Photo by H. F. Macmillan.

THE "CANDLE TREE," PARMENTIERA CEREIFERA.

THE

TROPICAL AGRICULTURIST

AND

MAGAZINE OF THE

CEYLON AGRICULTURAL SOCIETY.

VOL. XXVI. COLOMBO, MARCH 15TH, 1906. No. 2.

New Products in Ceylon.

A century ago, the few products cultivated in Ceylon—mainly rice, cinnamon and coconuts—were not "new products" but things native to the island. At the present day, the numerous crops mostly are or have been new products, *i.e.*, plants introduced into Ceylon at one time or another. Such for example are tea, cardamoms, cinchona, rubber, cacao, coffee, vanilla, camphor, coca, &c.

The rise of new products dates from 1824, when the estate of Gangaruwa, now the Government Experiment Station at Peradeniya, and still known to the Tamils as 'Raja' Thottam, was opened by Governor Sir Edward Barnes. He, like most who first came to Ceylon, took for granted that Indian crops must also succeed here, and tried indigo, sugar, &c., with failure as the result. Later it was discovered that coffee would succeed here, and with that began the coffee boom, which lasted till about 1875, when the rapid spread of the leaf disease began to kill the industry.

Until 1875 or 1880 no one wanted, and no one would even look at, any new product, but Government had not been idle in introducing them through the Botanic Gardens at Peradeniya, Henaratgoda and Hakgala. Dr. Thwaites had already introduced cinchona, Liberian coffee, rubbers, and other plants. With the downfall of coffee people began to try these.

The first to rise into prominence was of course cinchona, introduced at Hakgala in 1861. Had the people upon whom this cultivation was then pressed been willing to plant little patches of it through their coffee, they would have made large profits and also checked the spread of the coffee disease. But this unfortunately is not Ceylon's way of doing things. No one touched cinchona till about 1875, and then rather gingerly. The first pioneers made large profits, and then followed a rush which rapidly covered the upcountry districts with this tree, lowered the price of quinine from 12 shillings to 1 shilling an ounce, and destroyed the profitableness of the industry. No attempt was made to improve the yield of the barks, or any such thing, and Java, which went doggedly and scientifically to work to do so, has taken away from Ceylon the whole of her cinchona trade, and is never likely to be ousted from her position of supremacy.

Next came cacao, which in truth is a very old introduction to Ceylon, probably having been introduced by Moon to the old Kalutara Botanic Gardens. This, thanks to the work done by the Royal Botanic Gardens Department in the last few years in attacking the canker which threatened it, is still with us.

Tea followed. The Botanic Gardens were not the sole introducers of tea, though they had it very early, and Lear, an early Superintendent, planted tea in Nuwara Eliya in 1837. The rise of the industry dates from the commission to Assam, which was provided with questions by Dr. Thwaites.

Liberian coffee had a small 'run,' but has never been much of a success in Ceylon. Ceara rubber was tried in the early eighties, but did not yield well enough, and was soon cut out to make room for tea. Vanilla came later, but the artificial vanillin and overproduction have destroyed its profitableness; and now, last of all, comes rubber, especially Para, which was introduced by the Royal Botanic Gardens in 1876, and bids fair to have a "boom" of several years, being perhaps the most profitable crop ever cultivated in the tropics, and one with an enormous market.

Now there is still, though it is dying out, a widespread impression that this sort of thing will continue, and that Peradeniya is a kind of lucky bag from which new products will emerge as the old ones are overdone. It is necessary to state clearly once for all that the day of this kind of thing is over, and that it is now far more important to improve, extend, and consolidate the industries already existing in Ceylon, than to devote attention to the comparatively minor chance of finding something to take their place if they fail.

The great success of the various industries in Ceylon has been due to the fact that they have had to meet only the competition of wild jungle stuff (as in rubber and cinchona) or that of the tropical races of mankind (as in tea) who are not up to date in methods and machinery. This is now all over, and every thing of any value is now in the hands of Europeans, Americans or Japanese, and a fierce competition will have to be met, in which Ceylon will be handicapped by poor soil &c., but will have vast advantages in other directions. The victory will be to him who most intelligently applies the resources of science, politics, &c., to aid him.

Ceylon has now a very rich and varied list of products and is not, like Jamaica or Hawaii, almost entirely dependent on one, as she was in the coffee days, when at one time coffee formed 95 % of the value of her exports. The island cultivates, on a commercial scale, rice, tea, cacao, rubber, coconuts citronella, palmyra palms, tobacco, cinnamon and cardamoms, besides smaller quantities of nutmegs, cloves, kituls, coca, camphor, lemongrass, cassava, annatto, sapanwood, vanilla, pepper, coffee, kola, sugar, fruits and vegetables. This is a magnificent and varied list, and our attention should be devoted to improving these and extending their cultivation into new districts. Sugar is almost the only tropical product of importance not seriously cultivated in Ceylon (though there is a little), but our soil and elevations are unsuited to it, and it grows well in Java, Hawaii and Cuba.

So far, then, as Ceylon is concerned, the idea to be understood in the term "new product" requires great extension. We have now got, in general, to find products which are absolutely new, to find uses for these products, and to create a market for them. Obviously this is a task of far greater difficulty than merely introducing such a plant as cacao or rubber. Thus, for example, at the present time, it has been suggested that we should use our Mana-grass (*Andropogon Nardus*) as a source of paper, for which purpose it has never hitherto been used. We have then to show that this grass will give a good paper, that it can be laid upon the European market in vast quantity, and as cheaply as any existing source of paper, and that this rate will remunerate those who collect it in Ceylon. To get favourable answers to all these questions is evidently much more easily said than done, yet all must be so answered before we have "got" the new product.

GUMS, RESINS, SAPS AND EXUDATIONS.

The World's Rubber.

CEARA RUBBER (MANIHOT GLAZIOVII) IN CEYLON.

A few words in season respecting Ceara rubber which is gradually growing in favour in South India and Ceylon. A great many of this variety of rubber tree were abandoned in the island owing to unsatisfactory prices secured for rubber some years ago, but now that the market has considerably changed for the better, these abandoned trees are being tapped with the following result, viz. :—Sold as Ceylon Plantation Rubber, Ceara is realising the same price as Para *if properly cured.*

It would be, of course, ridiculous to plant up Ceara at elevations where Para rubber would grow, and give latex freely, but at *medium* elevations it would do well and is worth experimenting with in various parts of the island. This is being done to a certain extent. I have sold seed and stumps to be planted from 2,000 ft. to 4,000 ft. elevation, but whether the latex collected at the *latter* elevation will bring in a *profit* remains to be proved; but from 2,000 ft. to 3,000 ft. (even if the prices drop to 1*s.* per lb.) it should leave a fair margin of profit. Of course, it would be absurd to plant this rubber in *poor* abandoned soil in which even mana grass will not grow satisfactorily. But there are large acreages in Ceylon at the elevation given, of fairly good soil, that if planted in tea would not give a profit at present prices ruling, and yet would in Ceara; and those who wish to cut down expenditure to bring the trees into bearing (*i.e.*, six years or under) could weed 3 ft. only round the trees planted, say 20 ft. by 20 ft.

The outlay for cost of seed or stumps and opening up any abandoned land would be *less* than if planted in Para. The difficulty of germination of the seed has been overcome by filing the exterior which will assist germination, otherwise seed may remain dormant in the nurseries for months. An even *simpler* method is to place the seed in *boiling* water, and let the water boil for five or ten minutes or allow the same to cool and then remove the seed. The seed afterwards should be covered with a dressing of horse dung, which will accelerate germination in the nursery. Of course, by purchasing stumps anyone is practically *one year* ahead of his neighbours, which is a distinct advantage, supposing the rubber market does fall slightly.

A few words *re* tapping and curing may not be out of place. One must not be too *drastic* with tapping, otherwise he is liable to kill the tree or leave bare patches. If the following plan is adopted it will prevent this:—Remove only 2 feet of the outer bark for the first tapping all round the tree and cut only 4 (four) V-shaped cuts in one day, two incisions in the morning above; ditto two below in the evening *five inches* apart, commencing in the middle of the tree. Continue this all round the tree until you reach the lateral branches above and the roots beneath. After this is finished, then *scrape* only the newly-formed bark off with a piece of barrel hoop iron, and then cut an intervening incision. One must be careful not to cut down into the cambium or wood, or portions (with the help of white ants and insects) will die back. Do *not* clean out the latex collected in the incisions for scrap rubber because it acts as a balm to *heal* up the wound, besides keeping off white ants, etc. The price realised for rubber which contains bits of bark, etc., is very small sold as balls.

Should anyone wish a *rich amber* colour biscuit, all that is necessary is to add a few drops of pure lime juice when mixing the latex with water in the tin plate prior to coagulation. Not only does it force on the coagulation process, but is supposed to keep the biscuits from collecting mould to a certain extent when in the drying preparation. Some brokers and buyers do not like any admixture whatever and prefer the *palish* biscuit. This can be left to anyone's discretion. I need not send you valuations as only recently a report was inserted by you, under heading "Ceara Rubber in South India," in which Messrs. Sanderson & Co., of Mincing Lane, valued some of "Beechlands" Estate Ceara Rubber at 6*s.* to 6*s.* 1*d.*, which is the present market value of *well-cured* clean Ceara Rubber. However, I am forwarding to you under separate cover biscuits for you to get the *local value* to compare with London valuations.

[The biscuits which were of good colour and texture were valued in Colombo at top local prices. Rs. 4·20 per lb. equivalent to 6*s.* 1*d.* per lb. in London.—Ed. *C.O.*] —*Ceylon Observer.*

CULTIVATED CASTILLOA IN NICARAGUA.

