etc.

The illustration published in the present issue is of a garden at Balangoda girls' school, where the head teacher, in spite of serious drawbacks, is showing good work. The land on which the school stands unfortunately does not belong to the Crown, and hence many difficulties have arisen. It is hoped, however, that before long a Crown site will be available. It is rather an unusual sight to see Sinhalese girls doing garden work under the supervision of their teacher. The development of school gardening in the direction of girls' schools speaks well for the popularity of the scheme, and presages a new era in village life in Ceylon.

C. D,

MISCELLANEOUS.

CEYLON AGRICULTURAL SOCIETY.

Minutes of a meeting of the Board of Agriculture, held at the Council Chamber at noon on Monday, the 14th August, 1911.

His Excellency the Acting Governor presided.

There were also present :—The Hon'ble Messrs. L. W. Booth, Bernard Senior, and C. T. D. Vigors, Drs. J. C. Willis and R. H. Lock, Messrs. G. M. Lushington, R. S. Templeton, William Dunuwille, J. H. Meedeniya, James Peiris, Francis Daniel and C. Drieberg (Secretary).

The Minutes of the last meeting held on April 12th were read and confirmed.

Progress Report No. 55 was adopted.

Reports by Mr. vanLeenhoff and Mr. Cowan on the Tobacco Experiment at Mahailupalama were submitted. A discussion followed in which the President, Dr. Willis, Mr. Booth, Mr. Vigors and Mr. Lushington took part. On the motion of Mr. James Peiris, seconded by Mr. Daniel, the question as to whether the experiment should be continued under the same conditions was referred back to the Tobacco Committee for their recommendation.

Dr. Lock read his paper on "Experiments bearing on the Cultivation of Paddy," and was accorded a vote of thanks.

C. DRIEBERG,
Secretary, C.A.S.

THE BOTANICAL GARDENS OF CEYLON.

BY PROFESSOR FRANCIS RAMALEY,
University of Colorado.

"An English glass house glorified" is the description which a British friend of the writer gave to the garden at Peradeniya, Ceylon. And such it truly is. The brilliant foliage, the strange orchids and pitcher plants, the luxuriant ferns, the uncanny screwpines, are just what one might see in a gentleman's conservatory—only more wonderful and luxuriant, grown taller and more fair. As a "show place" these gardens are not equalled anywhere in the world, and as a place of scientific interest to botanists there are few rivals. Haeckel, the German zoologist and philosopher, said of his visit to Peradeniya that, in the four days which he spent there, he learned more botany than he could have learned at home in as many months of hard study.*

Ceylon has been described as a "dew-drop on the brow of India," and, so far as position is concerned, it is certainly very closely related to the Indian peninsula. In climate, too, and in the flora and fauna, the northern part of the island is strikingly Indian; the same may be said of the inhabitants. On the other hand, southern and central Ceylon has a climate of its own, and the people as well as the plants and animals are quite different.

Peradeniya is situated in the centre of Ceylon, about seventy miles by rail from Colombo, the capital of the island. There is no town here, but only a post-office and a few scattered huts. The city of Kandy, however, is only three miles distant by rail or wagon road.

In going from Colombo to Peradeniya the trains are slow, but the traveller does not complain. Indeed, he would wish his journey lengthened, for the trip affords a four-hour introduction to tropical scenery which is nowhere surpassed. Any one can enjoy the journey whether interested in the world of nature or in his fellow man. There are broad lowlands with coconut trees and fields of rice, alternating with patches of deep jungle in which the natives have cleared bits of ground and built their huts. In the higher altitudes tea fields and chocolate plantations are the rule. But here also are stretches of uncleared forest with trees of all heights and size, frequently some with handsome red or violet coloured flowers standing out boldly amid a mass of dark green.

The garden at Peradeniya is only one of a number on the island. It is, however, the largest and most important. Here are the offices of the Director of the Gardens, whose duties correspond to those of a Government Secretary of Agriculture. Other gardens and experiment stations, five in number, are established in parts of the island where differences in climate furnish altered conditions for plant life.

The Peradeniya garden is in the wet zone, or area of natural rain forest, at an altitude of 1,600 feet above the sea. With an annual precipitation of about 90 inches and a mean temperature of 75° Fahrenheit, there are furnished the necessary conditions for luxuriant plant growth. A "dry season," extending

* Haeckel, "India and Ceylon," Ch. VI.

through February, March and April, limits the growth of air plants hanging from trees, so that in this respect Peradeniya is not so interesting as Buitenzorg, in Java. The "dry season" is, however, not long enough to interfere with the growth of most plants, and nearly all of the trees retain their leaves through this period. It is quite otherwise in the arid districts of northern Ceylon, where a monsoon forest with a considerable number of deciduous trees is the natural plant formation. Peradeniya, though rather too cool for coconuts or Para rubber, has a climate well suited to Castilloa rubber and to tea and chocolate, while palms of nearly all kinds thrive to perfection.

The garden was not originally laid out according to any system of plant classification, but was rather a beautiful park in which trees were planted for landscape effect. Now, however, the Director,* is developing the garden according to systematic plans and making definite groups of plant families. Thus there are at present well-arranged plots devoted to palms, others to screw pines, others to cycads. It will necessarily be many years before the new plan can be fully carried out, for most of the plants in a tropical garden are trees. Indeed, the herbaceous garden forms but a small part of the whole.

Here, as in any first-class garden of the tropics, much is very new and strange to the botanist from temperate climes. Palms, screw pines, giant bamboos, orchids and tree ferns which he has known hitherto only from books or from the puny specimens of the plant house, become the commonplaces of every-day life. The sight of trees of the Composite family, Verbena family and many other groups represented at home only by herbs opens the eyes to some of the real wonders of tropical plant life. An interesting example is that of the "potato tree" belonging to the nightshade family. It does not produce potatoes, but its flower resembles that of a potato very much enlarged. At home we think of the nightshade family including only herbs and vines, but in the tropics it includes trees as large as our ordinary shade trees, such as elm and maple.

Nearly every kind of plant will grow at Peradeniya; tropical and sub-tropical plants very well indeed; temperate plants for the most part indifferently well. The latter are, however, taken care of at the mountain garden at Hakgala where the higher altitude (5,500 feet) gives them a climate resembling that of western Washington and Oregon. The comparative coolness of tropical highlands is well illustrated by Nuwara Eliya, a resort near Hakgala, where in the hotels a grate fire is lighted nearly every evening throughout the year.

* John C. Willis, M.A. (Camb.), F.L.S.

While an attempt is made to grow in the gardens all of the plants which are native to Ceylon, a great many plants from other parts of the world are also to be seen there. Indeed, the wealth of tropical beauty is here assembled. The flame tree of Madagascar, named from the brilliant colour of the flowers, is a wondrous sight in March and April, the whole tree being a mass of red which hides the dark-green foliage. From India there is a tree, *Saraca indica*, with a profusion of brilliant orange-yellow flowers; and from tropical America various trees of the genus *Brownea*, especially interesting because of the graceful clusters of pendant young leaves. The leaves droop when young and tender, thus presenting very little surface for injury by the overhead sun. As they grow older a horizontal position is assumed and the red colour is lost. It is supposed that the red colouring matter acts as a screen which protects the living substance of the young leaves just as the red glass in a photographer's dark-room window protects the sensitive plates from injury by light.

Among the most interesting plants are the bamboos, of which many different kinds are cultivated, some native, others imported from peninsular India or from other parts of Asia. Some interesting studies have been made at the gardens on the rate of growth of bamboo stems. These spring up almost as if by magic. To measure the growth from day to day no expensive auxanometer is needed, but only a tape measure and a coolie to climb an adjacent tree with the end of the tape. A day's growth is measured not in millimeters but in feet or inches. Bamboo stems are hollow, as are most grasses—for bamboos are but grasses—and are wonderfully strong considering the weight and the amount of material in them. Indeed, the principle of the hollow cylinder so well known to engineers was long understood by the Asiatics, who use bamboos for building purposes.

Of economic plants in the garden there seems almost no end. The balmy breezes of Ceylon may well be spice-laden. Ceylon cinnamon is known the world over. The various peppers, as black pepper, long pepper, betel pepper, are woody climbers. A handsome grove of nutmeg trees is planted near the entrance—the trees about seventy years old. On the ground under the trees may be found the seeds, *i.e.*, the nutmegs, and around them a covering, the aril of the botanist, which forms the spice known as mace. Clove trees may be seen also; it is the young flower buds of the tree which are dried to make the cloves of commerce. In the garden one may see the plants which furnish vanilla, citronella oil, tea, indigo, pineapple, ramie, sisal hemp and sago. Almost countless trees there are of economic importance. A few may be named, as those which furnish coffee, chocolate, cola, coconut, Brazil nut, camphor, rubber, gamboge and other tropical products.

In speaking of economic plants mention must be made of the Experiment Station which is really a part of the garden, although situated across the river. As a matter of fact nearly all the world lies across the river from the Peradeniya Gardens, as these are situated in a bend of the stream which flows first north, then east, then south around the gardens. The Experiment Station was formerly a private estate bought by the gardens at a low price, because it had been allowed to run down and the chocolate trees nearly all became diseased. Scientific methods of tending and care have been introduced and a model plantation developed. Here experiments are made with new agricultural crops and with new methods of treatment. The different species of trees furnishing rubber are being tried as well as improved varieties of chocolate, cardomoms and other crops. Throughout Ceylon there is much general interest in scientific agriculture, and the Controller of the Experiment Station has the encouragement and moral support of the thinking population, both European and native. The daily newspapers at Colombo also give much attention to such matters and assume a sympathetic attitude toward Government scientific work, in refreshing contrast to many of the newspapers in this country.

An attractive plot at Peradeniya is the Kitchen Garden, in which are assembled such "vegetables" as will grow in that hot, moist climate. Many of our common vegetables do well and can be had at all seasons, for example, beans, beets, peas, celery, lettuce, and cress. Potatoes are generally small and poor. Sweet corn will grow in Ceylon, but has not thus far come into use. Of tropical vegetables various "yams" are much used, particularly by the natives. The word "yam" is applied to tubers and thickened roots of many different species of plants. Eggplants, different from ours in the temperate zone, are cultivated, also certain plants used for "greens." Breadfruit trees produce the large heavy fruits of that name, but these would properly be classified among vegetables. Breadfruit is not much used by the British in Ceylon, who, in fact, eat chiefly the same things that they are accustomed to eat at home on their own tight little island.

Thus far we have been considering the attractions of the Peradeniya Gardens to the casual visitor. To the botanist they are even more interesting. Every facility is offered by the Director of the Gardens for investigation by visiting men of science. There is a good herbarium in charge of competent Curators and a working library of botanical books and periodicals. Good laboratory facilities are also offered. Although the laboratory for visitors is not fully equipped with physiological apparatus, there are the usual necessaries, and it is easy to obtain all ordinary supplies at Kandy or Colombo. Native joiners, tinsmiths and metal-workers can be secured at very low rates to make articles needed. Photographic materials may be obtained at Kandy, only three miles away, and skilled photographers may be engaged to develop negatives or do other photographic work such as making lantern slides.

Opportunities for securing museum material are excellent. Collections of tropical woods properly named are prepared to order by dealers in Kandy. Plant material may be collected from the garden and preserved in formaldehyde or alcohol. Herbarium specimens from the garden can be collected and dried, but the botanist will need to remember that nothing short of the most thorough drying will suffice. It will also be necessary to use a liberal amount of napthalene scattered through the dry specimens at all times. A native plant collector is detailed by the Director of the Gardens to assist visiting botanists in getting material from either the garden or the jungle. This man is well acquainted with nearly all of the species in the garden or growing in the vicinity, and can usually tell the scientific name offhand, although sometimes he needs to refer to the herbarium. At the laboratory native assistants are provided who clean up apparatus and glassware and make themselves generally useful.

One of the most interesting things about Ceylon is the way in which the jungle comes to the very door of civilization. In our own country we do not find "backwoods" close to cities and towns, but must travel a long way from Boston or New York to find the primeval forest. Ceylon, however, like other tropical countries, furnishes examples of jungle in close proximity to the large towns. Indeed, everywhere throughout the island the forest is easily reached. There is no half-way land in Ceylon. That which is needed for roads, gardens or fields is well cared for; other land grows up quickly to jungle. Old fields, abandoned a few years, soon become a dense thicket and later a forest. This is well seen at Anuradhapura, one of the ruined cities in the north-central part of the island. Here, the Government Archæologists, as they find various parts of buildings such as columns and arches, set them up in place; but sometimes they neglect to clear out the trees for a sufficient distance and their "finds" once more become overturned by growing roots or the stems of gigantic climbers.

So, where jungle is the rule, and clearings have to be protected, it is natural that the botanical gardens should have a patch of jungle. This is situated in the Experiment Station grounds, but easily reached by the visitor. Here may be seen the native trees of the region in their natural condition, and the visitor may get some idea of tropical luxuriance in the large number of species present on even a small tract of ground. It must be said, however, that a visit to this bit of jungle would be, to many visitors, a disappointment, for it is not filled with air plants hanging from the trees nor rendered impenetrable by interlacing stems of climbing plants. It is, however, much easier to travel through than the jungles at sea level in districts of great heat and humidity.

The botanist who is interested in ecology—the relation of the plant to its environment—is often on the lookout for field and roadside weeds. In temperate regions, particularly in the western United States, roadside weeds make a constant and striking feature of the landscape. This is not the case, as a rule, in the tropics. Indeed, there are not only rather few weeds, but few flowering herbs of any kind. The tropics are a region of big things and the herbaceous plants make little impression on the visitor. At the Peradeniya Garden, the writer noted a small area of perhaps half an acre that had been neglected for a time. Here, although there were many tree seedings started, there was a fairly good patch of weeds—enough to make a lonely American feel quite at home. These weeds were chiefly *Lantanas* and some of our American composites, particularly the fleabane *Erigeron* and also *Conyza.*

It would be difficult to find elsewhere in the world an area the size of Ceylon, or even much larger, with so many different vegetation regions. The differences in these regions are brought about largely by the winds which determine the distribution of rainfall and by altitude with consequent temperature changes. The wet weather comes with the rains from two different directions. The north-east monsoon commences in October and brings heavy rains throughout the higher parts of the island and in the lowland country of the north-east. A series of rains continues through November and December, with a rather light rainfall during January, February and March. In April the wind changes to south-west and there is more rain, with June especially wet. From then until October the rainfall is again lighter. It will be seen then, that in the highlands it is always moist, but that there are certain districts which have a rather pronounced dry season. The driest parts of the island are in the north and the south or north-west and south-east, in other words, in those parts placed as outlying districts at right angles to the directions of both monsoons.

The climate at Peradeniya is such that the botanist can live there in comfort and work regularly. It is a good place to begin the study of tropical plant life, as it is not extreme in either rainfall or temperature. From Peradeniya it is easy to reach the various parts of the island with their remarkably different floras. Travelling is not expensive, and as English is the regular commercial language it is easy to get around.

Although the different plant formations of Ceylon are almost without number, yet a rough classification may be made as follows: (1) lowland evergreen rain forest; (2) upland evergreen rain forest; (3) mountain evergreen rain forest; (4) monsoon forest (half deciduous). There is no plain or prairie of any extent. Our first named formation is in the south-western part of the island extending from Galle to Colombo and inland for twenty to fifty miles. Peradeniya is situated in the upland evergreen rain forest. Nuwara Eliya and Hakgala (about 6,000 feet altitude) may be taken as examples of our third region. These points are easily reached from Peradeniya by rail, the trip taking about half a day. Above these points the mountains rise 2,000 or 3,000 feet higher, but there is no true alpine vegetation anywhere in Ceylon. At Nuwara Eliya the general aspect of vegetation is much like that of temperate America or Europe. The trees are much stouter than those of lower altitudes and not so tall. In these mountain highlands in addition to forest there is a certain amount of "open country," the *patanas*. These are expanses of grassland on hillsides and rolling ground. The monsoon forest occurs in the drier regions of the island in the north-west and south-east. Here there are no very tall trees as compared with those of the rain forest, and many of them are short and scrubby—very much branched after the manner of dry-country plants the world over. A considerable number are deciduous, losing their leaves in the hotter and drier months of spring to put them on again in the period of the monsoon or rain-bearing winds.

In the hot, moist lowlands of the south-west part of the island a typical strand flora may be seen. There are mangrove swamps and thickets of Nipa palm. It is in such very hot districts that rubber is grown and the coconut flourishes also. The drier regions have usually what would be a fair allowance of rain if in the temperate zone, but the tropical heat causes such rapid evaporation that the fifty inches of annual rainfall at Anuradhapura is not sufficient to grow crops without irrigation. Here then is a truly arid district. Farther north at Jaffna it is still drier, so that almost desert conditions prevail at least for a part of the year. As these dry regions can be visited easily at all times of year they make a very attractive feature of the island from the standpoint of the botanist. They are especially interesting to the American student familiar with the arid conditions of the west. In America all arid lands are practically treeless, but in Ceylon the forest is the natural plant formation even in dry areas.

With all of the different floras to be seen in the various parts of the Island a botanist may get a good idea of the tropical world in a short time and with slight expense. The Director of the Gardens and his staff are anxious to have scientific visitors, not only botanists, but zoologists and geologists as well. Two rooms at the Government Rest-house (a kind of hotel) are reserved for scientific visitors, and no charge is made for lodging, although, of course, table board must be paid for. The cost of living will be found to be not more than in other tropical countries with fewer advantages for study

Ceylon has never attracted a great number of students, but a considerable amount of valuable work has been done there. Haeckel certainly obtained many of his philosophical ideas of the plant and animal worlds during his visit to the island. Modern science and philosophy owe much to the influence of Ceylon on his writings. But Haeckel's zoological collections were also valuable, and the collections of others at later times have added much to the world's store of knowledge in regard to tropical life. On the side of botany probably the name which is oftenest associated with Ceylon is that of the late H. Marshall Ward, who as a young man spent two years on the island studying the coffee disease. Although he worked out the etiology of the disease and the life-history of the parasite, he was unable to devise a method of prevention. Henry Trimen, who was Director of the Gardens at Peradeniya for sixteen years, published the "Flora of Ceylon," which was completed by Sir Joseph Hooker in 1900, after the death of Trimen. It is interesting to note that Hooker had himself collected plants in Ceylon fifty-three years before. Of recent publications the work of Mr. Willis, the Director, on a curious family of plants, the Podostomacæ, is especially noteworthy. An exhaustive study of the trees of the ebony genus has been made by Mr. Herbert Wright. Mr. R. H. Lock has also done some remarkably good work in plant-breeding experiments which deserve special mention. Various students have worked on minor problems, with results which have been published in both European and American journals. In June, 1901, there was begun the publication of the *Annals of the Royal Botanic Gardens, Peradeniya.** This publication is issued at irregular intervals at a nominal price. It contains contributions from the Director and other members of the scientific staff of the Gardens.

The West Indies and the Philippines will, no doubt, attract more students of Botany from America than will Ceylon, but in a few years no one will claim to be a trained botanist unless he has had the advantages of study in some tropical laboratory. There is no tropical land which offers better oppor-

* Students interested in knowing more concerning the opprtunities for research at Peradeniya should consult the first number of the *Annals* in which these opportunities are fully set forth. An excellent account of the island of Ceylon with a statement of its resources is given in the "World's Fair Handbook of Ceylon," prepared for the St. Louis Exposition.

tunity than Ceylon for botanical study. Nor can one find any tropical country with a more intelligent and progressive population, finer cities or more beautiful scenery.

One will naturally make comparisons between botanical opportunity at Peradeniya and at Buitenzorg,† in Java. It may be said that the establishment at Buitenzorg is much older and better provided with funds, but that Peradeniya is a more comfortable place to live, that travelling is much less complicated and communication more easy because of the use of English by the natives. In Java one must learn Malay in order to communicate with servants. On account of the very moist climate, Buitenzorg presents a more luxuriant vegetation, but this very great moisture makes work harder, and in the afternoons it is practically impossible to do any kind of study in the garden on account of rain. To many people the large number of visitors in the Buitenzorg gardens seems a detriment. The place is too much "civilized." At Peradeniya, on the other hand, the number of casual visitors is rather small, and they do not embarrass the student by their presence or their questions. It will be seen that it is impossible to say which of the two places will be better for the student. Something depends on the kind of work he wishes to do, and very much depends on his work temperament. In fact, both gardens should be visited, and the length of time spent in each be determined by conditions as they arise.

† See an article by the present writer in this magazine for November, 1905.

MOSQUITOES AND MALARIA.

BY E. E. GREEN.