During the year 1904 the first attempts at harvesting latex from cultivated rubber trees were made in Nicaragua. The plantation on which these experimental tappings were made belongs to an American, Mr. J. C. Horter, and is situated in the Perllagune district about 30 miles north of Bluefields. It is the oldest of the plantations of Castilloa. The trees tapped were raised in a nursery in 1897, transplanted in 1898, and in 1904, when 7 years old they had attained a height of 40 to 45 ft., and measured 17 to 30 inches in circumference. 6,000 trees were tapped, the smaller receiving only one cut, the medium two cuts, and the largest three each. A total weight of 534 lb. caoutchouc was obtained, being an average of 1½ oz. rubber per tree: a poor average. A tree after a certain time can be tapped a second and even a third time without appearing to suffer, and giving the same quantity of latex. By careful attention in collecting the latex the rubber obtained was of a greater value than the ordinary rubber of the district, commercially called "Nicaragua syrup" (*sirop*).

The natives are accustomed to tap the superficial roots of the trees, and the latex which runs out becomes mixed in coagulating with particles of soil, &c.; this product is called "syrup": what is obtained by coagulating the latex from the branches and trunk is called "burracha." But as the collectors of the latex in the wild state are at great distances, these two sorts of rubber are mixed together generally, the better class rubber surrounding the bad kind.—(*Translated from the French*).—*Ceylon Observer.*

CULTIVATION EXPERIMENTS IN MADRAS.

The following is from Mr. C. E. Brasier's Report on Forest Administration in Madras for the year ending 30th June, 1905:—

Rubber Trees—(*a*) *Landolphia florida.*—The twenty-two trees in South Malabar mentioned in last Report are in good condition though somewhat damaged by monkeys.

(*b*) *Ceara* (*Manihot glaziovii*).—The plants in Chatrapur, Ganjam, exist without thriving. A single tree, apparently remnant of an abandoned rubber plantation on Kondapalli hill, Kistna, has reproduced about fifty plants, all of which are doing well, the climate and other local circumstances of Kondapalli evidently suiting the species. Those put down in Someshwar, South Canara, did not germinate, but four out of 300 seedlings planted near Alur resthouse were nine inches

high and in good condition. Seeds sown in Kanoth in North Malabar did not germinate. In North Malabar two acres in Kanoth reserve contain well established and large trees which have been tapped once, without results being recorded however. There is another plantation at Manantoddy which has similarly been tapped. The trees in South Malabar diminished in number, some being blown down by wind, while their natural reproduction was considerably checked by deer and sambhur. None of the 1,304 seeds (Kallar variety) sown in the nursery last year germinated. In the Nilgiris there are sixteen well-grown trees in and around Benne nursery, and growth from their seeds is abundant. 3,514 seedlings were planted in Benne Teak plantations and station and Mudumalai, but none of the seeds sown in the nursery germinated. An attempt was once more made to introduce the species in North Coimbatore but was a failure, only two meagre seedlings surviving in the Range compound at Satyamangalam. The Ceara rubber trees planted at Mount Stuart in South Coimbatore are well established and are bearing seed; natural reproduction from seed is also prevalent. Sowings of this tree at Kodaikanal, Madura, proved a failure. A small percentage of seeds sown in Tinnevelly germinated.

(*c*) *Ficus elastica.*—The young plants put out in various places in Ganjam did well where sheltered from the sea-coast wind and sand blow, but died elsewhere. In Nellore the experiment proved a failure in Kollurpad plantation.

(*d*) *Hevea brasiliensis* (*Para rubber*).—Seeds failed to germinate in South Arcot. Three hundred and twenty plants survive in the nurseries at Someshwar in South Canara and are being transplanted. Of 535 seeds sown in Begur, North Malabar, 15 germinated, and only three now survive. In South Malabar, 24 trees exist in Iravillicave in good condition. Of the 535 seeds sown, 64 germinated, but owing to the damage done by rats, monkeys and porcupines, only eight plants survived.

(*e*) *Kicksia Africana.*—Only twenty-two of this exist in South Malabar. They show very shrubby growth and are not likely to produce much latex. They were much damaged by a boring caterpillar.

(*f*) *Dichopsis elliptica.*—One hundred and fifteen pounds of rubber were manufactured from the milk of this plant in South Coimbatore at a cost of Rs. 100 and sent to Messrs. Pierce, Leslie & Co., at whose instance the experiment was undertaken.

RUBBER IN TRAVANCORE.

PEERMADE.—On this side of the country there is no paddy cultivation to be interfered with by drainage of lands cleared for rubber, and there are thousands of acres of land at present almost unknown and absolutely without population, from which no timber has ever been exported, as roads do not exist, and which do not contain either teak or black-wood. The rainfall, soil and lie of land are all suitable for rubber cultivation. These lands, had they been surveyed and sold a year ago, would have placed Travancore at least second among rubber-producing countries of the East. I may mention that it has been decided to start a Central Travancore Rubber Planters' Association. The following is a fairly accurate list of rubber estates on this side of the country:—

LAND HELD UNDER TRAVANCORE GOVERNMENT.—Mundykayam Estate, about 500 acres; total planted about 250 acres. Vallanardie Estate, about 600 acres; total planted about 350 acres.

LAND HELD UNDER PUNJAT RAJAH.—Jenduar Estate, about 600 acres; planted about 340 acres. Kuttikal Estate, about 700 acres; being planted about 400 acres.

LAND HELD UNDER CHUNGANUR RAJAH.—Eldorado Estate, about 600 acres planted; and being planted about 500 acres. Kurdomankolam, about 1,200 acres planted; and being planted about 500 acres. Kuppukayam, about 800 acres planted and being planted about 150 acres. Grahamsland, about 300 acres planted; and being planted about 200 acres.—*Madras Mail.*

RUBBER AT HENARATGODA, CEYLON.

POLLARDING HEVEAS: HIGH TAPPING: SCIENTIFIC COAGULATION.

We were a square party who sat down to dinner at the Henaratgoda Resthouse one evening not long since. All were, of course, interested in the topic, *the* one great all-absorbing topic of the day in Ceylon—RUBBER, and all had a hand more or less deep in the industry. There were the Inventor, the Scientist, the Planter, and the Writer. The last of the quintet, the Company Promoter, was missing, but he turned up next morning betimes having dossed for the night at Veyangoda.

The rubber experiments plantation, for that is what the Henaratgoda gardens are now in addition to being a botanical garden, is but a walk from the Resthouse, and the tappers were just commencing their morning's task when we arrived next morn. The visit to the plantation resulted in what was really a practical lecture and demonstration on the rubber tree, and the working of it to the best advantage, the Scientist being the "spokesman," while the four others put forth questions and opinions and desired solutions of various knotty points, of which more later. The Inventor, as becomes such a remarkable man, had plenty of good statements to make; but, like many of the *bon mots* of the Company Promoter, such things are not all meant for the public, nor is it good for them to hear them.

POLLARDING HEVEA BRASILIENSIS.

Passing the grove of the old original Para trees—and these parents of the plantation rubber industry always inspire respect—we came to the plantation of trees of different ages raised at Henaratgoda, and on one of them the wood-cutters were at work. The middle one of three untapped 10 year old trees, all about the same girth, was being cut away at 15 ft. from the base. Now the Scientist came to the fore and commenced his story.

"In a Hevea plantation," was the drift of his words, "we don't necessarily want lofty trees with tall straight stems. What is required is a very big-girthed trunk of about 15 ft., with plenty of foliage on the top. To obtain this I recommend pollarding the young trees at about 15 to 20 ft. from the base; this may induce a great annual increase in the girth of the stem and consequently you may have a much enlarged tapping area. You don't usually want to tap higher than 15 ft. Of course, I cannot, at present, recommend pollarding 10 year old trees—this one is being done *solely as an experiment* to compare its growth with these two trees beside it. What I do recommend is thumb-nail pruning young trees when they've reached a height of 12 to 15 ft in order to induce lateral branch growth and an increased amount of foliage."

"What is thumb-nail pruning?" interjected the Planter.

"*This*," said the Scientist, demonstrating by taking the main shoot of some plant growing near and nipping off the tiny terminal bud with his thumb-nail, "that prevents any further growth in length and induces the stem to thicken and throw out side shoots. We have found here that by pollarding young trees an increase of girth growth is obtained of one inch per annum; that is 3—4 year old pollarded trees are equal to unpollarded 4—5 year old trees; and thus we can equal in Ceylon the extra growth of the Malay Peninsula."

The natural proof of this is seen in trees that begin to fork a short distance from the ground, for pollarding has the same effect as natural forking. Of the oldest Henaratgoda trees (30 years from seed) most are trees with tall straight stems, while a few are forked at 7 to 11 feet from the ground. The average girth of the straight trees at a yard from the ground is 75 inches, the average of the forked trees is 105 inches; while one tree forked 11 feet from the ground girths 110 inches and two others 109 inches each! (Fuller particulars on this interesting

and important point are given on page 50 of the latest book on Para Rubber.)* Planters do not seem to have yet realised what the result of this pollarding and thumb-nail pruning, originally announced in the book referred to, means. It means a year less to wait until the trees are ready to tap; it means a return on capital a year earlier and when prices are high; it means tapping with safety 4 year old trees!

HERRING-BONE AND SPIRAL TAPPING.—Meanwhile, tapping was going on on the trees. At Henaratgoda the systems under careful experiment are the half and full herring-bone and the half and full spiral—these are the only methods of tapping yet evolved that are really economical and scientific, and of these the full spiral, if carefully and properly done, is perhaps the best because the perfect shape of the trunk is maintained. The trunk always swells and increases in girth where tapped, and the best system is that which allows this growth in girth to be equal all over the trunk. The planter who adopts spiral tapping must emphatically insist on its being carried out in the very best manner, and in the long run the extra care and trouble taken will be well repaid. Certainly the Henaratgoda trees are a good example of careful and clean tapping. Tapping is done on different lots of trees every day, every alternate day, twice per week, and once per month.

"In tapping," began the Scientist, "it is necessary only to shave off the very thinnest paring, just to re-open the milk tubes which are already swollen through the phenomenon of wound response." In the outer bark of the tree there is no rubber at all, nearly all the milk tubes lie in the young growing bark close to the cambium, and these tubes are just pierced in tapping; the cut must not even go right through the young bark and certainly should not go down to or expose the cambium.

"Remember this," said the Scientist, and he held up a menacing finger at the Planter—"the first time you tap the tree spirally it must be done very lightly—we'll examine your first attempts presently—for though it's a perfectly sound method, there is no doubt that if any system of tapping will kill a tree the full spiral wi In fact I have on a certain estate killed out trees in a too densely planted estate by tapping hard on the full spiral system from the base up to 30 ft. high. Your object is to cut away the bark as slowly as possible, and we have had excellent results here. These trees have been tapped for *three months*—tapped twice per week using the knife and the pricker alternately—and *as you see*, we have worked through *one inch* of bark, that is 4 inches per annum, *or a foot in 3 years.* By pricking twice to each time the knife is used this could be further improved; that is, we strip the bark of the tapping area once in from three to six years. As you see on this tree the renewed bark is already almost on a level with the original bark, and is again full of milk in *only three months.* So that in three years, or more, when it will be tapped again, it will be old bark."

These results are certainly astonishing, and it can now be no matter for doubt that 6 lb. per tree and more per annum can be obtained from many trees ten years old that have been reasonably looked after. For it must be remembered that at Henaratgoda the trees are *uncultivated trees*, and not growing in particularly good soil.

But our attention was attracted to various lofty trees against which some pretty substantial scaffolding was erected. A cooly was mounting one; carrying a knife too, and yes! why, he's actually tapping at 30 ft. high! One could hardly believe it at first. Tapping at 30 ft. up after all that has been written and said in the last twenty years about tapping only the first six feet of the trunk!

---

* *Hevea Brasiliensis or Para Rubber* by Herbert Wright. Published by A. M. & J. Ferguson, Colombo.

Yes, the Scientist admitted, he was really doing it, and getting pretty fair results too, but it was merely an experiment and *a practice not advocated.*

"I am tapping these trees" he said presently, "from base to 10 feet, from 10 feet to 15 feet, from 15 feet to 20 feet, and from 20 feet to 30 feet on the herring-bone system, and one tree on the full spiral system is being tapped from the base to 30 feet high. The results are not as yet public, and it is too early to say anything definite as only a little has yet been done, but the results will be published for the information of planters when we have anything definite to go on. But I may say this, that high tapping on Hevea trees is not only absolutely useless on the ordinary plantation now being cleared and planted, but even dangerous to the wellfare of trees. It can *only* be done on such trees as we have here at Henaratgoda, which are unique, and on one or two estates where they have old or very lofty trees, such as Culloden and Kepitigalla, where Mr. Holloway is tapping very lightly up to a certain height. It cannot be done on the ordinary plantation which has to come into bearing in four to six years from planting; girth should be sought and pollarding tried."

"This particular tree," he continued, as we grouped round a gigantic-bowled Hevea on which three men were at work shaving the full spirals, "presents rather a curious phenomenon. It yields latex freely, but it won't coalesce, and acid only curdles the milk; why, I have not yet ascertained, but it may be because there is a lack of caoutchouc in the milk; it will probably recover in time."

Seeing three men at work on one tree to tap it properly gives some idea of the enormous amount of labour that will be required for the rubber industry in a few years' time if trees are allowed to grow into really large specimens. One cooly per acre will not be the estimate for many years! The Planter had been trying his hand the previous day at spirally tapping a tree, and with trepidation and fear of caustic criticism he watched us approaching the tree. But the tapping, carried out on theory, was good enough. The Scientist explained, however, that the original channel was too wide.

"The less bark you remove the better, and the first channel must be as narrow as possible. After the tree is marked out with chalk or tar, where each spiral is to be cut, take your knife like *this* and gradually work off the bark. All you want to do the first time is to irritate and cut the milk tubes just sufficient to induce a small flow of latex—in fact, it need not even run down but may be all scrap. The flow will increase at each tapping up to about the fourteenth, and until there is wound response much latex must not be expected. But don't cut deep thinking you'll get more flow with the first incision." While talking he had been cutting a neat channel round the tree showing how the work should be done, and the Planter looked on with envious eyes. "Hullo! Hullo! suddenly burst out the Scientist," what have you been doing! Cutting through a knot! I thought you'd know better than that. *Never* cut through a knot in the tapping area; take your cut round it, even if it alters the parallel of your line, and leave the knot to work itself out, which it will in time."

Discussing the flow of milk in the spiral system it was explained that it had been proved that, in some countries, the largest quantity of rubber was obtained in the leafless or wintering stage of the tree. This is due to the fact that there is no enormous transpiration of water going on from the leaves, and it is the same in the early morning before the sun's heat makes the leaves transpire, consequently there is a big flow of latex.

THE USE OF DRIP TINS.—The announcement of the use of drip tins in the book on rubber referred to was the first intimation of this invention. These are patented by Mr. Geo. S. Brown, of Messrs. Brown and Davidson, Talawakele, and a good idea of their use may be obtained by seeing the rough tins in use at Henaratgoda. Chemical is not yet used in these, nor is the drip properly regulated, but the absence of scrap by the use of water even is very noticeable. Ammonia or formalin prevents the clotting of the latex which continues to flow assisted by the dripping of these chemicals from the drip tin; and sufficient chemical is in the tin to keep the latex going until the wound is practically sucked dry. No scrap whatever is found in the cuts, and when one considers how much time each cooly has to spend in pulling the scrap out of ordinary cuts, it is seen what a great labour-saving device these drip tins are, as well as enabling all the rubber to be made into sheet or biscuit and having no poor grade scrap. Once more we were among the bigger grove of trees, and a very interesting sight was a coolie with a supply of white clay building up little canals on the trunks of trees tapped on the half herring-bone and half-spiral systems. Again, the Scientist was appealed to.

"It's well-known that the milk tubes run vertically in the bark, so that to obtain a flow an oblique cut is advisable and a vertical one is useless; therefore the vertical channel cut in the half herring-bone or the half-spiral is an extra strain on the recuperative powers of the tree, and does not produce any latex—in fact it is useless. Moreover, the vertical cut relieves the tension in the tubes and thus hinders the flow. We can get over this in two or three ways. First, in this set of trees we have the half-herring bone or half-spiral cuts without any vertical channel, and the milk from each cut runs out on the little patent tin spout fixed at the bottom of each. Each spout is a little longer than the one above, so that the milk drips from one down to the next below, and so on to the collecting pan at the base. But in this other set of trees we have a little clay channel or canal built up the tree and each side cut running into it. This does away with the use of the spouts, and there is no need for the vertical cut."

A cooly's task is 25 trees clayed per day, and once done the clay canals should last a long time. But time was rapidly fleeting, so we returned to the small rubber house which for the nonce was turned into a chemical lab.

THE LATEX AND ITS COAGULATION.

If any planter who reads these notes has done his duty and read the latest book on rubber he will have learnt something of the nature of rubber latex. He will know that latex is chemically neutral or slightly alkaline; and by practical demonstration red litmus paper immersed in it remains red, and blue litmus remains blue. In latex there are certain proteids (nearly 3 per cent. in prepared rubber) and also various sugary substances (mosite, matezite, etc.). It is these that are responsible for the growth of bacteria in dry rubber which produces decay and "tackiness." These proteids in the latex remain in solution so long as the latex is neutral or alkaline. If enough acid is added to more than neutralise the latex—that is to make it feebly acid—the proteids, which are insoluble in acid, are precipitated and the globules of caoutchouc are gathered together. This is coagulation of the latex. So that for perfect coagulation you want to add just sufficient acid to more than neutralise it. If too much acid is put in the latex the proteids are redissolved, and after the milk is coagulated there still remains some proteid and caoutchouc in the water—also the rubber is injured. The danger of using too much acid is at once apparent, and the result is seen in many rubber factories where the planter leaves the rubber water over for an extra 24 hours for the rest of the rubber to coagulate.

A Chemical Test in Coagulating.—The Scientist gave us practical proof of this with a pan of freshly-tapped latex. Red and blue litmus were immersed in the fresh milk and neither changed colour—the latex was neutral. Then the proper proportion of glacial acetic acid was added to just make the milk slightly acid; the red litmus then immersed remained red and the blue changed its colour to a half tint, neither really red nor really blue—on close inspection in a few minutes the coalescing of the globules could be observed on the surface of the milk.

"By properly doing this" said the Scientist, "and by using the washing and rolling machines you can tap your milk to-day and have your rubber to-morow dried. creosote coated, and ready to pack.

The proper proportion of acetic acid to use is not stated here, but it is all given with full particulars in chapter X. of the Para rubber book, to which the reader is referred. The process of coagulation, it can be read therein, precipitates the proteids; but it does not get rid of them from the dry rubber, where they form 3 to 4 per cent. of the whole. This purifying of the rubber must be done by washing it under a constant stream of water. "Rubber cannot be washed too well. Washing it while rolling by hand (rolling under a jet of water for instance) takes off the superficial proteids and stops the initial bacterial growth, but hand rolling and mangling do not effect the interior proteids. This must be done in a machine where it is properly disintegrated, rolled and efficiently cleaned."