The mythical association of Malaria with a subtle miasma liberated by newly turned soil dies hard. Some recent correspondence in a local newspaper shows how strongly rooted is this old exploded theory. It would not be of much importance did it not distract attention from what has been amply proved to be the true cause of malarial fever, and encourage neglect of the proper precautions. To one who has seriously studied the evidence, no doubt of the correctness of the conclusions is possible. To quote from one of the Royal Botanic Gardens Circulars ("Mosquitoes and Malaria," Vol. I., No. 25):—

"It would be difficult to name any biological discovery that has been worked out more carefully and patiently to its conclusion. The development of this microscopic blood-parasite has been traced,—stage by stage, first in the blood of man, then through the stomach and tissues of the mosquito, till it reaches such a position that it must inevitably enter the human system when next the mosquito takes its draft of human blood."

"Negative proof of the correctness of the mosquito theory of infection is afforded by the fact that Doctors Sambon and Low lived a whole summer in the deadliest part of the Roman Campagna, escaping infection by retiring each night into a mosquito-proof hut. Celli made practical experiments on railroad employés in Italy. A certain number of these were protected by the use of mosquito-proof dwellings, and almost completely avoided the fever which attacked a large majority of the unprotected men."

"Positive proof has been provided by the well-known case of the deliberate infection of Dr. Manson's son, who permitted himself to be bitten, in England, by infected mosquitoes specially imported from the malarious districts near Rome; with the result that an attack of the typical form of Roman fever was induced thereby." This is the sort of work that one correspondent dismisses as "bookish learning of conflicting ætiological theories."

The correspondence referred to was started by an otherwise very reasonable and useful letter, on the treatment of coolies, by an Indian planter. In discussing the causes of fever, after detailing the symptoms (evidently those of typical Malaria), the author of the letter remarks:—"Excluding mosquitoes, *which were not in evidence at the time of the outbreaks*, I put down the fever to climatic conditions and to the situation of the estate I was on, in a river valley at an elevation of 2,000 feet above sea level. The time of the year at which the fever occurred was generally in April, May, and up to mid-June, starting with the first heavy showers of the little monsoon. These seem to have a bad effect on the soil previously baked by a fierce sun from beginning of December to mid-April. At night, as a result, a heavy damp 'miasmic' mist would surround the lines, the atmosphere at the same time being so oppressive *that coolies slept in the open verandahs and so caught chills*." The italics are mine, to emphasize what I believe to be weak points in the argument. In all such arguments against the mosquito theory, we meet, constantly, the remark that no mosquitoes were in evidence, or even the dogmatic statement that mosquitoes did not occur in the locality. Many persons appear to believe that unless the air is humming with the note of mosquitoes there can be no Anopheles, and conversely, that the noticeable presence of noisy mosquitoes—without the occurrence of fever, is a sound argument against the mosquito theory. They do not realize that the noisier mosquitoes are not the most dangerous. In certain localities Anophelines are so numerous that they cannot escape notice: but, under ordinary conditions, Anopheles—though present in sufficient numbers to cause a serious outbreak of fever—are seldom audible and still less frequently visible. Anopheles is a shy and retiring mosquito, keeping close to the ground where its faint note cannot reach the ear, avoiding the light, and leaving the noisy business to its bolder relative—the Culex. Its favourite point of attack is the feet and ankles. I think it extremely probable that not one person in a hundred (in Ceylon) has ever actually seen an Anopheles—in the life, although species of the genus are to be found by one who knows where to look for them, in every part of the Island—from sea-level up to Nuwara Eliya.

With regard to the remark in the foregoing quotation, that the "coolies slept in the open verandah and so caught chills"—from the 'miasmic mist'; an equally reasonable statement of the facts would be that—owing to the oppressive atmosphere—the coolies slept in the open verandahs and so were more exposed to the attacks of mosquitoes.

Opponents of the mosquito-malarial theory are given to railing against science and to comparing the advantages of "an ounce of common sense to a ton of theory." While realizing that there may be different opinions upon every question, and sympathising with honest opponents, one can only regret that 'uncommon nonsense' is too often exploited under the plausible name of 'common sense.'

A DICTIONARY OF TERMS USED IN AGRICULTURE, BOTANY, CHEMISTRY, AND ALLIED SCIENCES:

FOR THE USE OF PLANTERS AND OTHERS.

BY J. C. WILLIS AND M. WILLIS.

A vast number of technical terms, native names, and other words not at once intelligible to most people, are used in books dealing with Agriculture, Botany, etc. At the request of friends, we have made a preliminary list of those used in Trimen's Flora of Ceylon, the *Tropical Agriculturist*, the Circulars of of the R. B. G., and other books commonly used in this Colony; and this is given below, with brief explanations attached. Its length will surprise most people.

A bracket is often put after a name, indicating the country where the term is used, *e.g.*, Ind (ia), W. Ind (ies), &c.

Abaca	... Manila hemp
Abassi	... A variety of Egyptian Cotton
Abattoir	... A place for slaughtering animals
Abbassi	... See Abassi
Abdomen	... The lower or hinder part of the body.
Aberrant	... Differing from normal
Abortion (Plants)	Rudimentary development.
Abrupt	... Terminating suddenly, not tapering
Acajou (W. Ind.)	Guarea trichilioides
Acaju	... Cashew-nut
Acclimatisation	... Adaptation to a new climate and country.
Accrescent	... Enlarging, and remaining attached.
Ach dye	... Morinda citrifolia.
Achene	... A dry fruit from one carpet, not opening
Ach-root	... Morinda tinctoria
Achlamydeous	... Without calyx or corolla
Acicular	... Needle-shaped
Acom (W. Ind.)	... Dioscorea bulbifera
Acotyledons	... An old term for non-flowering plants
Acre-foot	... An acre of water, one foot deep
Acre-inch	... Ditto, one inch deep
Acridiid	... Short-horn grass-hopper
Actinomorphic	... Symmetrical, in whichever direction divided across
Aculeate	... Prickly
Acuminate	... Tapering to a point in hollow curves
Acute	... Sharply pointed
Adam's needle	... Yucca, many species
Adhesion	... Union of organs of different kinds in a flower, *e.g.*, of stamens to petals.
Adnate (anther)	... United to stalk by whole surface
Adpressed	... Appressed
Ad valorem	... According to value
Adventitious	... Appearing out of regular order

Aerial ... Above ground
Aerial root ... Root appearing above ground
Aerophyte ... Epiphyte
Aestivation ... Arrangement of floral leaves in the bud.
African rubber ... Landolphia, Funtumia, etc.
Agar (Ind.) ... Aquilaria Agallocha
Agar-agar ... Ceylon moss, a seaweed, Plocaria lichenoides
Agricultural Banks ... Banks for agricultural advances, not necessarily co-operative or confined to one village
Agronomy ... Study of field crops
Agrostology ... Study of grasses
Aguacate ... Avocado pear
Ai-camphor ... Blumea balsamifera
Air-plants ... Epiphytes
Ajowan ... Carum copticum
Akee ... Blighia sapida
Al dye ... Morinda citrifolia
Ala ... Colocasia Antiquorum, &c.
Ala (Singh.) ... Yam
Alang-alang ... Illuk, Imperata arundinacea
Alavango ... Crowbar
Albinism ... State of being an albino
Albino ... An individual with the pigmentation little developed
Albumen ... Food materials in seed, outside the embryo
Albuminoid ... Proteid
Albuminous ... (Seed) with albumen
Alburnum ... Sap-wood
Aldehyde ... Product of oxidation of an alcohol
Alfalfa ... Lucerne
Alga ... Sea- or pond-weed
Algaroba ... Ceratonia siliqua, Prosopis alba
Alien ... Introduced plant which has become naturalised, *e.g.*, Lantana
Alkali ... A chemical substance with active properties opposed to those of an acid
Alkaloids ... A group of chemical substances, such as strychnine, morphine, &c.
Allheal (West Ind.) ... Micromeria obovata.
Alligator apple ... Anona palustris
Alligator pear ... Persea gratissima
Alligator wood (W. Ind.) ... Guarea trichilioides
Allseed ... Polycarpon
Allspice ... Pimenta officinalis
Alluvial ... Deposited by water
Almond, country Terminalia Catappa
Almond, Java ... Canarium commune
Almond-tree (W. Ind.) ... Terminalia Catappa
Aloes ... Aloe, many species
Aloe wood ... Cordia sebestana
Aloes-wood ... Aquilaria Agallocha
Alpaca ... A breed of the llama of S. America
Alsi (Ind.) ... Linseed
Alsike (clover) ... Trifolium
Alternate (leaves) One at each joint
Alu (Ind.) ... Potato
Am (Ind.) ... Mango
Aman ... Winter crop of rice (Bengal)
Ambasi hemp ... Hibiscus cannabinus
Amboyna wood ... Pterospermum indicum
Amelonado ... A variety of cacao
American aloe ... Agave americana
American Ebony Brya Ebenus
American Elemi Bursera gummifera
American Mastic Schinus molle
Amorphous ... Without definite form
Amphitropous ... Turning both ways from the stalk
Amplexicaul ... Clasping the stem
Ampulliform ... Flask-shaped
Amunam ... 6 bushels (Colombo) or 4½ (Kandy), also extent of land sown by this
Analysis ... Determination of constituent parts
Ananas ... Pine-apple
Anastomosing ... Uniting laterally
Anatropous ... Turned backwards in a U shape from end of stalk
Anchovy pear ... Grias cauliflora
Andiroba ... Carapa procera and C. guianensis
Androecium ... The stamens
Androgynous ... Male and female flowers separate, but in one inflorescence
Anemometer ... Measurer of wind-force
Anemophily ... Pollination by wind
Angeleen tree (W. Ind.) ... Andira inermis
Angely wood ... Artocarpus hirsuta
Angico gum ... Piptadenia rigida
Angostura bark ... Cusparia febrifuga
Anicut ... A dam or weir in a stream
Anil (Ind.) ... Indigo
Anime resin ... Hymenæa Courbaril
Anise, star ... Illicium anisatum
Anisophylly ... Leaves at a joint unequal
Anili (Ind.) ... Tamarind
Annatto ... Bixa Orellana

Annual rings ... The rings of growth that show in most timber, one being formed every year in temperate climates

Annular ... Ring-shaped

Annulate ... Marked with rings

Anopheles ... The fever carrying mosquito, marked by having the trunk in a line with the body when sucking

Antennæ ... Feelers

Anterior ... The front side: in a flower often the lower side

Anteroposterior ... Line from front to back

Anther ... The pollen-receptacle of a stamen

Anthocarp ... Fruit enclosed in persistent calyx

Anthrax ... Splenic fever

Anticous ... On the anterior side

Antidote Cocoon (W. Ind.) ... Fevillea Cordifolia

Antipetalous ... Opposite the petals

Antisepalous ... Opposite the sepals

Antiseptic ... Preventing growth of germs

Apetalous ... Without petals

Aphides ... Plant lice; green flies

Apiculus ... A sharp point at the end

Apiary ... Bee-hive or hives

Apiculate ... With apiculus

Apiculture ... Bee-culture

Apocarpous ... Carpels not united

Apogamous ... Omitting the sexual process

Apple, alligator... Anona palustris

,, , custard ... Anona squamosa

Apple, elephant... Feronia Elephantum

,, , kei Aberia caffra

Apple, love ... Tomato

,, , malay Eugenia malaccensis

Apple, pine ... Ananas sativus

,, , rose Eugenia malaccensis

Apple, star ...Chrysophyllum Cainito

,, , sugar Anona squamosa

Apple, thorn ... Datura Stramonium

,, , wood Feronia Elephantum

Approximate ... Close together

Apricot, San Domingo ... Mammea americana

Arabian coffee ... Coffea arabica

Arable ... Ready for ploughing: usually ploughed

Arahar (Ind.) ... Cajanus indicus

Arar wood ... Callitris quadrivalvis

Arand (Ind.) ... Castor oil

Arborescent ... Tree-like

Arboretum ... Collection of trees

Arboriculture ... Tree-culture

Arbourvine, Spanish (Ind.)... Ipomœa tuberosa

Arbor vitæ ... Thuja occidentalis

Archæan (rock) ... Primitive; pre-fossiliferous

Are ... 100 square meters

Areca nut ... Areca Catechu

Areolate ... Marked with little areas

Argillaceous .. Clayey

Argum ... Argania sideroxylon

Aril ... A growth surrounding the seed, and not part of the fruit wall, as in Mangosteen (the edible part)

Arisi (Tam.) ... Rice

Aristate ... Awned; provided with a bristle

Aristulate ... Diminutive of aristate

Arnotto ... Bixa Orellana

Arrack ... Spirit distilled from fermented palm toddy

Arrested ... Checked in growth

Arrowroot ... Maranta arundinacea

Arrowroot, Brazilian ... Manihot utilissima

Arrowroot, East Indian ... Curcuma angustifolia; Tacca pinnatifida

Arrowroot, West Indian ... Maranta arundinacea

Artesian (well) .. One sunk in a place where a clayey stratum underlies in a bowl form a porous layer, so that the water rises from a considerable depth.

Artichoke, Globe ... Cynara scolymus

Artichoke, Jerusalem ... Helianthus tuberosus

Articulated ... Jointed

Artificial manure ... A manure artificially compounded of chemical substances

Artillery plant ... Pilea muscosa

Arum-lily ... Richardia africana

Ascending ... Bending upwards at outer end.

Ascigerous ... Bearing asci

Ascospore ... The spore of an ascus

Ascus ... Spore chamber of an Ascomycete fungus

Aseptic ... Free from living infective spores, &c.

Asexual ... Sexless

Ash (in analysis) What is left after careful (enclosed) combustion of the substance analysed

Ashmouni ... A variety of Egyptian cotton

Ash-pumpkin ... Benincasa cerifera

Asparagus bean (W. Ind.)	... Dolichos sesquipedalis
Asperous	... Rough
Assai palm	... Euterpe edulis
Assam silk	... Eri silk
Assam tea	... A variety of tea
Assimilation	... Working up of the simple food materials taken in by root and leaves, into the complex food of the plant
Asweddumize	... Convert into paddy fields
Asymmetric	... Not symmetrical when divided by a line through the centre
Atap	... Nipa fruticans leaves made into a cadjan
Atavism	... Return to an ancestral type
Atlas moth	... A silk-making moth; silk valueless commercially
At stake	... Beside stakes set out at regular intervals
Attenuate	... Tapering
Aubergine	... Brinjal
Auricle	... An ear-like lobe at base of a leaf
Aus	... Spring crop of rice (Bengal)
Austral	... Southern
Australian—	
Blackwood	... Acacia melonoxylon
Chestnut	... Castanospermum australe
Currant	... Leucopogon
Avocado pear	Persea gratissima
Awn	... A bristle-like outgrowth in the flowers of grasses, &c.
Axil	... The angle between a leaf and the stem
Axile	... Of stem nature
Axillary	... In an axil.
Axis	... Stem
Ayapana	... Eupatorium Ayapana.
Baas (boss)	... A head carpenter
Babul	... Acacia arabica
Baccate	... Berried
Bachelor's button (W. Ind.)	... Gomphrena globosa
Bacteria	... Plants of excessive minuteness, which cause fermentations, diseases, decay, etc., in animal matter.
Bacteroids	... The organisms that grow in the root tubercles of Leguminosæ
Badinjan (W. Ind.)	... Brinjal, Solanum Melongena
Bael	... Ægle Marmelos.
Baffle-plate	... A plate in an apparatus for smoking etc., made to cause the current to turn another way
Bagasse	... Refuse cane, after crushing for sugar.
Bag worm	... (family Psychidæ). A caterpillar that lives inside a case of sticks, &c, that it makes about itself
Bahia piassaba	... Attalea gummifera
Bahama grass (W. Ind.)	... Arugam-pillu, Cynodon Dactylon
Bahamas hemp	... Agave rigida, variety
Baigan	... Brinjal
Bajri	... Bulrush Millet, Pennisetum typhoideum
Balata	... Dried latex of Mimusops Balata
Balata tree (W. Ind.)	... Bumelia.
Bale	... A compressed bundle of cotton or fibre
Balsa	... Ochroma Lagopus
Balsam	... A flindresin
Balsam	... Impatiens
Balsam apple (W. Ind.)	... Momordica Balsamina
Balsam, broad-leaved (W. Ind.)	Oreopanax capitatum
Balsam of Copaiba	... Copaifera, several species
Balsam fig (W. Ind.)	... Clusia rosea
Balsam, gurjun	... Dipterocarpus, several species
Balsam of Peru	... Toluifera Pereiræ
Balsam of Tamacoari	.. Caraipa, several species
Balsam of Tolu	... Toluifera punctata
Balsam tree, yellow (W. Ind.)	Croton flavens
Balsam (W. Ind.)	Clusia rosea
Bamboo	... A giant grass, belonging to the genera Bambusa, Arundinaria, Dendrocalamus, etc.
Banana	... Plantain, Musa sapientum
Band (Ind.)	... A crop of silk
Bandakai	... Okra, Hibiscus esculentus
Banjhi	... No longer giving rise to vigorous buds in the axil
Bante	... Panicum Crus-galli
Banrhea	... Villebrunea integrifolia
Banyan	... Ficus bengalensis
Baobab	... Adansonia digitata
Bara-Mattar (Ind.)	... Pisum sativum

Barbadoes pride ... Cæsalpinia pulcherrima, Adenanthera pavonina
Barbecue ... A drying ground
Barberry ... Berberis
Barilla (W. Ind.). Batis; and see Watt's Dictionary of commercial products of India
Bark ... The outer covering of a tree outside the cambium layer
Bark-binding ... A tree growing extra slowly, so that the bark seems to form a coat of armour upon it
Barren ... Infertile, not bearing any seed
Barte (Ind.) ... Setaria glauca
Barus Camphor ... Dryobalanops aromatica
Basal ... Attached at the base of the support
Basic slag ... A by-product in the manufacture of steel from ores containing phosphates.
Basidia ... The stalks of the spores in basidiomycete fungi
Basidiomycete ... Fungus that bears its spores on basidia
Basidiospore ... Spore borne on a basidium
Basifixed ... Basal
Basil ... Ocimum
Basilar ... Basal
Basket hoop (W. Ind.) ... Croton lucidus
Basket withe (W. Ind.) ... Tournefortea
Basket worm ... Bag-worm
Bassora gum ... A mixture of inferior (bassorin) gums.
Bassorin ... One of the constituents of gums, but slightly soluble in water. Gum-Tragacanth is almost entirely composed of it
Bast ... The outer part of a stem between the cambium and the true bark
Bastard cedar ... Chittagong wood, Chickrassia tabularis
Bastard teak ... Dhak-tree, Butea frondosa
Batata ... Potato
Bath sponge ... Locfah, Luffa ægyptiaca
Batta ... Subsistence allowance
Batten ... A flat slip of wood
Bay ... Laurus nobilis
Bay bean (Bermuda) ... Canavalia obtusifolia
Bay oil ... Oil of leaves of allspice
Bay rum ... Bay oil mixed with rum
Bead tree (W. Ind.) ... Ormosia
Bead tree ... Melia azedarach
Bead vine (W. Ind.) ... Rhynchosia
Beaked ... With pointed outgrowth
Bean (broad) ... Vicia Faba
Beans (cacao) ... Dried seeds
Beans, asparagus ... Dolichos sesquipedalis
Bean, Calabar ... Physostigma venenosum
Bean, cherry ... Cow-pea, Vigna sinensis
Bean, duffin ... Lima bean
Bean, French ... Phaseolus vulgaris
Bean, haricot ... Phaseolus vulgaris
Bean, Hibbert ... Lima bean
Bean, horse (W. Ind.) ... Canavalia ensiformis
Bean, horse-eye (W. Ind) ... Mucuna urens
Bean, Kidney ... Phaseolus vulgaris
Bean, Lima ... Phaseolus lunatus
Bean, ordeal ... Physostigma venenosum
Bean, red (W. Ind.) ... Vigna Catjang
Bean, sacred ... Nelumbium speciosum
Bean, seaside (W. Ind.) ... Canavalia obtusifolia, Vigna glabra
Bean, soja or soy Glycine soja, and G. hispida
Bean, St. Ignatius ... Strychnos Ignatii
Bean, sugar (W. Ind.) ... Lima bean
Bean, sword (W. Ind.) ... Canavalia ensiformis
Bean, Tonka ... Dipteryx odorata
Bean, Tonquin ... Tonka bean
Bean tree ... Australian chestnut
Bean tree (W. Ind.) ... Erythrina
Bean, yam .. Pachyrhizus, Dolichos
Bean, year (W. Ind.) ... Phaseolus vulgaris
Bear tree ... Zizyphus Jujuba
Beatu ... indigo
Beda nut ... Terminalia belerica
Bedstraw ... Galium
Beech, seaside (W, Ind) ... Exostemma
Beef apple (W. Ind.) ... Achras Sapota
Beef wood ... Casuarina
Beet ... Beta vulgaris
Beetles ... A group of insects

Beet root	... Beta vulgaris
Behen oil	... Moringa pterygosperma
Bell-apple (W. Ind.)	... Passiflora laurifolia
Belly-ache bush (W. Ind.)	... Jatropha gossypifolia
Bengal Kino	... Butea frondosa
Bengal quince	... Bael
Began (Ind.)	... Brinjal
Benjamin, gum	Styrax benzoin
Beni seed (W. Af.)	... Polygala butyracea
Benzoni gum	... Styrax benzoin
Benne	... Gingili
Ben nut (W. Ind.)	... Moringa pterygosperma
Ben oil	... do
Ber (Ind.)	... Zizyphus Jujuba
Berberry	... Berberis
Bergamot (orange)	... A variety of the orange
Bermuna grass	Cynodon Dactylon
Berry	... A fleshy fruit, the only hard part in which is the seed or seeds, *e.g.*, gooseberry.
Berry, black	... Rubus
Berry (coffee)	... The seed
Berry, rasp	... Rubus idæns
Berry, straw	... Fragaria vesca
Betel (leaf)	... Piper Betle

Betel nut	... Areca Catechu
Betel pepper	... Piper Betel
Bhabar (Ind.)	... Ischæmum angustifolium
Bhang	... Mature leaves of hemp packed together
Bhat (Ind.)	... Rice
Bheel	... Jheel
Bheel soils	... Peaty soils
Bhindi (Ind.)	... Bandakai
Bhotan pine	... Pinus excelsa
Bhui Mug (Ind.)	... Ground-nut
Bhutta (Ind.)	... Maize
Bicuspidate	... With two sharp points
Biennial	... Lasting two years; collecting stores of food the first, flowering and fruiting the second
Bifarious	... In two ranks
Bifid	... Partly divided into two
Bigha (Ind.)	... 3600 square yards
Bija	... Pterocarpus Marsupium
Bikh (Ind.)	... Aconite
Bilimbi	... Averohoa Bilimbi
Bilobed	... Forked partly into two
Bilocular	... With two chambers
Binate (leaf)	... Of two leaflets
Binh (W. Ind.)	... Bursera
Biology	... Study of life

Reviews.