Here, as the Scientist finished, the Inventor beamed and smiled a jovial, self-satisfied smile. The chauffeur was already sounding his horn. The Scientist put away his test tubes and wiped his brow; the Company Promoter made a last entry in his note book; the Planter wondered in vain where the drinks were; the Inventor reappeared from the bowels of the Motor-car which for some reason had momentarily stopped panting; the last man stepped in and, Hey presto! in two minutes Henaratgoda was left far behind as we sped Colombo-wards.—*Ceylon Observer.*

POLLARDING AND THUMB-NAIL PRUNING RUBBER TREES.

I.

The following letters in the local press followed the publication of the preceding article on "Rubber at Henaratgoda, Ceylon:"—

Neboda, Jan. 15th, 1906.

Dear Sir,—Your article under the heading "Rubber at Henaratgoda" in the *Ceylon Observer* of January 9th, I read with much interest. I would like to make a few criticisms thereon from knowledge gained by practical experience.

Pollarding.—What would be the result from pollarding was in my mind in 1904 when I tapped two 10—12 year old trees at about 15 feet from the ground. Both trees were healthy and freely yielding latex. The ultimate result has been the same in both cases, so that I shall only deal with one, No. 596, pollarded 11/3/04, and measuring at 3 ft. from the ground 34 in. in girth. For the purpose of comparison I must include another tree standing some 12 ft. off, No. 597, measured the same date, girth 31 in.—not pollarded or in any way interfered with. Since No. 596 was pollarded several attempts have been made to extract latex with unsatisfactory results. In fact, I may say, 596 has given no latex from that day to this. (It looks as if it might be induced to give us a little now, and we are making another attempt.) Both trees have been tapped with the V knife in 1903, and their skins at the time the experiment was commenced were fairly thin. No. 597 (not pollarded) was tapped three times in 1904 and every other day for the best part of 1905, and is still being tapped. The bark is thick, milk flows freely, and the tree is in every way healthy.

The following are the re-measurements taken on 12th inst:—

No. 596 (pollarded) 35¾″ 1904 34″ gain 1¾″
No. 597 (not pollarded) 35″ ,, 31″ ,, 4″

597 suffers in the re-measurement as the top of the 3 ft. stick meets the full herring-bone, and there is consequently considerable loss in girth over the pared surface. Of course, there is latex in the pollarded tree, but it is too busy apparently with its foliage and extra branch growth above to attend to our full requirements below. The leaves after pollarding were remarkable for their size. This is not so now; appearances are more normal. This experiment is enough for the present. so far as old trees are concerned, and your Scientist's undertaking will be watched with much interest. If your Scientist by the above method is able to make his Hevea clearings grow to meet the best tapping requirements, then indeed we have much to thank him for. I think generally our experience does not bear him out. How often have we tried, all of us probably, to make a young tree fork, and how often has the single shoot only been the result? After damage by animals, as many as a dozen times, yet the single shoot only has returned. If for some reason or other the tree dies back, then you get your side branches. Your Scientist may have hit the right spot at 12—15 feet, but I should like to inquire if he has persuaded the majority, or any, of his 18—24 months young trees, with single stems, to throw out branches before nature is ready to do so? If he has been so far successful a very important step has been gained. I submit, however, the probability of gaining more "later branch growth," "an increased amount of foliage," with a forced and increased tapping area with latex, has not yet been proved, nor can be for some time. So that when your Scientist puts forward "Pollarding" as a practice to be adopted, and to be urged on Planters in such forcible language as that contained in your article under reference, I consider he makes a very dangerous mistake. There is nothing at present to warrant such advice, and the arguments put forward are rather against than in favour of the supposition.

On page 21 of "Hevea Brasiliensis or Para Rubber," the argument there that we pollard Tea for branch growth and flush cannot be quoted in favour of pollarding Hevea trees for tapping surface and latex. "Wound response" and the result of my own little experiment leads me to think that the more forced foliage, the less latex and non-increase of tapping area. We know, too, that tapping has upset the credited wintering season. Trees can now be found wintering all the year round. One other point would be—does not the total tapping area of the long thin stem equal that of the short thick one? I rather think it is the higher tapping difficulties that we have to overcome and to which our attention should be given. Mr. Wright in his book published in 1905 speaks of pollarding as something to be tried. Sufficient time since this book was published has not elapsed to put pollarding forward to the whole tropical world in the form your article implies.

It is estimated in the Straits that the shavings from 100 coolies' work will give about 25 lb. dry rubber. I am inclined to think that the paring to produce this must be rather thicker than that done on carefully worked estates in Ceylon. There is no doubt about the rubber being there, and if your Scientist will send along some of his shavings I will let him know results. My figures are not final, but experience shows that from 100 lb. shavings some 7—8 lb. dry rubber only can be extracted. One cooly's shavings would hardly be ¾ of a pound. The machine used is a rubber washer—two rollers driven at different speeds under a stream of water.

To no one are our thanks more due than to those gentlemen, our Scientists, who are daily plodding along, for our ultimate benefit, with keen interest and determination to solve our latest agricultural problems, and to prepare results

for practical working. You find these gentlemen buried in paraphernalia—all of which is absolutely necessary for the work to be done. We, however, are not scientists, and have only to take over the net results where they leave off We have no use for all the paraphernalia so necessary to these gentlemen. Rubber tapping of the future is going to be no hobby. Go through the older estates which are sending away their tons of rubber; climb the hills where the work of our future lies. You will not find coolies going about with the whole bag of tricks, neither now, nor in the future. A good tapping knife and *something* to hold the latex—nothing more is required. The cooly must do everything else; he can and has done it without the aid of chalk and measures, etc., etc. There is a photo of a herring-bone pared tree in a recent publication. There is nothing very bad about it, it was not a specially selected tree but only one of thousands. I think this is good enough.

All our energy and spare cents must be devoted to protection of the cambium Take care of the cambium and the latex will take care of itself.—Yours faithfully,

G. H. GOLLEDGE.

Rubber at Henaratgoda.—A week ago we published an account of a visit paid to the rubber plantation at Henaratgoda and the experiments being carried out there. To-day Mr. G. H. Golledge writes an interesting critical letter on several of the points raised in that article. His remarks are of service as viewing the situation from the position of the busy, practical planter, compared with the view of the scientist. Mr. Golledge's experience of the result of pollarding a 10—12 year old tree is of much value; his tree after nearly two years shows a gain in girth of 1¾ inches only, whereas a tree of the same age, growing under similar conditions but unpollarded, shows a gain in girth of 4 inches. Moreover, the unpollarded tree contains practically no latex; so that his experiment shows a negative result in pollarding 10 years old trees. The Henaratgoda tree was pollarded "solely as an experiment," and was not recommended. Mr. Golledge regards the tapping of the higher surfaces of the tree as of great importance, and to which attention should be paid. We submit to him, however, the probability of high tapping being more troublesome and requiring more labour (an important point); and that *if* a practical method of obtaining an equal amount of latex from the lower trunk be discovered, *cæteris paribus*, this would be preferable to high tapping. It is, we believe, a fact that the latex in the lower trunk contains a greater percentage of caoutchouc and of better quality than the higher portions. Mr. Golledge gives further remarks on the wintering of trees and rubber in shavings, and has a word to say in thanks to the scientists who are working in the planters' interests, which we cordially endorse. We heartily agree with what he says regarding the care of the cambium; but surely there is something required beyond a good tapping knife and a latex holder; there must, we submit, be a proper system of tapping followed out and the more economical and systematic this is, the better.—*Ceylon Observer.*

II.

"All are Architects of Fate,
"Working on the Walls of time;
"Some with mighty Deeds and great,
"Some with Ornaments of Rhyme."

Longfellow.

Sir.—Mr. Golledge, in his very practical letter of this day's date, is, I think, a little hard on Mr. Herbert Wright. I take it that both Mr. Golledge and Mr. Wright are working on the same lines, viz., with a view to extracting from a given finite number of rubber trees (without injury) the maximum of rubber in the cheapest possible way. Now, Mr. Wright has distinctly stated

that, in his opinion, a limitation of the vertical growth of the stem will secure a larger area of tappable bark from a thicker stem than will be got by allowing the tree to grow unmolested. I leave it to Mr. Wright—who is well able to defend himself—to produce his evidence, merely remarking that all botanical and horticultural evidence is in his favour.

Now for Mr. Golledge:—He says he (in 1904) tapped two 10-12 year old rubber trees at a height of 15 feet from the ground, their diameter being 34 inches at 3 feet. He is disappointed at the result—and naturally so. His complaint is that there was a loss in growth of stem of 3¼ inches, and that latex is diminished or non-existent. What else could he expect? To take a tree of such age and subject it to such drastic treatment, may be interesting as showing what mal-treatment Hevea will stand; but it cannot stand as an example of scientific dwarfing or judgmatic pollarding. N.B.—*Mr. Gotledge has not said how many feet he cut away, nor how many tatera branches he left.* Pollarding or disbudding must be done early, and at least four (or better six) branches must be left below the saw-cut, or the disbudded terminal bud. It does not matter at what the height this disbudding (or pollarding) is done, so long as sufficient lateral branches are left to carry on the life of the tree and enough bark area is left to tap on subsequently.

If there are not four to six branches below the level of 12 to 15 feet—(whichever is determined on)—then you must go higher till you get the required number, and pollard or disbud at even 20 feet. This last will probably be outside the zone of practical work. You must *mould*, not force, your tree in the right direction by encouraging lateral growth and discouraging vertical. It will not do to let a bare pole throw out buds, thus making a pollard willow-like mass of vertical twigs flourish on a broomstick stem. Still less will it do to let the same thing occur later, by leaving a few (say 4 to 6) spindly lateral branches and then letting a broom-head of verticals shoot up above them to suck the strength out of them in the line of least resistance. *Every vertical shoot must be removed by a second, third or fourth operation until the vertical habit is nipped in the bud—literalty as wetl as figurativety.*

N.B.—Shoots should be taken off before they are as thick as the thumb—earlier, if possible.

Mr. Golledge is lucky—his are the rubbers on a hundred hills. Let him give this scheme a fair trial and no favour, and I think he will, in after days, bless Mr. Herbert Wright, and

POLLARD RUBBER.

P.S.—Mr. Golledge seems to think Mr. Wright wants to cut a rubber tree in half or to thumb-nail prune it, making the tree grow laterals against the vertical influence of ascending sap. This, I am sure, is not Mr. Wright's idea at all.

Pol. R.

January 16th, 1905.

III.

Neboda, Jan. 20th.

Dear Sir,—Is it necessary to ask you to dismiss any idea of antagonism? I have not condemned "pollarding" finally; only said that present results do not warrant the pollarding being urged on planters, as the article referred to by me implies. We require more time for experiment work and results. That the big tree now being pollarded at Henaratgoda is as an experiment was per-

fectly clear to all and acknowledged by me. Your correspondent "Pollard Rubber" should know that there are generally no lateral branches at the height advocated by Mr. Wright on young Heveas. This is another interesting scheme which requires to be tried. I follow all suggestions from the Botanic Gardens.—Yours faithfully,

G. H. GOLLEDGE.

IV.

January 21st.

DEAR SIR,—I have read with considerable interest your correspondence on the above subject. Though I write subject to correction, I think it is fairly obvious that neither the correspondent who tries to discourage the idea, nor the one who supports Mr. Herbert Wright, has got a real understanding of what the process involves and the effect on the plants. It is common practice in European and other gardens to discourage vertical or high growth in stems and to induce lateral (not *later*) branch growth by cutting off the terminal leaves or by thumb-nail pruning the terminal bud only. This operation is a delicate one, and is not intended to be carried out on thick stems of old trees; it is best carried out on stems from five to twenty feet in height. If the terminal bud, or the bud and the leaves near it, are cut away, growth in the vertical direction is necessarily stopped, and, if the operation is properly executed, is followed by the bursting of buds in the axils of the leaves below. Instead of high woody stems dwarf plants with increased foliage and thicker basal stems are produced. This is quite different from what Mr. Golledge has been doing, and I imagine that Mr. Wright could have guaranteed failure to follow such a drastic and illogical operation.

On page 21 of "Hevea Brasiliensis or Para Rubber," Mr. Wright states:—"The Para rubber tree naturally grows to a tall slender tree, and it *remains to be seen* how by pollarding the *young* plants an increase in circumference may be obtained at the expense of the growth in height. Considering what has been accomplished with tea, where plants—ordinarily growing into fairly stout trees over twenty feet high—have been converted into small bushes two to four feet in height, it *would be idle to predict* the possibilities with Para rubber. *The prevention of the unnecessary growth in height may well form the subject of many experiments.*"

On page 51 the actual measurements of forked trees are given, and it is further stated that "it does not need any argument to prove that an increase in circumference of over thirty inches is an advantage, and the fact that such an increase has occurred in the tapping areas of trees about thirty years old is sufficiently encouraging to tempt the planter to carry out a few pollarding or bud-pruning experiments once his trees have attained a height of about ten to twenty feet. The buds, which appear in undesirable places, can be removed by 'thumb-nail' pruning."

The full text, therefore, gives one a different idea of Mr. Herbert Wright's suggestion to that which one of your correspondents implied. The principle is quite sound, and is of vital importance to rubber planters who have only recently planted their clearings, but is of little value—and obviously dangerous—to planters with old trees "over a hundred hills." I have seen the forked trees of Para rubber at Henaratgoda, and your correspondent should take his average from thirty-year-old trees, and he will find that the remarks on page 50 and 51 and the intervening illustration in "Hevea Brasiliensis" are correct and very instructive.

You cannot get much change out of Mr. Herbert Wright as to the value of the higher parts of thirty-year old rubber trees, and I have not noticed a reply to your original correspondent on that point, but any one can see what is being done

daily at Henaratgoda. Results from the high parts of such trees are of little value to the vast majority of rubber planters of to-day, and Mr. Wright is acting wisely in not being enticed into replying on that point. Considering the strain on the tree, the length of time and the number of coolies the first six feet will take to tap economically, and the necessity of getting the trees to a tappable size *as early as possible*, I consider that the discouragement of high wood formation and the encouragement of fat stems at the base is what Para rubber planters should aim at. This subject, so clearly put forward, should be carefully studied. Mis-interpretations of the original suggestion of thumb-nail pruning, cutting away or pollarding the terminal bud and leaves, &c., are bound to crop up, and it is gross exaggeration to construe the recommendations to mean the cutting away of the upper half of an old Para rubber tree.—Yours, &c.,

THUMB-NAILER.

THUMB-NAIL PRUNING HEVEAS.—This discussion is continued in our columns to-day by an interesting contribution from "Thumb-Nailer," who has a sound knowledge of the subject, and whose letter would carry even more weight had he signed it with his own name. He explains the process of this pruning and its effect on the young plant. We may state that this process of pruning the terminal bud or topping the young rubber plant was editorially suggested in the *Ceylon Observer* of April, 1904. The old forked trees in Henaratgoda are certainly remarkable examples of the increase of girth in a forked tree. But we must again insist that readers must not imagine that this discussion is a case of Mr. Herbert Wright *vs.* Mr. Golledge, as has been suggested. Mr. Golledge, in his first letter, referred to the pollarding of a 10-12 year old tree on his estate in connection with an article specially written for the *Observer;* but he did not once mention Mr. Wright's name except in reference to his recent book. Mr. Herbert Wright has never, to our knowledge, recommended pollarding old trees: nor has this ever been recommended in the *Observer*, although in our special article on January 9th, it was mentioned as a certain experiment that was being carried out on a particular plantation. In his book on rubber Mr. Wright suggests thumb-nail pruning of *young* trees. Both Mr. Wright and Mr. Golledge have the interests of the industry at heart, and there is no possible idea of antagonism at all. Mr. R. W. Harrison, late of Culloden, is also in favour of thumb-nail pruning young trees to prevent great length of stem and to induce thickness and increased tapping area.

V.

UPCOUNTRY, Jan. 23.

SIR,—It appears that one must still try to drive an idea home to Mr. Golledge. That gentleman says that rubber trees never or rarely have lateral branches 10 to 12 feet. Nobody ever said they had at 10 to 12 years old. Having allowed a rubber tree to grow for 10 to 12 years—probably pretty close (for we all planted too close at first) to other trees, he assaulted the unfortunate specimen *below* the lateral branches, left nothing but a bare, galled and bleeding stump 10 to 12 feet high, and expected this to give him a yield of rubber—save the mark! I take it he hewed (or sawed) off the whole working area of a matured tree—some 20 feet of actively growing stem and a number of lateral branches, laden with the whole crop of succulent leafage that is the *Hevea's* crown of glory.

Then he howls in print (*in print*, mind you!) that this tortured tree gives him no rubber—yea! is even so obstinate that it refuses to grow in diameter. He gives us no information as to what it did in height. What kind of suckers did this brutally ill-used tree send up in order to try and live! What did Mr. Golledge do from the date of his primal assault in 1904, till his letter in 1906 to remedy the evil he had done? Did he relieve the tree of superfluous suckers? Did he encourage lateral growth? On all these points Mr. Golledge is dumb.

As far as I can make out, Mr. Golledge promptly began to *tap* with the object of still farther weakening this maimed tree. This, I take it, is about as sensible a proceeding as it would be to try to bleed a man, whose head you had just cut off, and be disappointed at the result, "*Who'd have thought the old man had so little blood in him?*" Then he comes into the press, sniffing superiorly at the Scientist—with his "paraphernalia"—(good word this, almost as good as that "blessed word," Mesopotamia),—and vaunting his own simple apparatus the knife, the drip tin, and the kerosine oil receptacle for *latex*—I had almost written "Paraffinolia."

No! No! this want do! Let us go through a complete series of experiments on a reasonable number of trees—pollard (or thumb-nail prune) them when they are young (10 to 12 ft. high) and well-feathered—and then appreciate the results. Until then, let us be dumb! Do not let us frighten ourselves with the bogie of a futile result from a wrongly-conducted experiment. I hope to turn to the practical aspects of thumb-nail pruning in another letter.—Yours, &c.,

POLLARD RUBBER.

P.S.—Since writing the above, I have seen a letter from "Thumb-nailer," characterised by much common sense. POLL. R.

"Pollard Rubber"—again returns of the attack in a smart and rather caustic letter to-day. Let us suggest to him first, that Mr. Golledge was bold enough to write under his own name and did not seek shelter under a *nom-de-plume*, and that it would be fairer and more sporting if "Pollard Rubber" would allow his identity to be disclosed, and not attack Mr. Golledge from under this cover. Mr. Golledge wrote entirely in the interests of the planting industry of Ceylon, and was careful to say nothing personal. Again, Mr. Golledge gave his own practical experience, of two years' duration, of an experiment which, the *Observer*'s special article stated, had just been commenced at Henaratgoda; he was predicting the probable result of this experiment from the result of his own after two years. "Pollard Rubber" is quite right when he assumes that Mr. Golledge "assaulted the unfortunate specimen *below* the lateral branches, left nothing but a bare, galled and bleeding stumps" (expect that such a stump bleeds very little after the operation!), "Pollard Rubber" pours out his sarcasm on Mr. Golledge's looking for latex from the stump; but let him not be too rash. Precisely this same experiment is now being carried on, *solely as an experiment*, at Henaratgoda. The "20 feet of actively-growing stem and a number of lateral branches, laden with the whole crop of succulent leafage, that is the *Hevea's* crown of glory," was sawed off the Henaratgoda tree described in our special article, which induced this discussion. "Pollard Rubber" should make a trip to Henaratgoda and see this tree for himself; he has a good "howl" in his letter to-day; but so far we think Mr. Golledge has the best of it. We shall be glad to publish "Pollard Rubber"'s promised letter on the practical aspects of thumb-nail pruning, It should be very interesting and useful; but we should much like it signed with his own name!—*Ceylon Observer.*

VI.