THE PHYSIOLOGY AND DISEASES OF HEVEA BRASILIENSIS.

BY T. PETCH, B.SC., B.A.,
Mycologist to the Government of Ceylon.
London, Dulau & Co., 1911.

That Mr. Petch's book on the botany and diseases of the great plantation rubber tree of the East would constitute a valuable contribution to the subject was a statement which we should scarcely have hesitated to make before even turning over its pages; that it should be the best book on the general physiology and pathology of rubber yet published was also no more than we had a natural right to expect. We have no hesitation in saying that our expectations are fully justified by the ably written volume before us. Having said so much we have still less hesitation in subjecting it to a careful scrutiny with the object of bringing to the author's attention any defects we may be able to discover. For from defects of some kind the best written book can never be wholly free.

The book is remarkable for the absence of any preface or introduction, so that the author's object in writing it is nowhere explicitly stated. We may therefore be wrong in supposing that he has desired to cater at the same time for the wants of the scientific expert and those of the planter. If this supposition is correct, however, it is scarcely a matter for surprise that the scientific botanist should find in it a good deal that is already familiar, or that the planter should find it necessary, as we anticipate, to apply a good deal of concentration to its persual.

Seventy-nine pages only out of 263 deal with actual fungus diseases. The remainder of the book is devoted to the structure and physiology of Hevea—particularly of its laticiferous system. Tapping experiments and the effect of different tapping systems are discussed at considerable length. Other chapters deal with the merits and defects of prepared plantation rubber, with general questions of sanitation and with various abnormalities. There is also a chapter on the "Art of Experiment" which is, we think, unique in a book of this kind, Whilst welcoming the innovation, we are inclined to fear that its teaching will prove ineffective with one class of readers, whereas for another class it is surely superfluous. It is superflucus for those rare individuals who possess the instinct and training necessary for experimental work; and we greatly doubt whether the mere perusal of such a chapter will be sufficient to induce scientific habits of thought in a mind which is unaccustomed to them. It is true enough that the number of people engaged in experimental work in tropical agriculture greatly exceeds the number of those who are competent to undertake such work; and the kind of work frequently published calls for all the author's strictures. But it is very doubtful whether the delinquents will ever mend their manners or come to publish useful results.

It appears, however, that Mr. Petch's main object in writing this chapter was to educate the critical faculty of the public which reads the published accounts of agricultural experiments. In this enterprise we wish him every success, and we hasten to add that we are in hearty agreement with the majority of his contentions.

There is one point, however, closely connected with the art of experiment in which we cannot entirely exonerate Mr. Petch himself from blame. This is in the matter of premature discussion of incomplete results. Mr. Petch has devoted a good deal of space to the consideration of figures published by Mr. Kelway Bamber and the reviewer in September, 1910. These figures represented the progress during the first eighteen months of tapping experiments begun in June, 1908. An interim report dealing with the further progress of these experiments was published in June, 1911, but they are still far from complete. In the first of these reports which was the only one in Mr Petch's hands at the time of writing, the authors deliberately reserved their own discussion owing to the insufficiency of data. In fact the appearance of these reports was not due to any desire on the part of the authors to rush prematurely into print, but to the exigencies of the public service which demand not only that the tale of bricks should be accomplished, but that this should be accomplished by a suitable display of printed results.

Thus Mr. Petch devotes four pages (pp. 28—32) to a full discussion of the relation of the interval between successive tappings to the question of so-called wound response, based upon figures published in the reviewer's first report. In his second report the reviewer has pointed out a fact which renders the figures entirely misleading from this point of view. The yields from individual trees also lead to a different conclusion from the one naturally drawn when the trees are taken in groups.

We may add that we have on one occasion found just as much (or as little) wound response on passing to a fresh area of bark as at the first tapping of the tree. We would point out, however, a circumstance which does not appear to have occurred to anyone in the course of these discussions, namely, that the opening cut cannot be regarded as in any way comparable with the subsequent paring cuts. The opening cut, for example, draws latex from its upper as well as from its lower side.

On pages 38 and 39 Mr. Petch calculates from our figures that ten trees tapped 440 times in a year and a half yielded about as much rubber as their bark could be supposed to contain at the beginning of the experiment. If we apply the same calculation to the best yielding specimen among the Henaratgoda trees now being tapped, but doubling the postulated thickness of laticiferous bark, we find that this tree yielded in a little over two years five times the amount of rubber present at the beginning of the tapping period. The reviewer's own calculation contained in Circular No. 20 published in June, 1911, in collaboration with Mr. Kelway Bamber, is based upon a much more liberal estimate of the capacity of the laticiferous system. Whichever estimate is adopted, however, we seem to be driven inevitably to the conclusion that rubber is formed afresh in the latex tubes during the process of tapping—that the tree does in fact acquire or possess the faculty of manufacturing rubber in the old latex tubes—a conclusion which Mr. Petch appears to adopt with considerable hesitation.

As regards tapping systems Mr. Petch favours the half-herring bone on successive quarters of the tree, first recommended we understand by Ridley. This is probably the system now most commonly in use. The author is however strongly impressed with the necessity for resting periods in addition, and believes that "Even on the one quarter year system the tree cannot be expected to survive many four year periods if one follows the other immediately." This is a question upon which we should hesitate to give a definite opinion without further evidence, but there can be no donbt that it is best to be upon the safe side.

Mr. Petch shows incidentally that the earlier Henaratgoda experiments were unreliable, probably owing to insufficient supervision, indeed the reliable data in all matters of tapping are so extremely meagre that we cannot help thinking the analysis to which Mr. Petch has subjected it somewhat excessive.

With regard to the structure of the laticiferous system (p. 17) this should rather be stated to consist of a series of concentric networks. So far as we are aware the presence of radial connections between the different layers of latex tubes has not been demonstrated.

The statement that the use of latex to the plant does not lie in the protection which it affords against the attacks of insects appears to be a little dogmatic. Adherents of the theory of adaptation have put forward much more surprising views than this, and their views have been received with almost universal respect.

It is scarcely necessary to recommend the chapters dealing with the actual fungus disease to anyone who is acquainted with Mr. Petch's circulars upon this subject. The two familiar root diseases—Fomes and Hymenochæte—are described together with one which is less common, Sphærostilbe. The three commonest diseases of the stem are well known by the popular names of canker, which has been shown to be identical with the stem and pod disease of cacao, pink disease, for which an earlier scientific name—Corticium salmonicolor—is shown to take precedence of the more familiar *C. javanicum* and die-back. Three other stem diseases are also recorded, one for the first time. In addition to these there appear to exist three leaf diseases.

Perhaps the most important chapter of all from the planter's point of view is the one dealing with general sanitation. The following extract affords material for thought:—"All the root diseases of Hevea, tea, and cacao, which have been investigated with any approach to completeness have been found to originate on a neighbouring stump; in some cases it is the stump of a jungle tree, while in others it is the stump of a tree which has been planted for shade and then cut down. But there is no known root disease of any of the plants mentioned which attacks the plant directly, *i.e.*, by the germination of spores upon the plant; they all require an external base of operations, and this they find in the dead wood of an adjacent stump."

Amongst abnormalities Mr. Petch still attributes the greatest number of cases of the formation of woody nodules to the use of the pricker, an instrument which he does not hesitate to condemn in all its forms. No discussion is however given of those apparently somewhat frequent cases where pricking or other forms of tapping on one side of the tree seem to lead to the formation of nodules on the opposite side.

In conclusion, we may tender to Mr. Petch our congratulations on producing a very interesting book, and one which should be read by all who are interested in the plantation rubber industry.

R. H. LOCK.

THE CULTIVATION OF HEVEA.

BY P. J. S. CRAMER,

Director of Agriculture in Surinam.

Translated by S. R. Cope and A. Content. Amsterdam, 1911.

This is a small but well-illustrated book, based on a journey in Ceylon and the F.M.S. in 1910, and is well worth perusal. It gives a clear and succinct account of the various operations involved in rubber cultivation, such as Clearing, Drainage, Nurseries, Planting, Upkeep, Catchcrops, Diseases, Tapping, and Curing. The accounts of all these are very well and clearly put, and what to do, and what not to do, is brought out. The book may be cordially recommended to the young planter.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 19th July, 1911.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	70s a 75s
Zanzibar & Hepatic ,,	Common to good ..	40s a 72s 6d
ARROWROOT (Natal) lb.	Fair to fine ..	8d a 9d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Sligbtly drossy to fair ...	£6 15s a £6 17s 6d
Bombay bleached ,,	Fair to good	£7 10s a £7 15s
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 7s 6d
Madagascar ,,	Dark to good palisb	£6 10s a £7
CAMPHOR, Japan ,,	Refined	1s 5¾d a 1s 8d
China ,,	Fair average quality ...	155s
CARDAMOMS, Tuticorin	Good to fine bold	2s 4d a 2s 8d
	Middling lean	1s 10d a 2s 1d
Malabar, Tellicberry	Good to fine bold ..	2s 2d a 2s 8d
Calicut	Brownish ..	1s 8d a 2s 2d
Mangalore ,,	Med brown to fair bold	2s 3d a 3s 2d
Ceylon, Mysore ,,	Small fair to fine plump	1s 8d a 3s
Malabar ,,	Fair to good ...	1s 8d a 1s 10d
Seeds, E. I. & Ceylon ,,	Fair to good ..	1s 11d a 2s
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d
CASTOR OIL, Calcutta ,,	Good 2nds .	3½d a [illegible]⅝d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	40s a 45s
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts	Good to fine quill	6½d a 1s 5d
per lb. 2nds	,, ,,	5¾d a 1s 4d
3rds	,, ,,	5d a 1s
4ths	,, ,,	4½d a 8½d
Chips, &c..	Fair to fine bold	2¼d a 3d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1s 2d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	7d a 7⅛d
Stems ..	Fair	3d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	70s a 113s
Native	Good ordinary	
Liberian ,,	Fair to bold	60s a 65s
COCOA, Ceylon Plant. ,,	Special Marks	70s a 85s 6d
	Red to good	65s a 69s
Native Estate ,,	Ordinary to red	40s a 62s
Java and Celebes ,,	Small to good red	25s a 77s
COLOMBO ROOT ,,	Middling to good	20s a 25s
CROTON SEEDS, sift. cwt.	Dull to fair	47s 6d a 55s
CUBEBS ,, ,,	Ord. stalky to good	190s a 200s
GINGER, Bengal, rough ,,	Fair	35s nom.
Calicut, Cut A ,,	Small to fine bold	80s a 85s
B & C ,,	Small and medium	60s a 70s
Cochin Rough ,,	Common to fine bold	40s a 42s 6d
	Small and D's	40s
Japan ,,	Unsplit	36d
GUM AMMONIACUM ,,	Ord. blocky to fair clean	40s a 67s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£15 a £16
	,, ,, little red	£12 a £14
	Bean and Pea size ditto	75s a £12 10s
	Fair to good red sorts	£7 10s a £10
	Med. & bold glassy sorts	£5 a £7
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d nom.
Turkey sorts ,,		47s 6d a 60d
Ghatti ,,	Sorts to fine pale ...	20s a 42s 6d nom.
Kurrachee ,,	Reddisb to good pale ...	20s a 30s ,,
Madras ,,	Dark to fine pale ...	15s a 25s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£18 10d a £21 5d
	com. stony to good block	25s a £15s
KINO	Fair to fine bright	9d a 1s
MYRRH, Aden sorts cwt	Middling to good	55s a 60s
Somali ,,	,, ,,	50s a 52s 6d
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	35s a 40s
pickings ,,	Low to good pale	12s 6d a 27s 6d
siftings ,,	Slightly foul to fine	20s a 22s 6d
INDIA RUBBER lb.	Fine Para bis. & sheets	4s 11d
	,, Ceara ,, ,,	4s 6d
Ceylon, Straits,	Crepe ordinary to fine..	4s 9d a 5s
Malay Straits, etc.	Fine Block ..	5s
	Scrap fair to fine ..	3s 10d a 4s 4d
Assam	Plantation ..	3s 6d
	Fair II to ord. red No. 1	2s 9d a 3s
Rangoon	,, ,,	2s a 2d 9s

	QUALITY.	QUOTATIONS
INDIARUBBER. *(Contd.)*		
Borneo	Common to good	1s 6d a 2s 2d
Java	Good to fine red ..	2s 3d
Penang	Low white to prime red	1s 8d a 2s 6d
Mozambique	Fair to fine red ball ...	3s 6d a 4s 1d
	Sausage, fair to good ..	3s 6d a 4s 1d
Nyassaland	Fair to fine ball ...	3s 4d a 3s 11d
Madagascar	Fr to fine pinky & white	3s a 3s 4d
	Majunga & blk coated ..	2s 1d a 2s 6d
	Niggers, low to good ..	8d a 2s 10d
New Guinea	Ordinary to fine ball ..	2s 6d a 3s 6d
INDIGO, E.I. Bengal	Shipping mid to gd violet	3s 2d a 3s 8d
	Consuming mid. to gd.	2s 8d a 3s 1d
	Ordinary to middling	2s 5d a 2s 8d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	None here
MACE, Bombay & Penang	Pale reddish to fine	2s 3d a 2s 6d
per lb.	Ordinary to fair	2s a 2s 2d
Java	,, ,, good pale	2s a 2s 4d
Bombay	Wild	4d a 5d
MYRABOLANES, cwt	UG and Coconada	4s 6d a 5s
Bombay ,,	Jubblepore	4s 6d a 6s 3d
	Bhimlies	5s a 6s 6d
	Rhajpore, &c.	4s 6d a 5s 9d
Bengal ,,	Calcutta	4s a 5s 6d
NUTMEGS— lb.	64's to 57's	10d a 1s 2d
Singapore & Penang ,,	80's	6½d a 7d
	110's	5¼d
NUTS, ARECA cwt.	Ordinary to fair fresh	17s 6d a 20s
NUX VOMICA, Cochin	Ordinary to good	8s 6d a 9s 6d
per cwt. Bengal	,, ,,	7s a 7s 6d
Madras	,, ,,	7s a 8s 6d
OIL OF ANISEED ,,	Fair merchantable	4s 10d
CASSIA ,,	According to analysis	3s 3d a 3s 7d
LEMONGRASS ,,	Good flavour & colour	4½d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2d a 1s 4d
CITRONELLE ,,	Bright & good flavour	11d
ORCHELLA WEED—cwt		
Ceylon ,,	Fair ...	10s
Madagascar ,,	Fair ...	10s
PEPPER – (Black) lb.		
Alleppy & Tellicherry	Fair ...	5d
Ceylon ,, ,,	,, to fine bold heavy ..	5d a 5¼d
Singapore ...	Fair	4¾d
Acbeen & W. C. Penang	Dull to fine	4¾d a 5d
(White) Singapore ,,	Fair to fine	7⅜d a 9d
Siam ,,	Fair	7¾d
Penang ,,	Fair	6⅝d
Muntok ,,	Fair	8½d
RHUBARB, Shenzi ..	Ordinary to good ..	1s 2d a 2s 6d
Canton ..	Ordinary to good ..	10d a 1s
High Dried..	Fair to fine flat ...	8½d a 9½d
	Dark to fair round ..	5½d a 7½d
SAGO, Pearl, large ...	Fair to fine	18s a 19s
medium ..	,, ,,	17s a 18s 6d
small ...	,, ,,	14s a 15s
SEEDLAC cwt.	Ordinary to gd. soluble	52s 6d a 72s 6d
SENNA, Tinnevelly lb.	Good to fine bold green	4½d a 7d
	Fair greenish	2½d a 4d
	Commonspeckyand small	1¼d a 1½d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ...	70s a 12 7s 6d
Bombay ,,	,, ,, ...	40s a 150s
Mergui ,,	,, ,, ..	£10 5s a £13 5s
Manilla ,,	Fair to good ..	£8 5s a £141 2/6
Banda ,,	Sorts	21s 6d a 29s 6d
TAMARINDS, Calcutta...	Mid. to fine bl'k not stony	10s a 12s
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	8s a 30s
	Pickings ..	8s 6d a 19d
TURMERIC, Bengal cwt.	Fair .	20s
Madras ,,	Finger fair to fine bold	25s a 27s
Do. ,,	Bulbs [bright	20s
Cochin ,,	Finger ..	18s
	Bulbs ..	14s
VANILLOES— lb.		
Mauritius .. } 1sts	Gd crystallized 3½ a 8½ in	14s a 19s
Madagascar ... } 2nds	Foxy & reddish 3½ a ,,	13s a 15s 6d
Seychelles ... } 3rds	Lean and inferior ...	12s 6d a 13s
VERMILLION ..	Fine, pure, bright .	3s
WAX, Japan, squares	Good wbite hard ...	40s

THE SUPPLEMENT TO THE

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THE PRODUCTION OF TEA IN CEYLON.

THE PRESENT YEAR'S SHORTAGE.

The *Financier* has been collating some figures relating to the production of tea and gives the following as showing what has taken place within the last fifteen years.

Additions to Acreage.

	1895 to 1899.	1900 to 1904	1905 to 1909.
India	115,000	9,000	30,000
Ceylon	89,000	11,000	6,000
Total acres added	204,000	20,000	36,000

Additions to Crops.

	1895 to 1899.	1900 to 1904.	1905 to 1909.
	lb.	lb.	lb.
India	47,000,000	40,000,000	41,000,000
Ceylon	45,000,000	29,000,000	32,000,000
Total	92,000,000	69,000,000	73,000,000

Average Yield Per Acre.

	1899.	1904.	1909.
India	353 lb.	423 lb.	473 lb.
Ceylon	343 lb.	408 lb.	486 lb.

Total Purchased Outside the United Kingdom.

1900.	1905.	1910.
85,000,000 lb.	142,000,000 lb.	186,000,000 lb.

Not including what is now used in India estimated to be between 10,000,000 and 12,000,000 lb. annually.

Average London Value.

1898.	1900.	1905.	1910.
8½d	7¼d	7⅝d	8⅜d

1898, the combined output was 278,000,000 lb.
1900, ... 346,000,000 lb.
1910, ... 450,000,000 lb.

On the question of the future production of Ceylon our contemporary enquires if the decline in Ceylon's returns from estates now planted with Rubber will be made good by new planting in Uva or other places where even small plots of land can be utilised. The total area interplanted with tea and rubber, as given in the Ceylon Directory, is approximately 75,000 acres and in quite 40,000 acres of that it is anticipated the older cultivation will ultimately have to go. There is a certain amount of opening up for tea going on, chiefly in the Uva and Sabaragamuwa provinces, but the acreage of those extensions comparatively speaking, is infinitesimal. Uva has gone through a serious drought. Not a drop of rain fell for months but now good rains are being measured and the shortage in crops is being reduced. Most of the producing districts reported bumper outputs during the first two or three months of this year, but since April there has been a gradual falling-off and though bushes now are flushing freely our exports to September 4th show that we have exported 2,901,397 lbs. less than last year to same date.