Dear Sir,—I give below the results of my observations on the above subject after the several letters that have appeared recently in your valuable journal:—

Tree No. 1,213 pollarded in May, 1903.		Girth at 3 ft. from the base 35 inches.	
,, ,,	1,212 unpollarded	,, ,,	30 ,,
,, ,,	1,211 do	,, ,,	31 ,,
,, ,,	1,337 pollarded in May, 1903	,, ,,	29 ,,
,, ,,	1,335 unpollarded	,, ,,	23½ ,,
,, ,,	1,336 naturally forked tree	,, ,,	30 ,,
,, ,,	627 Thumb-nail pruned in 1899	,, ,,	32 ,,
,, ,,	626 Not touched	,, ,,	23 ,,
,, ,,	625 do	,, ,,	25½ ,,

The pollarding was done *accidentally and not with an experimental view*, and hence their previous measurements are not stated. No. 1,213 was partially uprooted and No. 1,337 got broken below the head leaving a trunk of about 9 feet, by the heavy gale during the S. W. monsoon in 1903. To lift the former and keep it in its position, with a wooden support, was impossible, as it had a very heavy head with two primary branches at about 12 feet from the base and their ramifications and a lot of foliage; consequently the heavier primary branch was pollarded at about 13 feet from the base, and the other untouched. The latter was sawn off at 8 feet in height and trimmed with a pruning knife to make the cut clean and sloping. No. 1,213 was not tapped till March, 1905, and No. 1,337 till May, 1905. Both trees when tapped did not yield latex as they ought to.

Tree No. 627. This, too, had its *terminal bud nipped off* when two years old, in 1899, *by an accident.* This is standing close to a rock at about a chain's distance from my bungalow, and its terminal bud was nipped off, eaten away by a goat of mine, which operation cost the goat his life and gave me the benefit of knowing its results. This has been under my observation since, with the *result* that it was *tapped* in 1901, *a year earlier than its neighbours, Nos. 625 and 626.* It yields latex freely and has a graceful appearance with ten primary branches at about 7 feet from the base and a lot of foliage.

Trusting that the above may be of some interest at this juncture, and leaving you to draw your own conclusions therefrom.—I remain, yours faithfully,

T. L. SRINIVASAGAM.

EAGLES LAND, NEBODA, January 26th, 1906.

VII.

DEAR SIR,—"Pollard Rubber" seems to be an enthusiast and a hero-worshipper, and (if his letters show anything) not much of a practical planter. Mr. Golledge's letters deserve careful attention on the part of those who are working planters. Experts and scientists have their use, but the ideas they lay require careful hatching. We will leave aside the question of pollarding grown up trees, but confine ourselves to thumb-nail pruning young trees of twelve feet and over in height. The main object of thumb-nail pruning is alleged to be the device for inducing the growth of lateral branches, and the growth of lateral branches is said to result in an increased girth of stems. Pruning, it should be admitted does not always tend to the production of lateral branches. When a plant is topped, it usually puts on branches that grow vertically, this throws the tree back, though the deterioration may not be much marked. If you top two rubber plants of the same age, one or both *may* throw lateral branches, but they will always throw what we may call vertical shoots, for want of a better term. The increase in girth of a tree with lateral branches may be always marked, but it is not safe to deduce from this that lateral branches are the cause of the increase.

I am inclined to believe from observations I have made that both the production of lateral branches and the increase in girth can be attributed to the same cause, *e.g.*, to the vigorous growth of the plant. Where plants grow well, a fairly good number throw out lateral branches when over twelve feet in height, without any artificial aid of pruning or 'thumb-nailing.' So let us not be in a hurry to make deductions and advise new methods that *may*, instead of proving beneficial, give us disappointing results. Mr. Wright in his book has thrown out a suggestion from what he has observed, but he surely will not claim that his deduction may not be faulty? There are other similar suggestions in the book

that may, on further observation, require modifications: for instance, the system of manuring based on the alleged rate of root growth, the cultivation of catch crops, green manuring, &c.

Yours faithfully,

Colombo, January 26th. W. A. De S.

VIII.

Sir,—This question of pollarding young Hevea trees, or thumb-nail pruning them, which is being discussed so vigorously in your columns, is not only full of interest but it is also of no little importance to many planters. For if, as is claimed, it makes a difference of one year before the trees are ready for tapping, that means a great deal to many of us; and the subject is worthy of the lengthiest discussion in your paper—only, letters should be writen to the points discussed and not in the frenzied style of "Pollard Rubber," who apparently had a bad head that morning, or a touch of liver if he wrote at night. Mr. Wright says bud-pruning the young tree stops growth in height and encourages girth, so that the tree attains a size fit for tapping—*i.e.*, 20 inches at 3 ft. from base—one year in advance of others. From this one naturally concludes that the whole question of "when to tap" depends upon the girth of the tree alone; and if a tree attains 20 inches in three years, it could then be tapped. Has age nothing to do with time for tapping? Is not the latex in young trees far inferior to those of maturer age? Consequently, if you tap at 4—5 years the percentage of caoutchouc is less, and the analysis of it will show a far higher percentage of resin and proteids. Does Mr. Wright contradict this? If not, how does he reconcile his advice to bud-prune young trees with these facts?—for he is encouraging the production of inferior rubber, which we want to avoid in Ceylon. I quite understand, and I fully believe that this pruning process will develop the girth of the tree considerably, therefore it may be advisable to do it. But I should suggest at the same time that tapping be not commenced until the trees are of *an age* fit to be tapped, as well as of *a size*. On this point I refer to Mr. Wright's book, and I find he refers to Johnson (author of "Para Rubber") who goes by size and not age; while Dr. Weber goes rather by age. Now, judging by his book on rubber Mr. Johnson is no authority to go by, and I have read more stuff of practical use to planters in the *Ceylon Observer's* columns than in all Johnson's 100 pages. Further, we have Ceylon men with far more experience of rubber cultivation than anyone outside the place, and I think most of our leading rubber men would go on age *plus* size rather than size alone, and even on age alone rather than size alone.

As a further point to strengthen my argument, referring again to Wright's book, rubber from 2-year-old trees was "sickly and snapped when slightly stretched, it was obviously unfit for sale." Parkin, he says, holds same opinion, and Stanley Arden, of the Straits, has shown that the rubber from 3½ to 4-year-old trees is decidedly inferior. *Ergo*, size alone won't do. How then will Mr. Wright modify his advice? But there is a good deal more in all this than appears on the surface. Reading the analyses of rubber from different aged trees on page 48 of Wright's book, I find the six analyses given, from two-year old to 30-year old trees, differ mainly in the percentage of proteids, while the amount of caoutchouc in each differs little, especially from four years upward. From six years to twelve years they all have roughly 94 per cent. pure rubber; but why do the 30-year old trees give only 93 per cent. rubber, and 1 per cent. more proteid? Another point on which some of us would like Mr. Wright's explanation.

There are further points on which I am still a bit puzzled, but we must finish this pruning matter first. One more question before I finish—does bud-pruning offer any invitation to disease; does the scar grow over as the tree grows, or will it form a wide and increasing, roughly healed cicatrice? Does the thumb-

nail pruned tree send up two or three main poles from its thickened, shortened trunk, or does it turn into a misshapen caricature of a tree like a pollard willow? And, did Mr. Golledge tar over the top of his stumped ten-year old tree; if not, did it escape disease, canker, etc.?, for, if so, the disease bogie must be more of a myth than ever. Apologising for this rambling communication, and enclosing card, yours, &c.

H. V. A.

Western Province, January 25th.

BRITISH OPINIONS ON THE CEYLON RUBBER INDUSTRY.

I.

6, Mincing Lane, London, E,C.,

17th January 1906.

Dear Sir,—We notice with interest that a Rubber Exhibition on an extensive scale is to be held in Ceylon. We think this is an excellent idea, and have no doubt it will be most useful. You are, no doubt, aware by this time that a member of our firm—Mr. A. O. Devitt, who is thoroughly conversant with rubber, its treatment, preparation, etc.—is on a visit to Ceylon and the Straits and Malay States, with the express object of giving information and advice to all interested in rubber, whether as planters or merchants, and as he has gone at the special request of friends largely interested, and carries with him special letters of introduction to a large number of planters and others, we have no doubt a pleasant and useful exchange of ideas will result.

We do not think Ceylon planters or merchants need trouble about manufacturers opening works in Ceylon, which they are not likely to do— but it certainly is important that they should learn from our partner, or others, the lines upon which business can be done, and we have no doubt will be done, as the industry developes and increases. He takes with him all details relating to rubber, and will be only too happy to afford every information possible.—We are, dear Sir, yours faithfully,

LEWIS & PEAT.

II.

44 & 45, Fenchurch Street,

London, E.C., Jan. 19th.