RUBBER TAPPING CUPS.

There is seemingly no end to the varieties of Rubber Tapping Cups now on the market. Tin, Aluminium, Glass, and Papier Mache are among the substances these are made of, but the experience in Ceylon and in the Straits is that there is really nothing to surpass the coconut shell for the purpose. The objection to the tin cup is that it soon rusts; the aluminium stands little usage, and while the earthenware and glass ones have been found suitable and easily kept clean, breakages and the predilection the cooly shows for annexing them to his own use make them expensive. The coconut shell has not the same attraction for the cooly. It is cheap, has been found durable, and after being washed once or twice can be easily kept clean. In some districts a small cadjan hut is built in various parts of the estate, When the shells are ready for cleaning, water is boiled at the nearest hut in a kerosene tin and the shells washed. This adds another to the 169 uses to which the coconut can be put!

THE SOYA BEAN *VS.* THE COCONUT.

The possibility of the oil of the Soya Bean becoming a substitute for Coconut Oil has not given rise to much anxious thought among those interested in the Coconut Industry in Ceylon. The Soya Oil cannot be put to many of the uses for which our product is particularly suitable and for which almost every hundredweight of copra now produced has an assured demand. But when the price of copra mounts up substitutes come into use of necessity, and a New Zealand soap-manufacturer who has been visiting a number of the soap factories in England and on the Continent tells us he saw Soya bean in frequent use in the industry. In one large factory he went through Coconut Oil had quite given place to the Soya, but that he put down to the scarcity of Copra and the high prices for it now ruling. His opinion is, that Copra with its 66 per cent production of oil, which is being converted in large part into comestible fats, has nothing to fear from the Soya bean which produces only 16 to 18 per cent of an oil which is restricted in its uses.

TEA DRINKING IN FRANCE.

Analytical Laboratory, 79 Mark Lane, London, E.C., August 18th, 1911.

Dear Sir,—I have just returned from a somewhat extensive holiday tour through Brittany including Brest and St. Brienc on the North to Quimper, Concarneau, Carnac, Auray, Lorient, Quimberon, Belle Isle and Vannes on the South.

It was very interesting to note how the taste for tea has increased in France and that it was drunk apparently at all times of the day from the early morning instead of the usual coffee until late at night, in the place of wine, beer and cider.

It is wonderful how tea seems to have become so popular notwithstanding the very indifferent manner in which the infusion is prepared.

Instead of taking care that the water shall be freshly boiled and the tea-pot first warmed by rinsing with such boiling water before adding the tea, it would appear that the usual practice is to use simply ordinary warm water and instead of allowing one tea-spoonful for each person and one for the pot to put only about one tea spoonful for the pot of water.

As a consequence, the infusion when poured out has a pale yellow appearance like straw water, instead of the usual brown colour of well made tea.

Tea in France is drunk with a lump of the square beetroot sugar but no milk is added.

Notwithstanding the crude method of preparation tea is becoming popular even with the untravelled French, but in Auray in the Café of the Pavilion Hotel, which is a most excellent and comfortable one, I had a very practical illustration that Frenchmen who have travelled in England know quite well what good tea should be, for after remonstrating with the head waiter in respect of the inferior quality, he simply advanced to the edge of the pavement in front of the Hotel and poured the whole contents of the tea-pot on to the road, and then requested that a fresh pot should be prepared in the proper way and of the usual strength, which was done, the on-lookers like myself being much amused.

I submit that in order to promote the popular introduction of tea into coffee drinking countries, it would be most advisable that the packets of tea, whether 1 lb., ½ lb. or ¼ lb. in weight should in each case contain the necessary detailed instructions in the language of the respective country, how tea should be infused and prepared for drinking purposes; so that the pleasant properties of this refreshing beverage may be appreciated to the fullest extent by those who may be tasting it for the first time.

JOHN HUGHES.

SEA ISLAND COTTON AND ST. VINCENT SOILS.

Dear Sir,—Sir Daniel Morris in his recent lecture on agricultural progress in the West Indies at the Royal Colonial Institute mentioned that Sea Island Cotton had been produced in the Island of St. Vincent with particular success, and he stated that he thought such success must be due to some peculiarity of the soil.

In 1890, at the request of Sir Daniel Morris, I made some very careful analyses of ten samples of soil from St. Vincent in order to see whether poverty of soil constituents would account for the low quality of arrowroot then produced in St. Vincent.

The results of these analyses were referred to in the "Kew Bulletin" for August, 1893, page 198, and it may be of interest to republish three of the analyses then made in order to show that soils, which were incapable of producing satisfactory returns in arrowroot, have been found particularly adapted under favourable climatic conditions to the production of Sea Island Cotton.

Analyses of St. Vincent Soils.

Composition as dried at 212°f.

	No. 1	No. 2	No. 3
a Organic matter and combined water ..	2·650	3·520	1·900
Oxides of iron ..	5·440	8·185	6·150
Alumina ..	8·900	8·175	6·290
Lime ..	2·298	2·296	2·558
Magnesia ...	·756	·.54	·345
Potash ..	·062	·111	·042
Soda ..	·286	·287	·261
Phosphoric acid ..	·025	·070	·051
Sulphuric acid ...	·020	none	·054
Carbonic acid ..	·300	·98.	·200
Chlorine ...	·001	·007	·003
b Silica and insoluble silicates .	79·264	75·815	82·151
	100·000	100·000	100·000
a Containing nitrogen	·090	·079	·068
b ,, Coarse sand separated by washing	36·320	38·290	45·000

These soils are well supplied with lime, but are very deficient in nitrogen, phosphoric acid and potash.

Such soils possess a good mechanical condition and admit of being easily cultivated while they would certainly respond readily to dressings of suitable manure.

It is interesting to compare the above results with an analysis of a ferrugineous sandy soil actually growing cotton in the territory of Ibadan, Lagos, West Africa, sent me by the late Sir Alfred Jones, particulars of which will be found on page 195 of the *Tropical Agriculturist* for September, 1904.

The important constituents exist as follows :—Nitrogen ·06, phosphoric acid ·06, potash ·07, lime 1·12 per cent.

Here again the figures are low with the exception of lime, which is present in fair proportion.

It appears, therefore, that Sea Island cotton can be satisfactorily produced on naturally light sandy soils provided the climate be favourable.

Sir Daniel Morris has kindly forwarded a letter of inquiry to Dr. Francis Watts, the Commissioner of Agriculture for the West Indies, who writes me from Barbados under date of March 21st, that "the general impression is that the fine quality of the St. Vincent Sea Island cotton is due in a large measure to the moist climate and the light friable soils of the Colony."

It is, I think, of great importance when suggesting the trial of a new crop to be able to produce reliable information as to the kind of soil upon which such crop has been found to flourish in other localities, and the above results have been put together with a view of affording practical information as to the kind of soil upon which cotton such as Sea Island has been found to produce satisfactory results.—Yours faithfully,

JOHN HUGHES,
Agricultural Analyst, 79, Mark Lane,
London, E. C.

REMARKABLE HEAT IN LONDON.

CONTRASTS WITH INDIA AND CEYLON.

Dr. Hugh R. Mill, who was lately on a visit to Ceylon, reports to the London *Times* that August 9th was the hottest day of the present summer, and of the 54 summers of which records are kept in his office. We quote from his report, in which, it will be observed, he has a reference to "Colombo":—

"The temperature at 9 a.m. today was 78·7 degrees and it rose so rapidly that by 9-40 a.m. the thermometer read 83·0 degrees, by 1 p.m. 95·0 degrees, by 1-50 p.m. 96·7 degrees, 1½ degree above the highest previously recorded, and at 2-15 p.m. 97·1 degrees, almost 2 degrees beyond the reading for the hottest day previously known. At 3 p.m. the reading was 95 8 degrees, at 4 p.m. 95·0 degrees, and at 5 p.m. 93 1 degrees. A temperature of 97·1 degrees was put on record at Greenwich Observatory in July, 1881, when the temperature at Camden-square was 94·6 degrees.

"The highest temperature of all days in the last 54 years when the temperature reached or exceeded 93 degrees are given below, the reading being made in each case from a *maximum* thermometer in the shade mounted on a Glaisher stand similar to that in use at the Royal Observatory, Greenwich, but differing from the standard Stevenson screen, which usually gives temperature readings from 1 degree to 2 degrees less extreme.

"*Maximum* temperatures above 93 degrees recorded at Camden-square :—

	Date.	*Max.* Tem. degrees.
1868	July 21	93·3
	July 22	93·2
1881	July 15	94·6
1893	August 18	93·6
1900	July 16	95·2
	July 19	93·4
	July 25	94·0
1906	August 31	93·2
	September 2	94.0
1911	August 9	97·1

"It is interesting to observe how little effect on the routine of daily work in London is produced by a temperature which would be considered high in Calcutta (when no tourist or newcomer from home was within hearing), and which has, I believe, never been reached in Colombo."

Dr. Mill is right that the maximum shade temperature (97·1 degrees) he records for August 9th in London is higher than Colombo's maximum record which is 96·1 degrees (on March 12th this year); but strangely enough, Kandy, 1,654 ft. above sea level, had 96·2 degrees in April 1889, and Galle on sea level, 96·7 degrees in April 1906; while other stations on our sea coast South-East, East, North and North-West greatly exceeded Colombo until the maximum for the island is Trincomalee at 103·7 degrees in May 1890—the next being inland Anuradhapura with 103 degrees in September, 1887. (In the sun Colombo shewed up to 148·5 degrees; Anuradhapura 166·8 degrees, highest for the island.) At our Sanitarium, 6,200 feet altitude, the maximum shade, temperature recorded is 81·6 degrees on May 16th, 1892 ; minimum 28·2 degrees on Feb. 6th, 1904. The minimum for Colombo is 65 degrees on February 3=4 1904 and for Kandy 49·5 degrees on June 25th, 1890. It may be of interest to mention that the maximum temperature recorded for Bombay is 100·2 degrees ; for Calcutta 105·3 degrees, and for Madras 112·9 degrees ; but in the *Pioneer* of June 4th, 1895, there appeared a "statement of the absolutely highest temperature recorded throughout India for each of the 19 years 1876 to 1894." The list included the stations which we quote with the highest records and appertaining dates, namely, Sialkot 120 degrees in June, 1876; Jacobabad 123·5 degrees in June, 1889 ; Agra 120·3 degrees in June, 1878 ; Lahore 119·5 degrees in June, 1880 ; Pachpadra 123·1 degrees in May, 1886 ; D. I. Khan 121·5 degrees in June 1883. Our contemporary adds a warning that "thermometers only a few yards apart may give very divergent results if the methods of exposure are different." Consequently care must be taken in making comparisons between different stations ; but as the figures quoted above for India and Ceylon are those recorded for scientific purposes, it may be accepted that the thermometers were exposed under exactly similar conditions. So that 121 to 123 degrees may be taken as the average maximum heat experienced in India; and 95·8 to 103·7 degrees for the lowcountry of Ceylon and for the "hill-country" we have 96·2 degrees Kandy, 84·5 degrees Badulla; 79 degrees Hakgalla and 81·8 degrees Nuwara Eliya as recorded maximum temperatures. But the great difference between Colombo 95·8 degrees and Jacobabad in the Punjab 123·5 degrees is that the latter has a bracing winter season with corresponding temperature, while our city, 7 degrees from the equator, is always hot, and its recorded minimum is only 65 degrees; and again when we regard a sudden wave of heat, and one afternoon's spurt of 97 degrees for an hour or two (?) in London, the experience is a very brief one contrasted with a tropical hot season. But, on the other side, the mode of life, the clothing and the dwellings in the United Kingdom are, as a rule, quite unsuited for conditions recorded for London by Dr. Mills for this month of August, 1911. What this heat wave meant, however, is shown by the infantile death rate running up to about 65 per cent. The heaviest infant mortality in Colombo, in the worst Pettah quarter, is about 50 per cent.

BRITISH NEW GUINEA.

CHEAP COCONUT PLANTING.

Mr W H M Davies favours us with an interesting article which appears in "The British Exporter" for August under title of "A Tropical Land of Promise." Some of the opportunities, and advantages offered by British New Guinea. The reference to coconut cultivation is certain to interest local planters, more especially the figures relating to the cost of planting and upkeep, &c., which appear to he ridiculously low.

"A recent return showed that the plantations, in the order of their importance, were devoted to

COCONUTS, RUBBER, SISAL, HEMP AND COFFEE.

Coconuts, indeed, seem to grow in profusion and tho trees bear all the year round. In order to encourage the natives and to prevent them degenerating into mere hangers-on of the settlements and ports, they are compelled to plant coconuts for their own use, and it has been estimated that as many as 350,000 acres are devoted to this purpose. The average is stated to be 100 trees to the acre. The cultivation of coconuts should prove exceedingly profitable by increasing the supply of and, therefore, the demand for, the nuts themselves, and also for the dried nuts or copra. One advantage of the coconut industry is that it does not require anything like as much personal attention as the growth of rubber plants. The copra is produced by the natives with very little trouble.

THE YIELD OF COCONUTS

from New Guinea should steadily increase, and should also be relied on. The trees yield when five years old, and in three or four years more are bearing heavily. When full grown each should produce about sixty nuts a year, and with even as low as fifty trees to the acre, all giving this average yield, the result should be about half a ton of copra.

The copra market has one great advantage from the producer's point of view and as the demand is greater than the supply and there are consequently no serious fluctuations in the price. The producer, therefore, has the advantage of knowing what he will get for his yield.

Coconut trees give the best results when planted in good alluvial soil along the banks near a river mouth or near the sea.

THE TOTAL EXPENDITURE

on a plantation of 500 acres, beginning with clearing the land of the virgin forest and until the trees are yielding at the end of their sixth year, is officially estimated at £6,450, inclusive of lahour, plants, maintenance, houses and a liheral allowance for contingencies. The seventh year should see a yield of forty nuts to the tree, which in the ninth year should be increased to sixty nuts. This would produce about 300 tons of copra. The trees, if healthy, will live for over sixty years, and as they bear continuously, the profits on the original outlay should be very considerable. It is not necessary, however, that the would-be planter should start with so large an area as 500 acres. He can make a beginning with less than 100 if he wishes, and he has the satisfaction of knowing that the proportion of expense and yield per acre is about the same.

ANOTHER INDUSTRY

which is expected to develop considerably in Papua is the growing of the cacao or cocoa tree. But this is somewhat more expensive, and much more labour is required. Comparatively little has been done in this direction as yet."

SCARCITY OF CINNAMON IN CEYLON.

With the extension of ruhber and coconut cultivation in Ceylon, owners of cinnamon plantations in suitable localities have found it to their advantage to root out cinnamon, and plant either rubber or coconuts. It hardly pays the cinnamon planter to continue cultivation of the product at existing prices, and a good many of them have substituted the more remunerative products. This is especially noticeable in the Southern Province, where ruhber is replacing cinnamon, and in the Negombo district, where coconut cultivation is being extended. As a result of all this, there is a scarcity of cinnamon in the market just now. To make good the deficiency in the European market, cassia bark, imported from China, is being used as a substitute. Cassia bark is said to have a stronger and somewhat coarser flavour than cinnamon, and is coming to be much appreciated. According to the American Consul at Colombo, it is not improbable that it will swamp the cinnamon trade completely, if the cultivation of the latter is not encouraged. A rough estimate places the acreage of cinnamon cultivation in the island of Ceylon at 45,000 acres.—*Society of Arts Journal*, July 28. [That is the "Directory" estimate made some years ago: it may have to be revised a little if Rubber and Coconuts have encroached. —A. M. & J. F.]

THE HEALTH OF SUPERINTENDENTS AND COOLIES.

The maintenanco of health on eastern plantations is a subject most Company Directors have had to oonsider within the last year or two. Good health among both Superintendents and coolies is absolutely essential if shareholders are to profit to the fullest from their properties, and many of the annual reports recently issued show that great improvements in the housing arrangements are being effected, in better bungalows for the Europeans and more up-to-date and more sanitary lines for the labour force. The Planters' Association in Ceylon is fully awake to the importance of a healthy labour force and has offered a prize of R250 for the best practical essay on "Cooly Lines, how to build and how to keep sanitary." In the F.M.S. labour is better housed generally than ever before, the favourite type for new lines being one with raised floors supported on brick pillars and corrugated iron roof, and plans have been adopted which must be conformed to in the building of lines in future.

The most highly approved lines, however, are of little avail if the cooly is allowed to disobly the most ordinary laws of Hygiene, and it remains for the Superintendonts and their assistants to see that the coolies regularly and carefully carry out a thorough clean-up of their lines and surroundings. Mr Wallace Westland gives us a few hints or how this has been done in British New Guinea and the results obtained are truly remarkable.

In New Guinea.

Referring to the health of his labour force Mr. Westland remarked that he had to thank Sir Allan Perry for the present condition of things on his estate, for while coolies round about were dying off fast from dysentery and fever his own

COOLIES WERE QUITE FREE

and not a single case of fever has he had to report during the last eight or ten months—in fact not since Sir Allan Perry's advice in the matter was followed. The whole crux of the situation is

SANITATION.

Every day the lines and surroundings Mr. Westland reports, are carefully cleared and all rubbish removed and burned. Once a week the cleaning is of more thorough order, and after the scavenging brigade has done its duty the sanitary brigade sprays the place with disinfectant powder while another gang follows with a sprinkling of quicklime. This keeps the lines sweet and clean, but further precautions are taken.

A GOOD WATER SUPPLY

is necessary and every house has its own water pipe laid on. Latrines are provided and must be used. The lines, too, are only used for a couple of years or so when the coolies are moved on to a new set and the old ones are burned down. The old site is not built on again for perhaps a year or two during which time it is allowed to fallow as it were, and plantains may be grown on it.

Each cooly on his arrival on the estate is provided with

A BLANKET AND A MOSQUITO NET.

The mosquito net must be used and even should a cooly be sent to a neighbouring estate with a letter he must take his net with him if he has to remain away the night. These nets are cheaply produced, being made of hemp.

The coolies are not huddled together in lines as they are in Ceylon. Their accommodation is much more spacious and almost every one of them has his little piece of garden, in which he cultivates vegetables. On Sundays a regular marketing goes on when the cooly disposes of the produce of his plot.

IN JAVA

the cooly gets even more attention. There, many estates have a theatre in which a bioscope exhibition is held for the coolies' edification or which native touring theatrical companies may occupy. This entertainment of the cooly costs some estates a considerable amount of money but, as Mr. Westland points out, the estates are prepared to meet the expense when it means a settled and contented force.

We would now give the following which was contributed to our daily paper by a Peermade (South Indiau) planter. It contains very practical and valuable instructions on the treatment of sufferers from fevers and should be carefully studied by all planters :—

Fever.

SOME PERSONAL EXPERIENCES: HINTS TO PLANTERS ON TREATMENT OF COOLIES.

Some personal experiences of fever, which is painfully to the fore just now, may not come amiss. I think this is my only excuse for presuming to dilate upon the subject, writes a Peermade Planter to us, for I am no medical authority, only a humble planter but one who writes from his own painful personal knowledge of the disease. When one has suffered from it oneself and seen a hundred coolies daily down with it and doctored most of these coolies oneself for some years, one may fairly consider, it seems to me, that one knows something about fever.

THE CAUSES OF FEVER.

So much by way of proface ; to come to the subject itself, first a word, diffidently, as to causes. It seems to me that too much is often put down to mosquito and too little to other causes. In my own case, as far as I could see, the former had nothing to do with the outbreak, but perhaps it was not genuine malarial fever. I do not know, I can only say that the symptoms were: first ague, the patient shivering for 1 hour on the average, then high temperature and finally profuse perspiration and an after headache. The patient would be left very weak and the body would ache, especially the legs. The attacks recurred at regular intervals. These are symptoms of what?———being no doctor, I cannot say, but at least they resemble malaria. Excluding mosquitoes, which were not in evidence at the time of the outbreaks, I put down the fever to climatic conditions and to situation of the estate I was on, in a river valley at an elevation of 2,000 feet above sea-level.

The Fever Season.

The time of year at which the fever occurred was generally in April, May and up to mid-June, starting with the first heavy showers of the little monsoon. These seem to have a bad effect on the soil previously baked by a fierce sun from beginning of December to mid-April. At night as a result, a heavy damp 'miasmic' mist would surround the lines, the atmosphere at the same time being so oppressive that coolies slept in the open verandahs and so caught chills. Here is one cause of fever, I think. That in my case the fever was due to the weather and not to the malaria mosquito seems to me to be proved by what happened this year. There was practically no fever. Instead of the usual heavy showers in April and May, those 2 months were quite dry and unusually cool. When the rain did come it was the heavy downpour of the big monsoon, the sun vanished and the temperature dropped. There was not the combination of extreme heat, afternoon rain and subsequent fierce morning sun usually experienced which, together with the mist, invariably produced bad outbreaks of fever in the past I should like to know if other of your readers have not found this to be the case. It certainly seems to be that if you can avoid the peculiar weather condition of April and June—mosquito or no mosquito—you will have little fever, other things being favourable.

Treatment of Fever.

So much for the causes. I now come to what I humbly hope to be the more valuable and practical part of this article, my own experiences in treating the disease amongst my estate coolies. The natural unavoidable conditions, which no man can alter, were, as stated above, when I first met with fever. My predecessor had done his best to combat the evil in every way possible.

He had good wells where previously the water supply had been stagnant river water: in the worst months he gave his coolies who were working at a distance from the wells hot tea, "red leaf,"—and jaggery, so that they should not drink from the filthy puddles that were all that remained of streams.

He moved his lines from a hollow where no breeze ever came to sweep away evil vapours to a healthier higher position where the breezes of the S.-W. could have full play. His lines too were built 'pukka.' More he could not do: he could not dispel the mist or cool the fierce sunrays, but what he did had good results; previously coolies had died in tens every fever season, now only one or two deaths occurred during the whole period, but still there was fever when I came. So 100 coolies daily would be "sick." I did what I could, as anyone must have done I think, but no one will expect me to say I banished the malady. I only hope I may say that I lessened it. The weapons I fought with were:

- Bi-sulphate of Quinine in powder and pills,
- Eastons Syrup, a tonic of the best,
- Phenacetin.
- "Slops," Bovril and Sago, as a change of diet to rice.

Also, as far as possible, I managed to get my work and my coolies' work done in the cool of the morning and evening 5—11 and 3—6 as I found from my own experience when I myself joined the victims, that the fierce noon and early afternoon sun was positively dangerous in the weak state one gets in consequent on fever.

Medicines Employed in Treatment.

I add a few notes on the medicines mentioned before

Quinine.—*B. Sulp.* seemed to be most effective. Sulp. simply, not strong enough. A good way of administering it, which all may not know of, is in gelatine capsules containing 8 grns. These do away with the bad taste of quinine in the mouth, and are easily dissolved internally. A dose for 1st attack 8 grns. for 2 or 3 days: if no improvement 16 or 20 until cured and then 8 grns., say every three days for two months to prevent recurrence. In my own case 8 grns. was always sufficient to cure, and after taking it at regular intervals I had no more fever. With the cooly, of course, his weaker stamina, lack of nourishing diet and low spirits (he often makes up his mind he is going to die at the outset in this or any other illness) retard recovery. The gelatine capsules I found enabled one to carry (say) 100, 8-grn. doses about always in the pocket in a bottle.

Phenacetin—of course, as a prevention of the splitting headache that is the aftermath of an attack of fever and cools the heated blood by inducing a heavy perspiration.

"Eastons Syrup"—as a tonic after attacks. The cooly I found often developed swellings all over as result of after weakness, and the way in which a dose or two of this tonic removed all traces of swelling absolutely astonished me at first. Coolies had faith in it, too, which is saying a lot—and asked it first in preference to anything else. Quinine they did not like, though they used to have to swallow it in my presence, owing to the headache and loss of appetite due to after bad taste in mouth that invariably results.

The regular administration of Bovril and sago too, cannot be too strongly recommended and one thing which is sometimes done, but I did not do, seems to me the best measure of all——to have a line set apart as a hospital with the most reliable person or persons obtainable detailed to administer medicines regularly. This has the advantage of saving the superintendent's time, if, as in my case, he has to do all the dosing himself having no dispenser or assistant; and also it ensures the medicine being taken, coolies otherwise, being given it at muster, take it to the lines and there often do not avail themselves of it.

PRECAUTIONS TO BE OBSERVED.

To conclude these sketchy remarks which, I hope, will be of interest to some and possibly of assistance, too, I give the following 'tips' as the results of my own experience and as advice to those who do not already know of 'em. Live away from the riverside, out of the mist if possible and, if a European, sleep with windows shut at certain times of year. Avoid going out in the sun after 10 or 11 a.m. and before 3 p.m. Be careful about what you drink and "look after yourself" in the way of food. If in a low lying part carry an umbrella always in addition to a topee (if a European.) Whether you have actually had fever or not, take 8 grns. quinine once a week regularly from April to end June. Sleep off the ground and take occasional opening doses. Do not bathe in cold water. Lastly, and most important, do what you can to keep yourself from thinking too much about it, whether you have fever or not. Keep your spirits up, but not by pouring spirits down.

The publication of the above brought us the following useful contribution.

Chills and Resultant Fever.

AN CEYLON LADY'S VALUABLE HINTS.

DEAR SIR,—I read with great appreciation the article on "Fever" by a Peermade planter, which appeared in your valuable paper last week, and also the letters it evoked.

But it seemed to me that the whole reliance was placed on drugs, and that, perhaps, a few supplementary words on *treatment* and *diet* might not be superfluous. For myself I abjure drugs as far as possible, and though it may not perhaps be possible to do much for coolies in the way of treatment *en masse*, they might be enlightened in very few words as to the general lines to be followed when illness sets in.

COLD STAGE :

Thus : Go to bed and cover with blankets
Hot drinks of rice cungy water
Eat nothing
Hot bottle to feet
A little castor oil.

HOT STAGE :

Sip cool drinks of cungy water
Sponge face and hands
Keep still in bed.

Moreover there are the masters themselves, the planters, to consider, and many of them suddenly attacked by illness do not recognise which symptoms are serious, or why, and are utterly at sea as to what should be done.

Last week a learned Judge even said in my presence :—"I really cannot see how it is a chill works such harm. It certainly often has serious consequences, but I am blest if I can tell how it acts on one."

Well,—This is one of the things that are often "hidden from the wise and prudent," but as it is revealed unto this Babe I will—if he and others will condescend to listen for a few moments—try to make the reason very clear.

In every living organism there must of necessity be waste constantly forming. This waste must positively be got rid of and pass out of the system as fast as formed if one would keep in health. This waste or impurity is caused in a variety of ways : partly from the unassimilated debris of the food we eat, partly from the attrition of the muscles when in use, partly the impurities from the air we breathe—in fact every cellular tissue is constantly receiving new matter and depositing old waste substances.

These waste matters must be got rid of daily by various organs which we may call the organs of elimination. Chief of these are the skin, the liver, the kidneys and the intestines.

As much as *two and-a-half to three pints* of waste matter will exude in perspiration conscious or unconscious, by the skin, during the 24 hours.

The liver deals with a huge mass of carbonaceous matter which is separate from the blood, and if the action of the liver cease only for a day the yellow skin alone shows the retention of bilious matter.

The kidneys are the blood-filters, and by them another two and-a-half to three pints of waste nitrogenous matter, salts and minerals should be separated from the blood in the 24 hours. These poisons if retained, *poison the blood to putrefaction, and paralyse the brain.* Of all excretions this is the most important to observe, as it is deleterious when suppressed and with so much quicker effect than that of the others.

Now suppose you get a chill, perhaps you travel up from the plains to the hills without changing into thick underclothing, as well as warm outer wraps, or you get a drenching, or get cold after tennis or other games, or inhale a noxious germ when weary, worried, or hungry, and the vitality is too depressed to deal with it.

Result : The skin is congested, the millions of pores are constricted by the action of the cold, and all the waste that should pass off by it is thrown in upon the internal organs. Moreover the blood breathes by the skin and thus oxygenation is checked and waste settles in the air passages of the lungs and causes cough. Generally the chill affects also the liver and kidneys, congesting them and thus the blood speedily becomes full of waste matter more than the organs can deal with.

Then the kidneys become clogged and their secretion is diminished or almost ceases, just as when a filter is clogged and requires thorough cleansing. Result: headache, backache, violent shivering, sickness or nausea. The victim is in abject misery, and usually has no difficulty in giving adequate expression to it in making others know it too, and share his misery, as the poisons working in his blood make him at this stage acutely irritable. If the system is not able to help itself and this state of things is not soon relieved it may in a day or two be followed by drowsiness, coma, and death. A weak heart is not able to cope with the added burden combined with lack of oxygen, &c., and another case of "heart failure" is recorded.

Then how must we deal with a condition which is ushered in by acute shivering and aches: suppression, nausea or vomiting or scanty action of the functions.

The first thing to do is to restore the action of the skin and other organs of elimination.—How?

1. The patient must *at once go to bed and stay there till his condition changes for the better. Cover warmly with blankets.*
2. *Eat nothing.* Nature itself teaches this by taking away your appetite till the accumulations of waste have been got rid of; because, of course, eating would only add to the waste. If a foolish friend persists in feeding you, nature becomes furious in revolt and rejects the offending matter by setting up vomiting.
3. *Apply hot water bags or bottles to the feet and sides.* If you have no rubber water, bags fill ordinary bottles with hot water *cork securely* and fasten up in a sock or stocking with a safety pin.
4. *Sip hot bland drinks,* such as milk-and-barley water, or barley water alone. Milk alone is too strong and apt to curdle. To make barley water, wash a table spoonful of pearl barley. Put in quart jug. Pour on a quart of boiling water. Infuse. Some prefer it boiled for five minutes. Every patient with chill should drink a quantity of this to wash out the clogged-up kidneys. Touch no *cold* drinks till the skin begins to act, or as long as the patient is cold and congested. Hot tea if desired. *No beef tea at present.* It makes too much waste. *Hot bland* drinks.
5. No Alcohol. *Not a drop.* It tends to harden the tissues and increase congestion.
6. Sleep.
7. Sleep.
8. Sleep.
9. —If the head is very bad, use smelling salts; or bind a dry handkerchief sprinkled with Eau-de-Cologne round. Nothing damp till the cold stage is over.
10. No talking.
11. No visitors.
12. Let the patient alone as much as possible when made comfortable.

This congestion stage generally lasts two to three days in favourable cases and cannot be hurried. Towards evening generally the patient becomes hot and restless. Then sponge face and hands with warm water, and give *cold* drinks if he desires; cold barley water with lemon and a little sugar. Some one should certainly be in attendance the first 2 nights, and see that at least once in the night the patient's hot bottles are refilled and he be given a hot drink and made comfortable. This can often be done without disturbing him. At 3 to 4 a.m. the vitality is at the lowest and also from this time to dawn is the coldest part of the night.

A patient has nothing to do but to sip drinks and *sleep*. Properly treated, on the 2nd or 3rd evening the crisis should come, that is he should wake *bathed in profuse* perspiration, with head relieved and other functions acting.

Now be *extra careful* that he gets no cold again. He is not to lift his head or put even an arm out till he has had a cup of

(1) hot milk, or
(2) hot tea made with milk
(3) hot chicken broth.

The perspiration shows the skin is doing its work again, and one has to be *most* careful not to check it, for the patient is still very weak. Having drunk the hot milk and rested for an hour he may be sponged with warm water from head to foot *in a blanket*.

Method.—Attendant must spread a blanket on edge of the bed, and tell the patient to roll himself upon it. Then cover him at once with the other half of the blanket. Divest him of his damp perspiry garments, and putting the sponge underneath the blanket rub him down rapidly a limb at a time. Dry thoroughly and dress in warm new pyjamas. Bundle blankets round him and change the sheets quickly.

Get him back to bed *quickly* and put a hot bottle to his feet.

One more drink of hot chicken broth and milk, and he will fall asleep and probably sleep 12 hours waking *well*, but *weak*.

He requires nourishment, but *not ordinary* diet for several more days, However, the following dishes may be given if there is no relapse.

1. A beaten up egg, flavoured with vanilla and sugar, and mixed with milk.
2. Fish very lightly fricasseed in milk, or boiled with parsley sauce.
3. Onions stewed in milk.
4. Vegetable marrow, stewed in milk and parsley.
5. Savoury baked custard. (If sweets are disliked, the custard may be made as usual, seasoned with salt, pepper and a sprinkling of powdered cheese.)
6. Omelet
7. Sago jelly with custard.
8. Cream soup (milk thickened with yolk of egg, salt, pepper, cheese) with fried croutons.

All these dishes are nourishing, but make very little demand on the digestion, and leave very little waste for the enfeebled organs to deal with.

GENERAL REMARKS ON ILLNESS AND NURSING.

It is to be remembered that almost every illness *begins* in the same way, *i.e.*, with congestion, or failure in *some way* of the organs of elimination to do their work properly. Therefore, the treatment above described applies to the *initial* stages of almost every case of fever, malaria, chills and general sickness. This should not be taken that it should *supersede* the Doctor, but only if he is not at hand, or to go on with while waiting for him.

Those attending on the sick are sometimes very thoughtless in the little things for the patient's comfort. *Always* a little table with a hand bell should be beside him. *Always* every particle of food or drink should be covered with paper or muslin, if obliged to be left in the room. *Always* have plenty of hot water going. It is misery to have to wait for things.

Firstly, finally and chiefly, every bungalow ought to have a feeding cup. Really anyone who takes drink of any sort in a long soda tumbler to a patient who is helpless in bed ought to be *slapped!*

Just try it for yourself! Keep the head on the pillow and see if you can drink a drop without spilling it on the bedclothes and down your neck! And why should a patient have to lift his head and untuck the clothes and get chilled again? If there is no feeding cup, give the *lowest* cup or *shortest* little basin you can possibly get. But a feeding cup costs only 6d. to 1s., at *any* of the cash chemists in England. For 5s. each lonely man could provide himself with a capital sick-room-outfit and it would be well worth while.

Remember *fever* only means that the system cannot get rid of its rubbish by normal means, so it tries to *burn them up*!! All very well, but if the temperature goes too high it burns some of the good tissues as well as the rubbish. A clinical thermometer is a necessity.

There are many more remedial treatments I could name, but they require too much care. What I have here prescribed is so simple that the average "wayfaring fool, though a man need not err therein"!

I wish Sir Allan Perry and Mr John Harward would ask me to write Juvenile books on Hygiene for his Educational Department!—I am, Sir, yours faithfully,

NURSE CON AMORE.

We are indebted for the following to a Straits contemporary who heads it

"The Malaria Scourge."

ORGANISED ACTION BY SINGAPORE AUTHORITIES.

It would appear that, at long last, the Government and Municipality of Singapore have been moved to take some definite action to combat the scourge of malaria on the island. No public announcement has yet been made on the subject, but the contemplation of the scheme has gone sufficiently far to justify the expectation that it will come to something.

There is, we understand, nothing more in the scheme than has been urged upon the authorities time and again in various ways—by the medical faculty, by the layman writer in the press and by the forcible example of many other cities in the east. It is proposed to establish a Malaria Board, to be composed, presumably, of Government and Municipal medical officials, armed with executive powers and with penal by-laws to strengthen its hands. These by-laws will enforce certain responsibilities on the public and the board will see that they are borne dutifully. Although the details are not decided yet, there is reason to believe that the line of conduct of the campaign will coincide, to a large extent, with the recommendations made in February, 1910, by Dr. Middleton before the Municipal Commission of Enquiry. these recommendations were summarised by Mr Roland Braddell in his interesting letter on malaria in the columns of the *Straits Times* of August 12th, as follows :—

1 Survey of all ponds, swamps, ditches and pools for the presence of malaria.

2. Filling up, draining and brick-lining where necessary—lists of earth drains.

3. Oiling where more permanent measures cannot be carried out.

4. Repair of rain gutters.

5. Screening of all cisterns, tanks, barrels, jars and other receptacles in and about houses or periodical emptying of same.

6. Collection and disposal of all broken bottles, pots, jars, old tin cans, etc., in or about houses.

7. The opening of depôts in different parts of the town where quinine could be distributed free to suitable cases and under proper precautions.

8. The presence of larvae in any barrel, tank, cistern, jar, etc., to be considered an offence.

9. Drawing up regulations embodying 5, 6 and 8.

10. Distribution of leaflets in different languages explaining reasons for action taken and directions to be followed, advising use of mosquito curtains.

11. Provision of a staff to carry on this work.

So far, the scheme is still under consideration. It has, we believe, been presented in draft form to the Government, which, with implied approval, has passed it over to the Municipal Commissioners for their contemplation and amendment or approval. Some definite pronouncement on the matter should be made shortly.—*Straits Times*, Aug, 24.

COPRA TRADE IN THE PHILIPPINES.

A BOOM IN COCONUT PLANTING.

The Philippine Islands shipped abroad 116,374 metric tons of copra in the calendar year 1910, and the average price for the year was about 3½ cents. gold per lb., says an American Consular report. The price increased during the year from about 3 cents. to about 4 cents. gold per lb. in the last quarter. The steady growth of the trade is indicated by the fact that shipments increased from 168,473,499 lb., valued at $5,461,680 in 1908 to 232,728,116 lb., valued at $6,657,740 in 1909, and to 254,156,982 lb., valued at $9,153,951 in 1910 (fiscal years in each case), and that there was an increase from 113,643 metric tons in the fiscal year to 116,374 metric tons in the calendar year of 1910. Because of the high price, due chiefly to the extraordinary demand for vegetable oils, and because of the strong demand generally, there is something of

A BOOM IN THE COCONUT BUSINESS IN THE ISLANDS, and the increase in trade is having a marked effect, not only on the islands themselves, but upon shipping in the Far East and other lines of business. In the Philippines the export of copra is now the second largest element in the foreign trade, comprising almost a fourth (23 per cent) of the whole, and being exceeded only by hemp.

COCONUT PLANTING

is being carried on more extensively than ever before. Six years ago there was a period of high prices, during which time extensive plantings were made, and these trees will come into production this year. Indications are that the export of the product during 1911 will exceed all previous years in volume, while, owing to the shortage of other oil-producing crops, the prevailing high prices may continue for some time. Naturaly, such conditions are leading to a general expansion of business in all lines connected with coconut planting and plantation supplies. Exports of copra from the Philippines to the United States have more than kept pace with the increased imports into the latter country, due to the demand for coconut oil.

The total imports of copra into the United States during the fiscal years 1908, 1909 and 1910 were $481,232, $666,820, and $762,560 respectively, and the imports thereof from the Philippines were $213,999, $273,497, and $416,074 respectively. The increase in imports of copra into the United States during the three years was about 58 per cent., while the increase in imports from the Philippines are about 90 per cent. Nevertheless, most of the product went to France, mostly to Marseilles, where the great coconut-oil factories are largely dependent upon the Philippines for their copra supplies. France took $6,114,324 worth of the product in the last fiscal year. Germany, particularly Mannheim, takes an increasing quantity, while Spain maintains a trade long established.

THE TEXTILE FIBRE INDUSTRY OF BRAZIL.

With the world's source of cotton supply in the main limited to the United States, and in view of the reputed failures to develop the cotton-growing industry in India and Africa on a very large scale, it would seem that Brazil will, within the next generation, witness an extension of its cotton industry, and when such a time comes its cotton-bearing trees will have their share of attention in this respect. There are indigenous to Brazil, and growing wild in certains region, two well-known species of trees which are of interest to the commercial world because of their possibilities as producers of cotton fibre. Not the least remarkable feature about these trees is their occurrence in precisely those regions where it has seemed to be impossible, or at least difficult, to grow ordinary cotton. No other country in the world possesses so large an area of land which may be utilised for the growing of cotton as does Brazil, and that in other areas it is possible to cultivate trees for the production of cotton fibres must appeal to the textile-producing world as indicating that Brazil must be reckoned with as a future source of the world's cotton supply. The United States Consul at Rio de Janeiro says that one of these trees is called 'Barraguda,' from its being barrel-shaped, after the peculiar trunk which is its characteristic. The tree grows from twenty-five to thirty-five feet in height, tapering from the great bulge in the trunk to a very slender one, from which branches form about twelve feet above the ground. The trunk is entirely covered with hard and sharp thorns. The pods in which the cotton grows are from five to eight inches long, and, two to four inches in diameter.* The fibre is coarse and white, and adheres closely to the seeds, which are somewhat smaller than peas. It is a long and strong fibre and while too coarse for use in textiles of any degree of fineness, it would, it is said, lend itself to the fabrication of blankets, cotton twine, and a variety of other materials. The habitat of this tree is in central and southern Bahia, and it grows to a lesser extent in the State of Pernambuco. The uplands on which it seems to flourish are from a thousand to sixteen hundred feet above sea level, where there is a decided chill in the air during certain months of the year. The other tree produces a much finer cotton, of a brownish colour, exceedingly light, but not long enough to spin well, and resembles eider-down. The pods in which it grows are about ten inches long and one inch-and-a-half in diameter before bursting. When the pod bursts and the ripe cotton comes out, the pod takes on a rotund shape eight to ten inches in diameter. The fibre adheres loosely to the seeds, most of which fall out by merely shaking the pod, and is so light and fluffy that one can blow almost the entire contents of a pod free from the outer enclosure or hull. Occasionally this cotton is used in pillows, and when properly prepared is said to be as soft and downy as the lightest and best feathers, showing no tendency to harden with use. The inner bark of this cotton tree is utilised by the inhabitants for many purposes. It is a remarkably strong fibre, and a strip half an inch in width will, without any preparation, sustain a weight of fifty to a hundred pounds. The tree has its habitat in central Bahia and northern Minas Geraes, being most abundant in the latter State, and is called "imbirussu," being a name of Indian origin, probably given to it because of its peculiar and characteristic bark. The corrugations of the bark form diamond-shaped patches, the inner parts of which have a bright greenish-red and glossy surface. Both of these trees are hardy and long-lived, seventy-five to one hundred years being apparently a fair average for the period during which they bear cotton fibre, while the common cotton-plant bears in many parts of Brazil for fifteen to twenty-five years without any attention whatever.—*Journal of the Royal Society of Arts*, Aug. 11.