Dear Sirs,—You ask for our opinion as to the advisability of establishing a manufactory for India Rubber in your Island. We think it almost impossible. The *varieties* used are so many, and such a large proportion come from *Brazil*, which will be the leading source of supply for generations. The "heat" of your country's climate would probably prevent good manufacture. From experience and knowledge of this important trade for close on half-a-century, we consider your planters, *in the long run*, will get the best results by selling their rubber *here*, where we have competition from all the world. The freight and charges per pound are insignificant, notwithstanding interested reports, and there are buyers of *all varieties* regularly. We have urged extension of planting for years past in our annual reports, &c., and, as we said in the valuable one sent you on the 3rd inst., we rejoice at the prosperous results. Do not let planters go into the manufacturing trade, or grudge even middlemen earning a trifle out of their abundant profits, and do not expect any serious reductions in the supply of Brazil Rubber—now 36,000 tons—for many years.

We are at Planters' and Merchants' service, and do our best to obtain high prices for their rubbers. Concentrated action and selling in this market will, we are sure, produce planters the best results in the long run.—We are, dear Sirs, yours faithfully,

S. FIGGIS & CO.

III.

THE AVON INDIA RUBBER CO., LTD.,

MELKSHAM, WILTS, Jan. 17.

DEAR SIR,—We thank you for your letter of the 22nd ult., and are pleased to note the encouragement you are giving to rubber planting in Ceylon. As regards manufacturers buying in Ceylon we doubt whether this is likely to take place unless arrangements could be made direct between manufacturers and planters. We do not think it is more likely in future than at present for manufacturers to start factories in Ceylon.—Yours truly,

THE AVON INDIA RUBBER CO., LTD.
R. A. FULLER, *Manager.*

IV.

OPENSHAW, MANCHESTER, Jan. 19.

DEAR SIRS,—We are in receipt of your favour of the 22nd, and in reply there to think it is hardly possible to give any criticism on your remarks in the *Ceylon Observer* of the 22nd ult. We, however, think it is necessary for manufacturers of any article to have their works as near as possible to their markets; and as the rubber industry is divided up into many different branches, it would mean that several mills would be necessary to supply the various demands. Candidly, our opinion is that the manufacture would not pay in your country, and that the climate would be unsuitable for the storage of manufactured goods.—We are, dear Sirs, yours faithfully,

THE GORTON RUBBER COMPANY, LIMITTED.,
E. L. CURBISHLEY.

—*Ceylon Observer.*

A STANDARD FOR RUBBER WANTED.

An important ideal, which we think should be of great use to the rubber planter in connection with the description and sale of his produce, has been suggested to us to-day by a leading planter. It is that there should be a general standard by which rubber could be tested in three respects:—for (1) its transparency, (2) its extensibility, and (3) its elasticity. For transparency, it should be possible to read type of a recognised size through a certain thickness of rubber, and by the size of type and rubber thickness the standard of its transparency would be measured. For extensibility a length of rubber of a certain width would be suspended, with a standard weight attached, and from the original length (shown on a scale placed against the length of rubber) the co-efficient of extensibility could be found by dividing this into the length to which the rubber was extended by the weight. Elasticity would be shown by the length to which the strip would recover from its extended size—say to 5 or 10 per cent. above its original length still—within a certain time; this time would be five minutes at most—resilience, if it exists, being necessary at once. Five per cent is about the loss of weight on the voyage to Europe, and the rubber loses thereby in the last two qualities dealt with; but the original test would serve the buyers in Colombo for testing, and the planter could at the same time test the rubber for himself by the standard, when established, and find out its value. We commend the suggestion to the Planters Association Committee.—*Ceylon Observer.*

NOTES FOR RUBBER PLANTERS.

Mr. Andrew O. Devitt, member of the London rubber broking firm of Messrs. Lewis & Peat, has recently arrived on a visit to Ceylon, in order to get into close touch with the planters here. That a firm of brokers should go to the

expense of sending out a representative so early in the history of the industry is very significant of the importance placed on the future Ceylon and Malay rubber industry. Mr. Devitt during his visit will visit as many estates as possible, and do all he can to assist planters by giving them the London view on matters. Mr. Devitt does not think planters will find it any more profitable or advantageous to send their rubber to the continental markets.

Mr. Devitt explains that before the sales the cases of rubber are turned out and sorted into three or four qualities, for it varies in colour, and some biscuits are mottled and blotched, etc. This mottled rubber is perfectly sound and good, but buyers go mostly on the appearance of the rubber. The assortments when placed out on the tables are of various weights down to even 5 lb. lots. All samples taken are allowed for to the planter. If a buyer takes a pound or even a single biscuit as a sample, he has to pay for it at the rate the bulk sells for; every sample must be paid for. This is a point which will be very satisfactory to planters, for rumours to the contrary have been circulated.

As regards packing plantation rubber Mr. Devitt lays stress on the importance of having it perfectly dry. Rubber has been unpacked by him that had on it a rich coloured bloom, a fungoid growth, the result of packing wet material. The drier the rubber before being packed the better. Mr. Devitt has handled Brazil rubber which took two years from the time it was collected to arrive in London, and it was all the drier and not harmed at all. Crêpe and lace rubber were very quickly dried, he believed, but preference was given by buyers to sheet. Mr. W. W. Bailey had sent home from the Malay States sheets which bore the impress of rollers through which it had evidently been passed to squeeze out all the superfluous moisture, and this was dried rapidly, and was excellent rubber.

The manufacturer, our visitor states, wants the rubber in as raw a form as possible; he objects to washed rubber in any form for these reasons—it is trespassing on the manufacturer's work; and rubber always loses something in elasticity and quality in washing. The planter, says Mr. Devitt, must not encroach on the manufacturer's department, and the best way to send the rubber is in its rawest though purest state. Mr. Devitt has known of cases where the planter has come into contact with the manufacturer, trying to do direct trade. This, he firmly believes, will be detrimental to the planters' interests. The manufacturer is apparently a troublesome customer, and he will readily find excuses for finding fault with the rubber sent, and then demands "arbitration," and endless trouble and litigation may follow. Mr. Devitt speaks from experience. His firm are solely brokers, and it is in their interests to get the highest possible prices for the product; the buyer must have the rubber and will always come for it and pay good prices.

Regarding the purposes to which plantation rubber is put, Mr. Devitt says it is impossible to know. The manufacturers guard their trade secrets too zealously, and no one outside knows to what use special rubber is put. "Solution" no doubt accounts for some, and that is generally stated as an easy answer to the question. The big manufacturers, like the Silvertown and North British Companies, do not use plantation rubber except experimentally; they have their costly washing machines and it does not pay them to take the clean plantation product. These big firms formerly supplied the small manufacturers with their wants, but now the latter can buy the plantation rubber and prefer to do this than give the extra cost to the big manufacturer.

Mr. Devitt thinks there is no harm in using a little acetic acid for coagulating the latex. All sorts of acid are used in some parts of the world for wild rubber; some is coagulated with lime-juice and in Mangabeira rubber, for instance,

he has seen big pieces of alum in the blocks of rubber, which were used for coagulating purposes. He is full of confidence as to the future of the rubber planting industry, and assures us that for another ten years the price cannot go down much, and as to the overproduction bogey Mr. Devitt ridicules it.

REPORT ON LACE RUBBER.

KEPITIGALLA, MATALE, Jan. 15th.

DEAR SIR,—I now have the pleasure of stating that the first consignment of Lace rubber sent to Hamburg was sold at 14 marks per kilo, or as near as possible 6*s.* 1¼*d.*, about the highest price paid, during the same week in London for Biscuits or Sheet. When you consider the fact that Lace is ready for packing in 48 hours, and that no expensive machinery is required, no power to drive the machine as in the case of crêpe, which requires 8-9 horse-power (whereas Lace requires only about 1-8th horse-power), besides the great saving in labour, the superiority of manufacturing the Rubber into the form of Lace is apparent. The Brokers' report is as follows :—

"The rubber is reported upon to be first-class, and is valued at 14 mks. per kilo, at which price the parcel has been sold."

The Brokers are all mad on sheet rubber just now; but is this practicable on a large estate, where a large acreage is in bearing? For it takes just as long to dry as biscuits, or in fact longer; consequently a very large drying space will be required—Yours faithfully,

—*Local Press.* FRANCIS J. HOLLOWAY.

The Rubber Market.

THE LONDON RUBBER SHARE MARKET IN 1905.

The past year, though a lean year in a commercial sense, has nevertheless introduced a new sphere of industry to the London share market. This, in a word, is the market now established in the shares of rubber producing companies, which starting in a very small way has, from very insignificant beginnings, developed into a sound proposition with bright prospects for the future. Companies which were comparatively unknown are now growing and producing rubber, and the shares of these companies are now being dealt in at close prices formerly unheard of. Daily more interest is being taken in the rubber-producing companies both in the Straits and Ceylon by the investing public. The production of rubber is now being undertaken by many of the companies situated in this part of the globe, and during the year 1,400 packages from Ceylon and 1,000 from the Straits were dealt with by the London market, all of excellent quality. which is proved by the price obtained for the best quality, viz., 6*s.* 9½*d.* per lb. This price, even at the present high level of share quotations would give investors a handsome return on their money. The most prominent features of the market during the past year have been the flotations of the Anglo-Malay and Consolidated Malay Companies, for both of which the public subscribed handsomely, in each instance the shares being applied for many times over the amount of the issue. The shares of both of these companies now command very considerable premiums. The Selangor Company has by way of a dividend issued to its shareholders' shares in the Sungei Way Co. The Pataling Company has the honour to be the first rubber company to pay a dividend, and its payment of an interim dividend of 7½ per

cent is, we may hope, a forecast of what may be expected of the majority of the other companies in the future. In Ceylon and the Straits very considerable areas have been planted with rubber, and this fact has in some quarters given rise to the cry that planting is being overdone; but even if all the area now planted in Ceylon and the Straits was producing rubber, the quantity would be comparatively small, considering the consumption.