[* This must be allied to the "Cotton tree" (*Bombax Malabaricum*) of Ceylon, giving the "Kapok" or mattress stuffing cotton. We see that the Tropical American species was called by Linnæus "*B. Ceiba.*"—Ed. C.O.]

KAPOK AND ITS CULTIVATION.

Kapok is a fine fibrous material, somewhat resembling cotton, but weaker and more lustrous, derived from the tree known as *Eridendron anfractuosum*, which occurs in the Dutch East Indies, India, Ceylon, tropical Africa, the West Indies, Mexico, and Central America. The fibres arise from the inner wall of the capsule and surround the seeds.

The kapok tree grows at the sea-level and up to an altitude of 3,000 or even 4,000 feet, but gives the best yield and quality of fibre when situated at less than 1,000 feet above the sea. It is said to flourish best on a porous, sandy-clay soil, in a climate with a dry east monsoon, and to be capable of withstanding heavy rains and resisting long periods of drought.

The propagation of the tree can be easily effected by means of either cuttings or seed. In the latter case the seed is sown in nurseries, and is only lightly covered with earth. If the soil is poor, it is recommended that stable manure should be applied about ten days before sowing. The seed should be planted in rows at a distance of 10 to 12 inches. When the young plants are about 5 or 6 inches high they should be no longer shaded but exposed to the sun. If the plants do not obtain plenty of sunshine, they grow thin and lanky. The seedlings are planted out when from eight to twelve months old. In Java, kapok trees are commonly planted about 12 to 15 feet apart along the roads in the coffee and cocoa plantations. When the trees are grown in special plantations, they should be placed about 18 feet apart (about 144 trees to the acre), for if planted more closely they soon interfere with one another. The trees commonly attain a height of 30 feet, but sometimes grow to 50 feet or even more.

Before transplanting, it is advisable to strip off all the leaves and to cut the stem down to a height of 1½ to 2 feet and also to cut the chief roots so as to make stumps of them. If the top is not cut it will usually die down to the ground. The trees subsequently require very little attention, but the soil must be kept free from weeds.

During the early years of growth other plants can be cultivated between the young trees. In Java it is a common practice to grow pepper in this way, but it should not be planted before the kapok trees are three or four years old.

The trees begin to bear in the third or forth year, but sometimes not till later. The crop is never very large until the sixth year. A large tree brings 1,000 to 1,500 fruits to maturity per annum, each of which contains about 0·7 to 1·2 grams of dry fibre. Hence, on an average, a well developed tree may be expected to give an annual yield of ¾ to 1¼ kilograms (or about 1½ to 2¾ lb.) of clean fibre.

The tree flowers in April or May, and the fruits mature at the end of October or in November. As the fruit ripens it becomes yellowish-brown and then begins to open. As soon as this point is reached, the fruits are gathered by means of long bamboo poles bearing small hooks at the upper ends. They are then left on a clean floor, preferably of cement, and exposed to the sun in order that they may ripen completely and open fully. The fibre and seeds are picked out of the capsules by women and children and are dried in the sun for some days.

The seeds are usually removed from the fibre by beating with sticks or by means of a simple machine. A special form of gin, resembling a cotton gin, has been recommended for the purpose, but it must be remembered that in most cases the kapok is only a subsidiary product and produced in small quantities, so that the provision of expensive machinery would not be remunerative.

The kapok is packed in bales by means of hydraulic or hand presses, but must not be compressed too severely or its resilience will be impaired and its value consequently diminished. Each bale weighs about 80 lb. The number of bales exported from Java in recent years is as follows ; 1907, 92,874 ; 1908, 109,852 ; 1909, 87,685.

The value of the total imports of kapok into the United Kingdom amounted to £23,752 in 1908, and to £27,645 in 1909.

The market price of kapok has advanced during the last few months from 7d to about 9d per lb., and it is therefore possible that the collection and preparation of this fibre for export would prove a remunerative industry in certain British Colonies and Dependencies.—*Imperial Institute, Bulletin, No. 2, 1911.*

TEA IN CHINA IN THE 17TH CENTURY:

A Jesuit's Book—Translated in 1698.

We are much obliged to Mr. McEwan (of Messrs. McMeekin & Co. of Lime Street)—a well-known authority on tea—for the extracts he sends from the interesting old book of a Jesuit priest, who must have been a Missionary in China and Siam, about the middle of the 16th century. The oldest book on tea in our hands is one published in London in 1799—an illustrated folio entitled "The Natural History of the Tea-tree with observations on the Medical Qualities of Tea and on the effects of Tea-Drinking—a new edition—by John Coakley Lettsom, M. D. But the Preface refers to "an inaugural dissertation" on the virtues of tea printed in 1769 and in 1772 a first edition of the volume given in 1799. It seems that Sir George Staunton's Embassy to China, some time before, attracted notice to the tea trade and he had a table compiled (now before us) giving "an Account of the Quotations of Tea exported from China to English and Foreign ships in each year from 1776 to 1795 distinguishing each year." The quantity was :—

12,841,500 lb. in foreign ships in 1776
3,402,415 lb. in English ,, ,,

and 5,577,200 lb. (foreign) in 1783
against 23,733,810 lb. (in English ships) in 1783.

London, July 28th, 1911.

Dear Sir,—There was recently placed in my hands a quaint and interesting old book published in London in *1698*, and stated to be a second edition of a translation from the French. There is nothing to indicate when the first edition, or the French original, were published. I enclose a typewritten copy of the title page and of various extracts bearing on the subject of Tea. The interest of these lies in the fact that I have been unable to trace that they have been reproduced in any modern writing dealing with the subject of Tea, and that they are of earlier date than the well-known quotations so frequently made use of. The archaic spelling has been reproduced. I am sending you the extracts that you may reproduce anything you like from them.—I am, yours faithfully,

JOHN McEWAN.

MEMOIRS AND OBSERVATIONS.

Topographical, Physical, Mathematical Mechanical,	Natural, Civil, and Ecclesiastical.

Made in a late
Journey
through the
Empire of China

And published in several letters.

Particularly upon the Chinese Pottery and Varnishing ; the Silk and other Manufactures ; the Pearl Fishing ; the History of Plants and Animals ; with a description of their Cities and Public Works ; Number of People, their Language, Manners and Commerce ; their Habits, Œconomy, and Government. The Philosophy of Confucius. The State of Christianity, and many other Curious and Useful Remarks.

By Louis Le Comte, Jesuit,

Confessor to the Duchess of Burgundy, one of the Royal Mathematicians, and lately Missionary into the Eastern Countries.

Translated from the Paris Edition, and illustrated with Figures.

The Second Edition very much corrected, with the Addition of a Map of China, and a Table.

London : Printed for Benj. Tooke, and are to be sold by Geo. Huddleston at the Black-moor's Head, near Exeter-Exchange in the Strand. 1698.

There is to be seen in China abundance of other Rivers less Famous, but yet more Commodious for Commerce and Trade.

Since they afford nothing uncommon, it would be to abuse your Patience, Sir, to descend to the Particulars. As to what concerns Fountains, it were to be wisht there were more of them, and better. 'Tis certain that their usual Waters are not good, which, perhaps, hath obliged the Inhabitants, especially in the Southern Provinces, to drink it always warm ; but because warm Water is unpalatable and nauseous, they bethought themselves of putting some Leaves of a Tree to it, to give it a Gusto. Those of Tea seemed to be the best, and so they frequently made use of it.

It may be also that God Almighty, whose Providence hath so universally provided for the Wants of His People, and if I may be bold to say it, for their Delight and Pleasure, would not deprive China of that which is necessary to Life ; so that for to Supply the Defect of the Wells and Fountains, which the Nature of the Ground hath made everywhere salt and brackish. He hath been pleased to produce that Species of a particular Tree in aboundance, whose Leaves serve not only to purge the Waters from their noxious Qualities, but also to make them wholesome and pleasant.

Amongst these Simples there are two that I may speak of before hand: The first is the Leaf of Thee, as they call it in China. (Thee is a corrupt word of the Province of Fokien, it must be called Tcha, this is the term of the Mandarin Language.) They are much divided in their Opinions touching the Properties they ascribe to it. Some do maintain that it hath admirable ones; others, that it is but a fancy and meer whim of the Europeans, that are always in love with Novelties, and put a value upon that which they do not understand: in that, as in all other things where Men do not agree, I think we ought to take the middle path.

In China they are subject neither to Gout, Sciatica, nor Stone; and many imagine, that Thee preserves them against all these Distempers. The Tartars that feed upon raw Flesh, fall sick, and suffer continual Indigestions so soon as ever they give over drinking of it; and that they may have plenty of it, they bargain to furnish the Emperor with almost all the Horses that serve to remount his Cavalry. When any one is troubled with a Vertigo that over charges the Brain, he finds himself extreamly relieved so soon as he accustoms himself to Thee, In France there are abundance of People that find it good for the Gravel, Crudities, Headaches; nay, some pretend to have been Cured of the Gout by it, almost miraculously; so quick and sensible has been its effect. All this proves that Thee is no Chimera, and Conceit. Nay, some after drinking of it sleep the better, which argues that it is not proper to suppress Fumes. Some there be who never take it after Meales, without Experiencing mischievous Effects; their Digestion is interrupted and disturbed; and they find a long time after Crudities, and a troublesome Repletion. Others find no benefit by it neither in Gout nor Sciatica. A great many say that it dries, makes lean, and that it obstructs and that if there be any good qualities in it, the most part of other leaves would in a manner produce the same effect. These Experiments evince that its Vertue is not so universal as People imagine.

So that in my opinion, one should speak moderately of it, both as to its good and bad qualities. Perhaps warm Water alone is a good Medicine against destempers, the cure of which they attribute to Thee. And there are several People that are exempt from many Inconveniences because they are used to drink warm Liquors. Nevertheless it is certain, that Thee is of a corrosive nature, for it ettenuates hard Victuals wherewith it is boiled, and consequently is proper for digestion, that is to say for dissolution; which also proves that it resists Obstructions, and that Liquors impregnated with its Particles and Salts, carry off, and more easily separate whatsoever adheres to the Tunicles of the Vessels. This very quality is proper to consume superfluous Humors, to put into motion those that stagnate and corrupt, to evacuate others, that cause the Gout and Sciatica. So that Thee, with caution, is a very good Remedy, altho' it be not so effectual, nor universal, but that the temperament of certain Persons, the heighth of the Distemper, together with certain occult Dispositions, may many times retard the Effect, or even frustrate its Virtue.

To use it with benefit, it is requisite to know it, for there is more than one sort of it. That of the Province of Xensi is course, harsh, and unpleasant. The Tartars drink of it: There is necessary to them a stronger Menstrum than to the Chinese, because they feed on raw Flesh. It is exceeding cheap in the Country, a pound of it will cost three Pence. In this same province there is found a particular Species of it, more resembling Moss, than the Leaves of a Tree; and they pretend that the oldest is of excellent use in acute Distempers. They likewise Administer to sick People a third sort, whose Leaves are very long and thick, and its goodness increases in proportion to its being kept; but that is not the Thee in use.

That which they commonly drink in China, hath no particular Name, because it is gather'd anywhere in different Territories and Soils. It is good, the infusion is reddish, the Taste faint and somewhat bitter: the People use it indifferently at all hours of the day, and it is their most usual drink.

But Persons of Quality use two other kinds that are in request in China. The first is called Thee Soumlo; it is the name of the Place where it is gathered; the Leaves are somewhat long, the Infusion clear and green when it is fresh, the Taste pleasant; it smells, as they say in France, a little of Violets, but this Taste is not natural; and the Chinese have often assured me, that to be good, it ought to have no Taste at all. This is that they commonly present at Visits; but it is exceeding corrosive; perhaps the Sugar they mix with it here corrects its Acrimony; but in China, where it is drunk pure, too great a use of it would be apt to spoil the Stomach.

The second kind is called Thee Voüi; the Leaves that are little, and enclining to black, tinge the Water with a yellow Colour. The Taste is delicious, and even the weakest Stomach always agrees with it. In winter it is to be used temperately, but in Summer one cannot drink too much. It is especially good in Sweating, after Travelling, Running, or any other violent Exercise. They give of it also to sick People; and those who have any care of their Health, drink no other. When I was at Siam, I heard them often talk of the Flower of Thee, of Imperial Thee, and of several other sorts of Thee, the price of which was yet more extraordinary, than the Properties they ascribe to it; but in China I heard no such thing.

Generally speaking, that the Thee may prove excellent, it ought to be gathered early, when the Leaves are yet small, tender and juicy. They begin commonly to gather it in the Months of March and April, according as the Season is forward; they afterward expose them to the steam of boiling Water to soften them again; so soon as they are penetrated by it, they draw them over Copper-plates kept on the fire, which dries them by degrees, till they grow brown, and rowl up of themselves in that manner we see them. If the Chinese were not such great Cheats, their Thee would be better ; but they often-times mix other Herbs with it, to swell the size at a small charge, and so get more money by it; so that it is a rare thing to meet with any purely without mixture.

It commonly grows in valleys, and at the foot of mountains ; the choicest grows in stony soils; that which is planted in light grounds holds the second rank. The least valuable of all is found in yellow earth ; but in what place soever it is cultivated care must be taken to expose it to the South ; it gets more strength by that, and bears three years after being sowen. Its root resembles that of a peach tree, and its flowers resemble white wild roses. The trees grow of all sizes, from two foot to a hundred, and some are to be met with that two men can scarce grasp in their arms ; this is what the Chinese Heibal relates. But from my own Observation I can give you the following account

Entring upon the Province of Fokien, they first made me observe Thee upon the declining of a little Hill; it was not above five or six foot high, several Stalks, each of which was an inch thick, joyned together, and divided at the top into a many small Branches, composed a kind of Cluster, much what like our Myrtle. The Trunk, tho' seemingly dry, yet bore very green Branches and Leaves. These Leaves were drawn out in length at the point, pretty strait, an inch, or an inch and a half long, and indented in their whole Circumference. The oldest seemed somewhat white without, they were hard, brittle, and bitter. The new ones, on the contrary, were soft, plyable, reddish, smooth, transparent, and pretty sweet to the Taste, especially after they had been a little chewed.

It being the Month of September, I found three sorts of Fruit. In the new Branches there were little slimy Pease, green without, and full of yellow Grains within. In others, the Fruit is as big as Beans, but of different Figures ; some round, containing a Pea ; others drawn out in length, that contained two ; some others of a Triangular Figure, bore three, very like to those that bear the Tallow-grain, so famous in China. The first Membrane or Skin wherein these Grains are infolded, is green, very thick, and somewhat even. The second is white, and thinner ; under which a third very fine Pellicle covers a kind of Gland, or small Nut perfectly round, that sticks to the Bark by a little Fibre, from whence it derives its nourishment. When this Fruit is young, it hath bitterness in it ; but a day or two after it has been gathered, it withers, grows long and yellow, and wrinkles like an old Hazel-Nut ; at length it becomes unctious and very bitter. Besides that, I found a third sort of hard, old Fruits, the first Skin of which, between open and shut, shewed within a hard bark, brittle, and altogether resembling that of a Chesnut. After I had broken it, scarce did I find any sign of Fruit, so dry and flat was it grown. In some others the same Fruit was pulverized in others was found a little Nut quite dried up, and covered with its first Pellicle.

Amongst these Fruits, a great number of them have no Germ or Bud, which they call Females ; those that have any may be sown, and produce Trees : but the Chinese do commonly make use of Grasss to plant. The better to understand the nature of this Tree, I had the Curiosity to taste the Bark of the Trunk and Branches. I chiewed likewise some of the Wood and Fibres ; both of them seemed to me not at all bitter, so far from it, they left a relish sweet like that of Liquorish, which yet one does not taste till some time after the chewing. Altho' this particular Account may displease those that are not concerned in the knowledge of Plants, yet I am sure that the more curious could with a more nice and exact Account, as to the delicate mixture of Colours in the Flower, the orderly disposition of their Fibres, the conformation of the small Branches and Roots, and a thousond other particulars relating to the Anatomy of them ; but that is the business of time and leisure : I had but a quarter of an hour to examine the Tree of which I have the honour to write to you.

COCONUTS IN THE PHILIPPINES.

A great many coconut trees have been planted the last few years because of the advancing price of and seemingly assured market for copra and the lower prices prevailing for hemp. So far correspondents have reported the total number of trees only, without separating those in bearing and those which have not yet come into bearing. It is roughly estimated that about 22,000,000 coconut trees are now in bearing. Correspondents have in large part failed to fully understand the data desired as to coconut productions, so the following figures are an estimate based on insufficient information. Formerly trees were planted much nearer together than at present, it having been demonstrated that trees planted at intervals of 7½ meters or even more give much better results than those planted closer together. It is because of the wide differences in the density of growth and irregularity of the surfaces they occupy that coconut trees are reported by number instead of the hectares they cover.

Trees.—32,838,544.
Nuts Gathered.—937,927,927.
Nuts Consumed for Food.—311,609,148.
Copra.—Kilos—125,140,822.
Oil.—Liters—6,993,513.
Tuba.—174,483,484.

—*Philippine Agricultural Review* for July.

CEARA RUBBER.

Ceara rubber is being successfully cultivated about six miles from Bangalore, where just above a large natural reservoir, 16,000 plants have reached the tapping stage over an area of 320 acres. It is interplanted with mango. The ages of the plants vary somewhat, because they were put down according to the personal convenience of the owner, who is a European coffee planter residing about 200 miles off. He first planted Ceara in 1907, so that the oldest trees are from 20 to 23 in. in girth. An experimental tapping shows that the liquid flows freely. No disease has been located.

INDIGO AND INDIGO PROSPECTS.

THE OUTLOOK FOR AN INDIAN INDUSTRY WHICH, DESPITE SYNTHETIC COMPETITION, IS SAID TO POSSESS POSSIBILITIES.

The virtual effacement of the Indian indigo industry some ten years ago constitutes one of the tragedies of commerce. The cultivation of the indigo plant and the subsequent extraction of the dye of that name had been for centuries one of the standard industries of India. To the cultivation and treatment of the plant British commercial enterprise took very kindly early in the last century, and for years participation in the industry was almost synonymous with a justifiable claim to fortune, or even to great wealth. During the latter quarter of the nineteenth century, it is true, the monopoly which India had held as the main source of the world's supply of indgo-dye had been challenged by planters in the Dutch colonies, and these, calling to their aid the assistance of skilled scientists, were obviously working along lines which were calculated to make their competition with the Indian producer effective. The staggering blow to the Indian Industry, however, was not to be administered by the Dutch planter, but by the German chemist. The possibility of obtaining an indigo dye from the main by-product resulting from the manufacture of coal gas had been proved fully thirty years before a serious attempt was made to deal with this discovery on strictly commercial lines. Experimental production of synthetic indigo-dye on a more or less commercial scale had to be conducted, however, over a fairly lengthy term of years before it could be said that in matter of price the artificial product could compete with the natural. Although it was generally admitted that this reduction was merely a matter of time, it would appear that the Indian indigo planters declined to look upon the challenge before them as serious. They, at at any rate, took no steps to improve the quality of the natural product for which their plantations and their factories was responsible, and made no attempt to restrict cost of production, so that when competition from a comparatively cheaply-obtained synthetic indigo actually commenced they would be able to carry on a contest on fairly equal terms. Just ten years ago Professor Meldola, in a lecture on the synthesis of indigo, delivered at the Society of Arts, after, it may be mentioned, the artificial product had achieved what was regarded as a phenomenal success, dealt with this very laxity on the part of those interested in the Indian industry. Holding out to the Indian planters no hope that they could meet successfully the competition of the German factory, but at the same time declining to describe their cause as a forlorn one, the Professor said the planters had allowed twenty years' activity on the part of the chemists to pass by with apathy and indifference, only condescending to turn to the expert for assistance and guidance at the eleventh hour.

EARLY EFFORTS AT IMPROVEMENT.

The speaker, indeed, drew a very dark picture of the then position of the Indian indigo industry and its prospects, and incidentally dealt with the more capable efforts which had been made by the Dutch East Indian planters not only to improve their indigo product in competition with that of India, but to put themselves in a better position to combat the commercial advent of the German factory. The Indian planter found himself face to face with competition which could ignore climatic conditions in the matter of production, and was in a position to offer the user of the dye a commodity which gave guaranteed results. Here in only two of the many points naturally associated with production he was beaten, in Mr. Roosevelt's phrase, to a frazzle, and the dawn of the present century might be taken as indicating that, so far as indigo-dye went, India was no longer a factor of any importance whatsoever. The value of the exports of the commodity from India fell from millions sterling per annum to about half-a-million sterling, and, to all appearances, what still survived of a once prosperous industry would in time die with the deaths of the few surviving conservative users of natural indigo left in Europe. The Indian Government, however, rendered what can only be described as belated and somewhat parsimonious aid to those planters who clung on to the cultivation of the indigo plant and the preparation of the dye therefrom. Experiments were initiated for the cultivation of what is known as the Java or Natal indigo plant, and some earlier results achieved gave considerable ground for hoping a revival of the industry in India by this means was possible. It was claimed, and, perhaps, with justice, so far as the Dutch colonies are concerned, that this Java plant gave an increased yield of indigo, which was obtained at a cost no greater than was entailed in the cultivation of the indigenous plant. This claim seems to have been made good so far as some of the Indian plantings of the Java variety were concerned, but troubles with disease, which are only too frequently associated with the cultivation of any non-indigenous agricultural growth under tropical climatic conditions, considerably damped the earlier enthusiasm among some of the remaining planters, while the success which has attended the production of an Indian-Java hybrid plant has not been overwhelming. It is probable, however, that some of these adverse judgments passed on the Java variety have been over-nasty, and that time will show ways not only of successfully combating the tendency to disease already noted but of making more of this particular plant in the future. The actual cultivation of the Java variety would appear to be more economical, inasmuch as sowing each year, as is the case with Indian indigo, is unnecessary. At least two years' crops can be obtained from the roots, or four crops in all, and, as the branches are longer and the number of leaves larger, the advantages of cultivating the Java variety, given, of course, the yield of indigo in the matter of quality is equally good when compared with that from the indigenous plant, would seem fairly obvious.

IMPROVED PRODUCTION METHODS : REDUCED COSTS.

More important, however, to the future of the Indian indigo industry was the necessity of speedily arriving at improved methods of dye-production and the achievement of economies in the cost of this production. Under the ægis of the India Government, Mr W Popplewell Bloxam carried out a series of researches in connection with the scientific production of natural indigo at the University of Leeds during the years 1905-7, the work being a continuation of certain investigations which he had commenced in India. One of the principal trade objections to natural indigo had been the uncertainty of the results obtainable from the use of the dye. This was in a large measure due to the rule-of-thumb methods followed by the majority of the Indian factories in the production of the commodity, and these discrepancies in the results the dye not infrequently gave afforded the synthetic product one of its main claims for consideration at the hands of the dyers. It was possible, when the synthetic indigo was finally launched as a commercial product, to guarantee to the user certain results, and to guarantee these results practically in perpetuity. Natural indigo, on the other hand, presents an ever-recurring series of problems in the matter of result to even the most expert dyers, since non-standardisation in production, combined, possibly, with climatic influences at the time of the actual making of the dye, introduced from the standpoint of the consumer perpetual uncertainties which did not make for economy or efficiency. At this juncture it is only necessary to state that the result of Mr. Popplewell Bloxam's long series of investigations was *inter alia*, the discovery of a method of standardising natural indigo, which, if it does not place it in this matter on an exact par with the synthetic product, has gone very far towards guaranteeing the consumer against the inequalities of which he had good cause to complain in the old indigo days. The most skilful laboratory work in connection with any industry, however, merely represents so much wasted time, unless the results which the scientist gains are properly utilised by the manufacturer on whose behalf the experimental investigations were undertaken. The Indian indigo planter in these latter years, for somewhat obvious reasons, was slow to introduce new methods either in his fields or his factory, but, having convinced himself as to the advantages of suggestions for improvement of his outturn, such as those Mr. Popplewell Bloxham has put forward, he has adopted these either wholly or in part to anything but his detriment or the quality of the commodity he is now placing on the market.

NATURAL VERSUS SYNTHETIC INDIGO.

When we come to consider the prospects of the Indian indigo industry the first question which naturally arises is whether this product can hope to compete in the future with that of the German factory. Assuming all that is claimed for natural indigo is correct—namely, that as a dye it is superior to the synthetic product, and that when used it not only thoroughly dyes the cloth but improves its quality—the point at once arises, and claims consideration, as to whether the majority of the users of indigo dye will find it to their advantage to recognise such claims as against those generally admitted as perfectly valid, put forward on behalf of the artificial dye. A recent inquiry into the matter of cost showed that the best synthetic indigo dye works out at about one-farthing per yard of dyed cloth cheaper than the best indigo dye, but this advantage might be offset, in the opinion of many, by the other advantages which are claimed for the natural product. If it were possible, then, for the cost of the two processes to be brought to a level, could natural indigo hope to regain in part, at any rate, its old popularity, always bearing in mind that the product as now marketed is to a large extent standardised, and that it only wants an increase in the demand to carry improvements in this connection still further? The cost of synthetic indigo, however, is governed at present by the demand for it. Production has never been allowed of recent years to so exceed demand as to materially affect the selling price, but this does not mean that it could not be sold, still at a very handsome profit to the producers, at very much lower prices than those which at present obtain. It therefore becomes a question in considering competition between the synthetic and the natural products as to whether the latter can be produced to sell at a profit at a price lower than it would pay to market the former. It is claimed by some Indian producers that this can be done, and if they are able to make good their claim they have the ball once more at their feet. We must be put in possession, however, of evidence further divorced from hearsay than that which is at present available, before it is possible to seriously discuss this point, but the mere fact that the statement has gained circulation in some business quarters, as well as a certain amount of credence on the part of men who are competent to decide as to its possible accuracy, leaves us desirous of hearing further and fuller details at the earliest possible moment.

THIS SEASON'S CROP AND PROSPECTS.

The statement may have originated in the known fact that this season's indigo crop is the best that has been known for the past six years. It is estimated that the outturn will range between 7,000 and 8,000 chests (of from 250 to 300lb. each)—a paltry total, no doubt, compared with the annual exports of between 35,000 and 40,000 chests which not so very long ago India was in the habit of shipping each indigo season to Europe, but better, as we have just stated, than the amounts marketed during the preceding five years. In the immediate past all the natural indigo produced in the Middle East has found a fairly ready market at prices ranging from 2s 6d to 3s 10d per lb., with, say, an average price of 3s per lb. At this average it paid the planter very well to produce indigo, and now that production costs have undergone an all-round reduction, while the quality of the commodity has undergone an all-round improvement, it is possible that in the future still better profits can be looked for by the producers A good deal depends, however, upon the demand which will be shown for the increased production of the present year. Circumstances as at present seen do not point to the prospective increase in the supply adversely affecting the price, but substantial increases in the outturns for subsequent years might easily do so, unless, of course, it can be shown that the Indian planter can successfully compete in the matter of production cost with the German factory. It may be possible to carry improvements in the production of natural indigo much further than merely standardising the quality of the product and reducing the costs of operations in the fields and the factories. But to ask the planter in India to face such improvement charges when the results obtainable are admittedly problematical would be to ask too much of human nature. Indigo cultivation, however, is of considerable importance to India, apart altogether from the question of the planter's profits or losses, and, that being so, the Indian Government might with advantage undertake the investigation, on behalf of the community at large, into any claims of improved processes connected with the production of natural indigo. So far as we can gather, very little has been done in this direction since the Indian Government met the cost of the lengthy researches carried out by Mr. Popplewell Boxham, the authorities, the conclusions of this investigation having been published and circulated, apparently considering that they had amply fulfilled their duties to this particular planting community. What appears to be wanted is the systematic scientific investigation of all reasonable claims to improvement in the preparation of the product once the plant has been cut for the steeping vats. Improvements in this direction would very soon reflect upon the acreages under indigo in India and increased cultivation could only mean the increased, or rather the renewed, prosperity of the industry.—*Financier.*

SYNTHETIC INDIGO.

(To the Editor of *The Financier.*)

Your article on synthetic rubber in today's *Financier* corroborates all I have been saying for more than 16 years about the chemical synthetic indigotine. Now that I have this corroboration, may I ask that the whole subject of synthetic indigo may be again considered without undue awe and respect for the learned scientific chemist's opinion?

I belong to the class of men part of whose business it is to buy dyes and dyers' services, and I have never found myself going against the skilled judgment of the largest responsible buyers of dyes. The chemists base their valuation of indigo not on a common-sense dye test but on some volumetric analysis, after first treating it with 74 times its own weight of the strongest corrosive acid known to science. Every dyer knows that treatment with 10 times its weight of this acid totally changes indigo into an altogether different dye of the most fugitive nature, called "Saxony Blue," or "Indigo Extract."

India used to grow £5,000,000 worth of indigo a year, but, thanks to the chemical raid, they only made £250,000 worth last year; and yet it is by far the fastest known dye, and, if you know how to use it, one of the cheapest!

ALEX. W. PLAYNE.

9, Stanley Street, Bedford, August 10th.

—*Financier*, Aug. 12.

UTILIZATION OF THE PAPAYA.

The Papaya, a native of the Caribbean region, the Gulf of Mexco, and South America, was introduced into India in 1611, and has been under cultivation here ever since. The plant and its culture have also extended throughout the eastern and western tropics; so that, few of the likely regions for its cultivation, throughout the warm parts of the globe, are without at least some payaya trees. Though at so distant a date in the history of its cultivation, a description of the plant and its valuable products might seem to be somewhat late and superfluous, the growing importance of some of the latter may be urged in favour of bringing the facts that are known about them to notice again. Of these, the most generally accepted is the ability of the species to grow in localities, under varied conditions of climate and soil, in all the warm parts of the globe. The papaya, however, is seen to thrive only in those regions within the tropics, where the heat and garish light of the sun are mellowed by heavy and constant rain. The phenomenon, frequently exhibited there, of showers of rain falling through sheets of bright sunshine is indicative of the climatic conditions that favour the most economically-successful growth of the plant. Like the eminently tropical species it is, it delights to live in the vapour-bath of a moist and a perennial heat. Accordingly, it flourishes only within the zone of perpetual shower and sunshine in select localities that lie between the isotherms of 77 degrees, Fahrenheit. Outside of the limits of its indigenous distribution, typified, perhaps, by the verdant Antilles the papaya grows to the greatest perfection on the Malay Peninsula and the Eastern Archipelagoes. Three other oriental regions deserve to be mentioned among those in which the plant has, so far, met with factors resembling those that obtain in the sunny lands of its home in the West, viz., Assam, Ceylon, and the Malabar Coast. In the majority of the other lands of its adoption, the unsuitability of the factors to which it is exposed is frequently revealed by a tendency to branch and the excess of male over female trees. The relatively small yield of latex (milk) from the fruits and the shortness in the duration of its flow may also be taken as due to the action of factors foreign to it and its wants. As regards soil, too, preference is shown for such as are rich, mellow, and free; while, for the highest success in its cultivation, the presence in the soil of organic remains is essential, because it is indicated. The ability of the plant to recuperate from the effects of tapping its fruits for the milk is regulated by the fertility of the soil and the amount and frequency of the rain it receives. The demand made on the factors of fertility cannot, however. be regarded as excessive; for, though it is great, the life of the plant is generally brief enough to produce a discontinuity in the strain of requirement.

The most useful and valuable product of the papaya is its large and luscious, melon-like fruit; but, though this, as a fruit, is admitted to be both wholesome, nutritious, and most satisfying, it is the milky sap of the unripe fruit that is prized the most at the present time. Though this milky sap is contained in the tissues of every part of the papaya plant and trickles out from the slightest bruise or injury to any of them, the readiest and the freest flow results from the scarification of the unripe fruit. whilst it is still attached to the tree. In it, the vessels containing the milk occur in abundance beneath the skin and as this is thin, it usually suffices to lightly score it with a knife-point to intercept and liberate the milk. The milk, as it flows out, may be received or collected by letting it drop on to plates of glass, porcelain, or other hard, smooth-surfaced material which is non-absorbent and non-metalic. The layer of milk received on the plate must then be air-dried in a cool place. When dry, it is a flaky substance which, being scrapped up from the plate, is usually mixed with twice its bulk of rectified spirit, filtered, dried, and stored in air-tight stoppered bottles. In this condition, or after further refinemeut, the dried milk is known as papain, a substance which is believed to be of the greatest use in the treatment of dyspepsia, that common, yet least defined of diseases which does not kill so often as it makes its victims "drag, at every step, a lingering pain," for many days. Papain is, frequently, also known under the name of vegetable pepsin, to distinguish it from animal pepsin, the prepared gastric coating of the pig. Papain, however, differs from the latter in the following most interesting particulars:—(1). It is active in acid, neutral, or alkaline solutions, so that, it can be mixed with other ferments in a solution of any reaction; (2) Whilst it is active in neutral solutions, its activity is enhanced by rendering such solutions acid and, if these, in turn, be made alkaline the ferment continues to be active still: in other words, it is practically active under all reactions and conditions; (3). It is able to act through a wide range of temperature; for, beginning to act at about 50 degrees, Fahrenheit, its activity rises with the rise in temperature, reaches its maximum at 160 degrees, Fahrenheit, and is not destroyed, at slight exposures, even at the boiling-point itself. The yield of the inspissated papain is about 25 per cent. (by weight) of the fresh milk. The milk is most abundant in first fruits, vigorous trees, and after rain. Under favourable conditions of climate and soil, a single fruit may yield as much as 100 grammes of the fresh milk; while, under adverse ones, it often requires the latex of 50, or more, trees to yield a pound-weight of the dried material. In consonance with the general truth that the study of the utilization of a product can be made to advantage only in the regions of its natural production, the uses of the fruit of the papaya tree are found to be most extensive and complete among the Caribs, the natives of the West Indies and the descendants of the Latin Nations who inhabit the countries of the continent lying to the west. With them, the fruit, long before the virtues of the papain it contains were known to the world, was used, as it continues to be, as an important article of daily consumption. The ripe fruit is largely eaten, as such, or after it has been stewed in sugar and flavoured with lime or lemon-juice. This is its chief application elsewhere, too, though the stew and the acid-flavouring are rare, Salt improves the flavour of the ripe fruit which, with its aid, combined with careful boiling down in sugar and candying, is converted into preserves resembling lemon peel or citron glace. Besides these and other "excellent preserves," the pulp of the ripe fruit is used, in the West, in the preparation of syrups, wines, and elixirs of reputed value in the treatment of affections of the fungs, bowers, and nervous system. But the use of the ripe fruit as a skin-soap and a favoured cosmetic by young and old seems to be still confined to the Caribs whose soft and supple clear complexions, so greatly and so justly admired, are said to be due to the action of the juice in levelling the asperities or harshness of the skin. Again its reputation, in the form of a poultice, as a cleanser of ulcers, sores, and yaws is unheard of beyond its home; while a similar use of the unripe fruit in the treatment of warts, eczema, and the like is also unknown except there. But, perhaps, the most remarkable use to which the unripe fruit is applied in the West is as a dispeller of the discomfort of surfeit. It is a well-known fact that the descendants of the Spaniards, Portuguese, and other nations, who form the bulk of the populations that reside in Mexico and the countries to the south are much addicted to a meat diet. It is frequently asserted that some of these peoples consume raw meat in large quantities, and that, to relieve the uncomfortable distension of the stomach that follows its liberal use, slices of the fresh fruit are either rubbed over the meat before it is consumed or eaten with or immediately after it. The commoner practice of rendering meat, which is uneatably tough, into a reasonably soft and juicy condition by boiling it down with slices of the green fruit is already known to Indian cooks. But the statement that the wrapping of such meat in the leaves or the mere hanging of it in the crowns of the trees has the effect of softening its fibres to mellowness requires to be received 'on a pair of scales.' Not so, however, the alleged application of the green leaves and fruits for the removal of clothes' stains or the cleansing and restoration of worn-out black garments in water in which the leaves have been steeped. But, perhaps, the commonest local applications of the fruit, in its mature yet unripe condition, are its pickling in vinegar, plain or spiced, and its service as a salad with cucumber, or, after being boiled, as a vegetable. The small black, rugose seeds of the ripe fruit, so reminiscent of radish and water-cress, are aromatic, mildly pungent, and piquant. In the West Indies they are eaten as a delicacy, plain or as a vinegared condiment; they are administered to quench the thirst of fever; and are, generally, believed to be possessed of carminative, anthelmintic, and other therapeutic virtue. The fibrous material in the bark of the stem is said to be spun into rope, in the West: while, the radish-like roots are reputed to be a nervine tonic and stimulant.

A. M. S.

—*Capital*, Sept. 7.

NOTES FROM THE COCONUT DISTRICT.—N.W.P.

Marawila, September 6th.

We are still without any rain, and the outlook is serious. September is generally a wet month, but so far, we have been tantalised with heavy rain clouds that are being attracted by the mountain ranges inland and with distant thunder. The canal is very low, and boats find it very difficult to negotiate it. Boat-hire to Colombo has risen from R45 to R75. Though situated on the banks of the canal, the local desiccating mill has not sufficient water to work full time. Fibre mills experience an insufficiency of water for steeping husks. Wells and tanks are remaining dry. I have not met with one cultivated paddy field. The range of fields in Madampe of about 2,000 acres in extent is uncultivated. The rainfall for August was ·35 of an inch and for July ·96 of an inch. To the end of June was 16·14 inches. Farther north at Puttalam, the rainfall to the end of August was less than 6 inches.

The only hope for coconut planters under such adverse meteorological conditions is, to thoroughly cultivate their soils. The benefits of this are apparent even where the soil is sandy. Where the soil is cultivated, the trees are weathering the drought bravely, while trees on neglected lands adjoining are suffering badly. Catch-water drains and the cultivation of the soil should become general in hard soils to overcome the effects of drought.

In this connection, I may mention that Mr. Wallace Westland, scion of a good stock, whose name has been a household word upcountry for over a quarter of a century, has returned from Papua, where he is the Manager of Rubber and Coconut Estates. He very courteously sent me a photograph of a single furrow disc plough (24″ disc) driven by a West New Guinea native and drawn by a team of 3 small mules. The land being ploughed is under coconuts two years old and much over-grown with grass. The plough is a "Massy Harris," and is said to be doing good work. These should be very useful on coconut estates. Will not some enterprising firms import a few as samples and give demonstrations of their work, through the Agricultural Society?—*Cor.*

CARNAUBA WAX

which can be used in the place of beeswax, is exported from Ceara and the northern ports, where it is also utilised in the manufacture of candles. The leaves of the Carnaubeira tree are dried in the sun and the powder beaten out. Several processes are used in the manufacture of the wax. The crop lasts from September to March, the leaves being cut at intervals during that period.—*British and Colonial Druggist*, Aug. 11. [The Carnauba Wax palm has been tried in Ceylon on a commercial scale but without success.—Ed. *C.O.*]

CULTIVATION OF FLOWERS ON FRENCH RIVIERA.

The exports of flowers from the French Riviera has of late years assumed proportions not contemplated even ten years ago. The value of the cut flowers sent away annually from the "Côte d'Azur" may be roughly estimated at fifty millions of frances (two millions sterling). Amongst the principal flowers grown for export in this region, which comprises Grasse, Nice, and Cannes, the carnation takes a prominent place. Of late years a demand has arisen for a strong, rigid, stalked variety, *à tiges de fer*, in place of the old-fashioned kinds with more pliant stems formerly grown This condition has been met by the introduction of American varieties of the plant. It has been found by careful analysis that the flower stems of these new varieties contain not only a larger percentage of dry substances—nitrogen, phosphoric acid, and potash—than those with less rigid stems, but that they absorb a greater amount of nourishment from the soil. These facts should not be lost sight of in the cultivation of the flower, and in the use of suitable manures.—*Journal of the Royal Society of Arts*, Aug. 11.

DRY FARMING.

In the inhospitable, semi-arid regions of the globe, where the rainfall is usually below the normal, the sum of the operations forming the practice of growing field-crops without irrigation has come to be known as Dry Farming. This expression had its origin in America over the Great Plain or Dry Belt on which dry farming is now extensively practised. Some of the chief centres of the industry in America are Kansas, Montana, Oregon, Washington, Wyoming, and Oklahoma; while, elsewhere in the world, it is coming into vogue in Canada, Australia, South Africa and India. Thousands of acres of arid waste-land in the south-eastern part of the State of Wyoming have already been reclaimed from desert conditions by the application to them of methods of dry farming; while, in Oklahoma, it has been successfully demonstrated that varieties of Juar (*Sorghum vulgare*) can be grown without rain and made to yield crops of even 35 bushels of grain on the acre. Some of the other commoner cereal crops there are Oats, with a yield of 36; Spring Wheat, with 27, Rye, with 18; and Barley, with 46 bushels per acre: a bushel of the oats weighed 46 pounds and one of the wheat 60 pounds. These and other interesting facts are, doubtless, of great importance to India where the major portion of the cultivable land is exposed to conditions of chronic drought. To those engaged in the agriculture of the country, or compacted, to pulverise and firm its surface. This firming is immediately followed by harrowing,—the ploughing, firming, and harrowing being conducted, if possible and preferably, on the same day. In some districts, a disc-harrow ing, or two, is made to precede the early ploughing. In localities of unevenly-distributed rainfall, elaborate terracing or building is undertaken to prevent loss of water by its running off the surface; and any streams that form are made to follow sinuous courses over the field so that absorption may be as complete as possible. As soon after the stoppage of a shower of rain as will permit of the soil being worked with ease, its surface is thoroughly stirred with "cultivators" (harrows with wheels) and the resultant mulch thereafter maintained by the soil being stirred as often as it rains or whenever its surface is found to become compact. Level cultivation, and the formation and maintenance throughout the life and growth of the crop, of a fine top-surface are the aims of the farmer. The seeds, which are drilled in, are sown sparsely and deep—often three or four inches below the surface of the soil. The land is harrowed after it is sown, and, if there be danger of drying, rolled after the harrowing. Even a quarter of an inch of rainfall exerts a beneficent effect upon the growth of a crop. The lower the rainfall, the smaller the seed-rate,—the generally sparse sowing resulting in a relatively small seed-rate per acre, *e.g.*, half a bushel of wheat seed is said to be more than enough to sow one acre. Moreover, the farther apart the plants stand on the field, the greater are the facilities afforded for inter-cultivation. Though large yields are sometimes obtained, they cannot, as a rule, in fairness to the practice, be reasonably expected to result from such farming. The object is rather to produce something where nothing else naturally grew before, "half a loaf" being, particularly in the desert, infinitely better than "no bread" at all. The yield of wheat is about 15 bushels, and that of lucerne 2 tons per acre. The usual crops are the Durum wheats (hard Maccaroni wheats), Spelt wheat, oats, barley, millets, and sorghum (e. g., Fodder Cane, Kaffir Corn, Milo Maize, Dourra), and the chief leguminous crop is lucerne.

Dry farming implies the presence of cheap labour or the application of labour-saving devices and machinery. It can be practised to the highest advantage only on large areas of very cheap land. The utmost economy in seed and culture has to be exercised for its success. The conditions, natural and economic, that prevail over extensive areas in India and Burma appear to be favourable for dry-land farming. But its introduction must, for the present, at any rate, be confined to cautious experimentation; for, in tropical and sub-tropical countries, generally, there is danger of excessive tillage depleting fertility of the soil from the fact that its activities continue unchecked throughout the year. And, for the rest, it might, perhaps, be well also to remember the fact that "in farming, just as much as in religion, salvation is worked out through personal effort, illumined by much personal knowledge, and directed according to the laws which govern the specialities of the subject investigated.

—*Capital*, Aug. 10. A. M. S.

CASTOR OIL SEEDS.

THEIR CULTIVATION, PRODUCTION, PREPARATION AND UTILISATION.

[At present there is some enquiry about Castor Oil Seed, and many interested in the subject both here and abroad, have been asking for full information about their cultivation;—land, suitable varieties, yield per acre, percentage of oil, etc.]

The following treatise is taken from the "Bulletin of the Imperial Institute" and we add same number of our own.

The castor plant known botanically as *Ricinus communis* is widely distributed throughout the tropics. There are numerous varieties of castor plants, some of which have been considered distinct species by botanists, but are now generally believed to be cultivated or geographical forms of one variable and widely distributed species.

The castor plant is largely grown in India, Java, Brazil, the United States and Italy, and occurs wild or in a state of semi-cultivation in most tropical and sub-tropical countries. The economic importance of the plant depends chiefly on the seeds, which yield a valuable oil that is used in medicine and for numerous industrial purposes. In India the leaves are also of value, being used as fodder for cattle, and in Assam and other countries as food for the Eri silk-worm.

In tropical countries the castor plant reaches dimensions of a small tree, and may attain a height of from 20 to 30 feet, or more, with a stout trunk and branches. In other climates it becomes a shrub or bush, 8 to 12 feet high, and in localities where frosts occur it is a herbaceous perennial. Under cultivation in warm-temperate climates it is usually treated as an annual. Owing to its decorative value, it is frequently cultivated under the name of "Palma Christi," and sold in pots for ornamental purposes. The seeds vary much in colour, size and shape; they are usually oval, flattened on one side, and of a mottled grey colour with a conspicuous white caruncle at the hilum end. When ripe, the capsules of some varieties dehisce and scatter the seeds a considerable distance. This peculiarity probably accounts for the wide distribution of the plant in countries, such as Brazil, to which it is not native. The method of seed-dispersal should be borne in mind by the cultivator, as seed is liable to be lost if the capsules are allowed to remain too long on the plants.

For practical purposes the numerous forms of the castor plant may be grouped into two classes, the large-seeded and the small-seeded kinds. The former are the more prolific in yield of seeds, and the oil obtained from them is suitable for lubricating and industrial purposes; the small-seeded varieties yield a finer oil, that is preferred for use in medicine.

CLIMATE AND SOIL.

As a rough guide to the climatic conditions necessary for the production of castor seed it may be stated that where maize can be grown and ripened the castor plant may be expected to succeed. It is sensitive to frost, and is therefore only adapted to warm climates or to countries where the summers are sufficiently long to mature the seeds. The plant requires a fair amount of moisture, and rainfall after sowing is essential to ensure good germination; but after the root-system has developed, less moisture is needed, and in the tropics its cultivation seems to be restricted by excessive rainfall.

The soil best suited to the castor plant is a good, well-drained, sandy or clayey loam, or any land that produces good corn. Very loose sandy soils or heavy clays are alike unsuitable. In India red soils situated at tho foot of hills are specially chosen. These are poor in organic matter and require to be enriched with farmyard manure. The plant is also commonly grown in isolated patches on land surrounding dwellings, or along the tops of high mud banks that surround orchards and vegetable gardens.

CULTIVATION.

The land destined for a crop of castor seed requires good preparatory cultivation before sowing takes place. Owing to its well-developed root-system the castor plant demands a deep-rooting medium. Deep ploughing and harrowing are therefore essential.

The castor plant soon exhausts the soil, and if fresh land is not available for the crop natural or artificial manures are soon necessary to keep up the supply of available nitrogen, potash and phosphoric acid. One of the most valuable manures for this purpose is the residual cake, left after the expression of oil from the seed. The empty capsules, shells, leaves and stems of the plant should be returned to the soil. In India farmyard manure is commonly employed, or when this is not available silt is used. The castor plant is however, seldom grown as a pure crop in India, but is generally used as a border to cotton or sugar fields or mixed with potatoes, cereals or some leguminous crop, hence soil exhaustion is less rapid than would otherwise be the case were pure crops grown. Pure crops should not be taken from the same land more than once in five to six years.

Before the seeds are sown it is advisable to pour warm water over them and allow them to steep, without further heating, for about 24 hours. This treatment softens the hard seed-coat, and tends to ensure quick and uniform germination. The large seeded kinds may be planted closer: about 3 feet between the rows and 18 inches from the plant being the usual spacing in India. If planted too thickly the plants tend to develop tall stems and few branches, but if ample space is allowed so that air and light are admitted, free branching takes place and more flowers and seed are in consequence produced.

In order to secure a good "stand" it is advisable to place from 2 to 4 seeds in each little mound along the rows, the seeds being about 6 inches apart, or they may be dropped in the furrow made by the plough, and covered by the plough following, or dibbled in by hand. After germination has taken place and the seedling plants are from 6 to 8 inches high, they should be thinned out, the weakly plants in each mound being removed and the most vigorous specimen left to develop.

About 10 lb of seed of the large-seeded varieties are required to plant an acre, and about 14 lb in the case of the small-seeded. The best time to sow the seed is at the commencement of the rainy season. (Here March and April and August and September.) In India the large seeded kinds are generally grown during the monsoon rainfall, and are usually confined to small patches in house gardens. The small-seeded kinds are generally grown as field crops at the end of the monsoon season, and at the commencement of the cold weather.

After the plants have been thinned out, the land between the rows should be ploughed or hoed occasionally to keep down weeds and to conserve soil moisture. It is also advisable to slightly mould up the plants by drawing the soil up round the stems to prevent moisture collecting at the base. When the plants have attained a height of about 2 feet, further working of the soil is unnecessary, as the plants will then be of sufficient size to shade the ground and strong enough to outgrow weeds.

It sometimes happens that the plants grow too vigorously, and then long shoots are produced but few flowers are formed. When this takes place pruning should be resorted to; the long shoots should be topped to induce branching and the formation of flowers, and thereby increase the production of seed. The crop is also easier to collect from dwarf plants than from tall specimens.

HARVESTING.

The capsules of the small-seeded varieties begin to ripen in from 4 to 5 months from the time of sowing, and those of the large-seeded kinds in from 7 to 10 months, according to variety and the prevailing climatic conditions. When ripe the capsules become hard and brown, and spread out somewhat on tho stalk on which they are borne. At this stage tho spikes should be removed from the plant by cutting. This should be done rapidly as soon as the capsules show signs of ripening, as if left too long on the plant they are likely to dehisce and scatter the seed. When the collecting has once commenced the whole crop should be looked over about once a week. Owing to the irregular ripening of the crop, the harvesting is a somewhat tedious process, but as the work involved in not laborious, it can be done by women and children. In the United States an endeavour has been made to produce a type of plant which ripens the capsules in any one cluster at the same time. The work of harvesting such plants is considerably lessened, and there is a smaller loss of seed. The collected capsules should be placed in bags or in a box-waggon, and conveyed from the field to a drying shed or barn. Where buildings are not available for their reception, a drying floor in the open may be easily made by sweeping clean a piece of firm, level ground, and enclosing it with boards or sheet iron from 4 to 6 feet high, to prevent the seeds being scattered and lost when the capsules open. Provision against rain must also be made if an open-air drying ground is used. The capsules should be spread on the floor, exposed to the sun and air, and occasionally turned over, In less than a week most of them will have opened and shed their seed. The empty husks should then be removed and the seeds swept together and collected. The pieces of husk and other debris with which they are mixed should be removed by winnowing, either by hand or by passing the seeds through a fanning machine. In some varieties the capsules do not readily open, and it is then advisable to beat them. or wooden rollers can be drawn over them by a pony whose hoofs are protected by being padded with flannel or sacking. In some parts of India the capsules are stacked in heaps in a building, and covered with straw and weighted. After about a week the outer husk is soft and rotten. They are then exposed to the sun, and beaten to free the seeds. Another process sometimes adopted is to bury the capsules until the outer husk has decayed and set free the seed. The seed should be stored in a dry place until sold or pressed for oil.

In countries where the castor plant is not systematically cultivated (as in Jamaica), but where it grows wild or semi-cultivated, and in places where labour is cheap, the collection and preparation of seeds on the lines indicated above should be encouraged. The numerous uses to which castor oil is now applied ensures a ready sale for the castor seed, and the present market value of the latter provides, as a rule, ample remuneration for the labour involved.

In India, when grown as a mixed crop, the yield of seed per acre is about 250 lb., and when grown as a pure crop is from 500 lb. to 900 lb. per acre. The yield of individual plants grown together as a single crop is much less than that of well-developed, freely-branched plants that have grown singly or in isolated clumps. As much as 20 lb. of seed per plant has been sometimes gathered from these In the United States the yield is said to be from 900 lb. to 1,350 lb. per acre when grown on suitable soil and with good cultivation. In Brazil it is culculated that in the castor plantations each plant yields from 4·5 lb. to 11·25 lb. of seed.

The same can be said of Jamaica as of Brazil:—The castor plant grows here rapidly from the seaside to over 3,000 ft., flourishing in the very driest spots, indeed, is seems to prefer a medium dry locality here. There are no regular cultivations here, but in almost every plot of land in the Island, in house yards, in the corner of cultivations, there are castor plants, and wherever the castor tree has once grown the moment land is cleared or burned up come numerous small plants

Although the making of castor oil is a small home industry in which any housewife could make a little money there is not enough produced in the Island to supply our wants and a considerable quantity is imported, mostly from India. Castor oil is used in the country for lubricating sugar mills, oiling boots and harness and in small quantities as medicine for man and beast.

Our soils are very much superior to the ordinary run of soils in India and the remarks about manuring in the above would not apply for many years here. We would not require to use our best soils for growing castor oil, but there are many uncultivated lands in the drier parts which could be used profitably for the growing of this product; lands that are fairly level so that they can be ploughed are preferable and this would make cultivation so much cheaper.

We have many varieties of seeds here, different sizes, different colours, different rates of growth, but have, unfortunately, no reliable data as to the average yield of the different kinds per acre, or the comparative yields of oil from the different varieties. There are, however, experiments being carried out in nearly every parish of the Island now on behalf of a company and we hope that useful data may result from these experiments. The commercial value of castor seeds at present is about £12 5s per ton and a yield of a ton per acre would only be a fair return. The yield of oil varies very much. The yield of oil should not be less than 40 per cent. if the proper kinds of seeds are planted, and there are some varieties which will give 50 per cent. It has not been discovered yet whether the varieties rich in oil give as large a yield as the varieties which are poor in oil; naturally the contents of oil has a great deal to do with fixing the price. It will be important to know this.

Production of Castor Seed.

India is the principal producing country, and the bulk of the supply of castor seed that enters international trade is drawn from this source. The Indian exports of castor oil also exceed those of any other country. Although the actual production of this crop is not shown in statistical returns for India, the following tables showing the amounts exported will indicate the magnitude of the trade in this commodity.

The quantities of castor seed exported from India to the principal consuming countries during 1908-1909, year for which figures are available have been as follows :—

United Kingdom, 806,789 cwt.,; France, 333,959 cwt.; Belgium, 207,093 cwt. ; Italy, 176.223 cwt. ; Germany, 109,603 cwt.—Total exports, 1,650,466.

The quantities of castor oil exported for the same period have been as follows:—

United Kingdom, 131,308 galls.; Ceylon, 63,980 galls.; Straits Settlements, 176,824 galls.; Hongkong, 13,533 galls.; Cape Colony, 9069 galls.; Natal, 73,690 galls.; Mauritius and Dependencies, 82,414 galls,; New Zealand, 166,718 galls.; Australian Commonwealth, 352,841 galls.; Foreign countries, 23,275 galls.—Total exports, 1,099,967 galls.

The imports of castor seed are not shown separately in the trade returns of the United Kingdom, but the imports of castor oil during the period 1905-9 have been as follows :—

Belgium, 9,847 cwts.; France, 6,756 cwts.; Italy, 2,388 cwts.; other foreign countries, 1,258 cwts.; British India, 12,494 cwt.

After the United Kingdom, the United States is perhaps the largest consumer, part of the demand being met by the home produce, and part by imported material. The cultivation of castor seed in the United States is confined chiefly to a few districts in Oklahoma, Eastern Kansas, Western Missouri and South-west Illinois. The amount of the annual crop is not given in the returns, but it is estimated to be under 100,000 bushels. The imports of castor seed to the United States in the fiscal year 1908-9 amounted to 613,708 bushels, and of castor oil for the same period to 6,846 gallons. These were derived chiefly from India, but seed was also imported from Brazil.

Although not native to Brazil the castor plant finds in that country a suitable soil and climate, and has become naturalised to a large extent. The consumption of castor oil in Brazil is large, and there are a number of castor-oil factories mainly in the State of Pernambuco.

It will be seen from the foregoing information that, whilst there is a very large demand for castor seed and castor oil, this demand is met from comparatively few sources, and that many of the importing countries are in a position, as regards climate, to produce all the castor seed they require. This aspect of the question has been seriously considered in recent years, in Australia and certain of the South African States, but, so far as is known at present, but little has been done to establish an industry in either of these countries. Tho manufacture of castor oil in the United Kingdom has been established comparatively recently, and this has given a further incentive to the production of castor seed in various British tropical and subtropical colonies. For these reasons a large number of inquiries had been received at the Imperial Institute in recent years, on the one hand from manufacturers desiring new sources of supply of castor seed, and on the other from planters in the colonies desirous of undertaking the production of this seed.

Preparation of Castor Oil.

Large quantities of castor oil are prepared in India by crude native methods of expression as well as by modern machinery. In the United Kingdom the greater part of the castor seed imported is crushed at Hull, and in France at Marseilles, the methods of obtaining the oil being similar to those employed for other oil seeds.

For the finer grades of castor oil, such as that required for medicinal use, selected seed is taken, the husk, which is devoid of oil and comprises about 20 per cent of the weight of tho seed, is removed, and the soft kernels are expressed in the cold ; by this means an almost colourless oil is obtained, which is free from the poisonous principle, ricin, present in the seeds. This is termed "cold drawn" oil. The remaining cake is then broken up and pressed a second, or even a third time, when it yields an inferior oil of yellowish or brownish colour unfit for medicinal use. The last traces of oil can be extracted by solvents, carbon disulphide or alcohol being used instead of light petroleum on account of the insolubility of castor oil in light petroleum.

Inferior seed is hot pressed directly or is extracted by solvents alone. After expression the oil is refined by steaming, which causes coagulation of albuminous matter and renders inert the fat-splitting onzyme which, if left in the oil, would cause it to rapidly turn rancid.

Castor seed of commerce contains from 46 to 53 por cent of oil, and Lewkowitsch states that on a manufacturing scale about 40 per cent is obtained by expression, the first pressing yielding about 33 per cnt.

Uses of Castor Oil.

The pure "cold drawn" oil is largely employed in medicine as a purgative, its action being due to the ricinoleic acid. Numerous dry preparations are now made in which the taste of the oil is marked by various means. In one method (German Patent 150,554) the oil is mixed with milk sugar; whilst another preparation is manufactured by emulsifying the oil with gum arabic and treating with magnesia and lecithin.

Castor oil is largely employed as a lubricant in India, but is rather too viscous to be used in this way in cold climates, although it is used for marine engines and for internal combustion (petrol) engines. It is employed for dressing leather belting and for "fat liquoring" in the leather industry.

An important application is in the manufacture of "turkey red" oil, largely used in alizarin dyeing. This is prepared by treating the oil with concentrated sulphuric acid at a temperature below 35 deg. C. This "sulphonated" oil is washed, and ammonia or soda added until a sample of the liquid gives a clear solution in water. The use of turkey-red oil improves the lustre of the dye, but the reason for this action is not clearly understood.

Castor oil is insoluble in light petroleum or hydrocarbon (mineral) oils, but by heating to about 300 deg. C. for several hours, either at atmospheric pressure or under increased pressure, the oil polymerises and becomes soluble in hydrocarbon oils, and can then be used for making compound lubricating oils.

Castor oil is also employed in the manufacture of so-called 'rubber substitutes.' These are prepared by treating the oil with sulphur at an elevated temperature, or by treating a solution ofthe oil with sulphur chloride at ordinary temperatures. The 'soda soap' of castor oil rerequires large quantites of brine for soapmaking to any extent ; it has, however. the property of imparting transparency to soaps, and is consequently employed in the manufacturo of transparent soaps.

A less important use of castor oil is the production of 'cognac' oil. For this purpose castor oil is submitted to dry distillation, when a mixture of œnanthaldehyde and undecylenic acid, constituting the 'cognac oil,' pass over, a bulky rubber-like mass remaining in the retort.

Castor cake or meal is largely employed as a manure, the large quantities produced in Marseilles being employed by growers of early vegetables.

In India the residue from the native method of preparing the oil, castor 'pomace' contains a higher percentage of oil than that produced by expression in hydraulic machinery or by extraction with solvents, and is employed largely in India for manuring, and to a smaller extent for stuffing the soles of native made shoes, for caulking timber, as fuel, and for making illuminating gas.—*The Journal of the Jamaica Agricultural Society.*—July, 1911.