During the year there has been a large amount of business in the shares of Ceylon tea companies which have planted or are planting rubber, and in some cases the shares shew a very considerable rise, and with better and favourable prospects augured for tea, these shares are very difficult to procure even at enhanced prices. Below we give some particulars in tabulated form:—

	Highest.	*Lowest.*	*December.*
Anglo Malay	2¼ p.m. ...	1⅝ p.m. ...	1 11-16 p.m.
Batu Caves	1⅛ p.m. ...	⅞ p.m. ...	1¼ p.m.
Bukit Rajahs	4½ ...	1 ...	3¾
Cicely ordinary ...	2⅝ ...	2 5-16 ...	2
Do prefs.	2½ ...	1 ...	2⅛
Federated Selangor ...	3 1-32 ...	1⅝ ...	3
Linggi	4 ...	1 ...	3¾
Pataling	5½ ...	1⅝ ...	4⅝
Selangor	8 ...	2¾ ...	7 13-16
Vallambrosas	5 ...	2 ...	4¾
TEA WITH RUBBER.			
Alliance	9¼ ...	7½ ...	8⅞
Ceylon Proprietary ...	10 ...	6-6 ...	9-6
Ceylon Tea Plantations ...	32 ...	23 ...	31
Consolidated Estates ...	9½ ...	7⅝ ...	9½
Eastern Produce ...	6⅞ ...	4¼ ...	6
General Ceylon	69 ...	15 ...	50
Lankas	4¼ ...	3½ ...	3⅞
Sunnygamas	13 ...	10 ...	15
Yatiyantotas	16½ ...	7¾ ...	15½

J. RUSSEL GRANT & Co.

REVIEW OF PLANTATION RUBBER MARKET DURING 1905.

We have reported upon this fine rubber, and urged its cultivation for many years, and are glad to know that the cultivation of the Para "Hevea Brasiliensis" has rapidly extended. We estimate to-day about 45,000 acres planted and being planted in Ceylon, and 50,000 acres in Malay, and no doubt further rapid extension will go on as so many new companies are talked of. The preparation of the rubber generally has been excellent, and results most satisfactory. As the quantities increase, and need more labour and increased space "to cure it," new ways of preparing the rubber will be found. As a rule, we have found by our long and wide experience that the manufacturers prefer either large rolled sheet prepared on some Malay estates, or biscuits not too thin and of nice colour, such as frequently come from Ceylon, especially "Culloden." Pale clean crêpe in sheet seems also liked. Do not pack in paper.

We reported in our special issue of May 12th: "With the extension of plantations and larger crops it has become difficult to continue on some estates the preparation in biscuits, and new processes are being tried. We have seen small sample lots of thin sheets cut into narrow strips which look nice rubber, but being not known to manufacturers in this form there has not been so ready bidding for it. Some washed and pressed pale clean rolled 'crêpe' in sheet was sold to-day at 6*s.* 8*d.* 6*s.* 8½*d.*, but the darker coloured lots only realised 6*s.* 1*d.* No doubt this preparation will save planters time and trouble in preparation of their rubber, but they may perhaps find that there is some extra loss in weight to them in the preparation."

The difference of 1*s.* per lb. in favour of plantation fine, as compared with fine Para (Brazil) obtained when the supply of the former was smaller, may not be maintained when supplies increase. The preparation of "scrap" has improved and prices accordingly, the value as we close being of fine biscuits or sheet 6*s.* 1*d.*, scrap 5*s.* to 5*s.* 4*d.*, fine Para 5*s.* 5*d.*, negrohead (best) 4*s.* Shipments from Ceylon we estimate 70 tons as against 40 tons in 1904. From Malay 75 tons. Rambong brought high prices, 4*s.* 6*d.* to 5*s.* There is but little Ceara. Castilloa we have scarcely seen. The world's supply of all rubber in 1905 was 60,000 tons.

It must be taken into account that "planting" rubber goes on in Mexico, Nicaragua, other Central American States, and some in Brazil and Bolivia, besides India, Burmah, Borneo, and Java, and recently in Samoa and Pacific Isles. Plantations in the Congo region of the native rubbers are being rapidly extended. We repeat the suggestion that owners will plant from Para seed and produce hard clean rubber, for which there is an excellent and increasing demand. But as the Amazonas show no signs of reduction of crops (Brazil exports 36,000 tons); too much expectation of serious decrease in Brazil supply may prove unwise.

S. FIGGS & Co.

INDIA RUBBER MARKET REPORT.

LONDON, February 2nd, 1906.—At to-day's auction, 155 packages of Ceylon and Straits Settlements Plantation grown rubber were offered, 148 of which were sold. The total weight amounted to 8½ tons, Ceylon and the Straits Settlements each contributing 4¼ tons. There was a good demand for all kinds, fine Crêpe, Sheet and Biscuit changing hands at 6*s.* 2*d.*, and a few dull parcels of Biscuits and Sheet at 6*s.* 1¾*d.* Fine Scrap sold from 5*s.* to 5*s.* 3*d.*, some lower quality selling down to 3*s.* 8*d.* The Highlands Estate (Straits Settlements) was represented by a fine invoice of washed Sheet amounting to just over one ton, which realised 6*s.* 2*d.* In face of the large receipts from Para, to-day's rates point to there being a strong and increasing demand for all grades, and the tone of the market generally is satisfactory. Average price of Ceylon and Straits Settlements Plantation Rubber.—148 packages at 5*s.* 10¾*d.* per lb., against 96 packages at 5*s.* 9¾*d.* per lb. at last auction.

CEYLON.

MARK.	QUANTITY.	DESCRIPTION.	PRICE PER LB.
Tallagalla	2 cases	Fine large darkish biscuits ...	6*s.* 2*d.*
do	1 do	Fine palish scrap ...	5*s.* 2¼*d.*
Deviturai	2 do	Good palish and darkish sheet ...	6*s.* 2*d.*
do	1 do	Good scrap ...	5*s.* 2¾*d.*
Ballacadua	2 do	Fine pale and darkish biscuits ...	6*s.* 2*d.*
Nikakotua	1 do	Good rough palish and darkish biscuits ...	6*s.* 1½*d.*
do	2 do	Good scrap ...	5*s.* 1*d.*
Langsland	3 do	Fine palish biscuits ...	6*s.* 2*d.*
do	3 do	Fine darkish biscuits ...	6*s.* 1¾*d.*
do	1 do	Fine palish scrap ...	5*s.* 2½*d.*
New Rasagalla	1 do	Fine palish scrap ...	5*s.* 2¾*d.*
do	1 do	Good darkish scrap ...	4*s.* 6*d.*
Halwatura	3 do	Good darkish cloudy biscuits ...	6*s.* 1¾*d.*
do	1 do	Sticky biscuits ...	5*s.*
do	4 do	Fine darkish scrap ...	5*s.* 2¾*d.*
Glanrhos	3 do	Fine palish and darkish biscuits ...	6*s.* 2*d.*
Clontarf	2 do	Fine do smaller ...	6*s.* 2*d.*
do	1 do	Fine palish scrap ...	5*s.* 2½*d.*
F. B.	1 do	Fine pale biscuits ...	6*s.* 2*d.*
do	3 do	Fine pale scrap ...	5*s.* 3¼*d.*
do	1 do	Darkish washed worm ...	5*s.*
do	1 do	Darkish scrap ...	3*s.* 8*d.*
do	2 do	Fair darkish biscuits ...	5*s.* 8*d.*
Tudugalla	11 do	Good palish hard biscuits ...	6*s.* 2*d.*

MARK.	QUANTITY.	DESCRIPTION.	PRICE PER LB.
Tudugalla	6 cases	Good palish hard biscuits	... 6*s.* 1¾*d.*
do	4 do	Good palish hard scrap	5*s.* 2*d.* to 5*s.* 2¼*d.*
do	11 do	Fine palish to darkish biscuits	... 6*s.* 2*d.*
do	3 do	Fine pale scrap	5*s.* 2½*d.* to 5*s.* 2¾*d.*
do	4 do	Dark scrap	3*s.* 11*d.* to 4*s.* 0½*d.*
Maddagedera	3 do	Fine palish to darkish biscuits	... 6*s.* 2*d.*
do	1 do	Fine palish scrap	... 5*s.* 2*d.*
do	1 do	Good darkish scrap and rejected biscuits	5*s.* 1*d.*
Halgolle	1 do	Fine pale and dark biscuits	... 6*s.* 2*d.*
do	1 do	Good palish scrap	... 5*s.* 1*d.*
Sirigalla	1 do	Fine pale biscuits, few dark	... 6*s.* 1¾*d.*
do	1 bag	Good pale scrap	... 4*s.*
		STRAITS SETTLEMENTS.	
L. E. (Muar in triangle)			
Straits	3 cases	Fine scored sheet	... 6*s.* 2*d.*
do	1 do	Fine dark pressed scrappy sheet	... 5*s.* 0½*d.*
B. N. A. & B.	1 do	Fine palish sheet	... 6*s.* 1¾*d.*
do	1 do	Rejected sheet	... 5*s.*
do	1 do	Fine palish scrap	... 5*s.* 1*d.*
B. N. E.	1 do	Fine pale scrap	... 5*s.* 2¼*d.*
R. R. (S. in diamond)	3 do	Fine pale pressed sheet	... 6*s.* 2*d.*
S. R. (S. in diamond)	4 do	Pressed scrappy sheet	... 5*s.*
G.M.S.B.	6 do	Fine palish amber sheet	... 6*s.* 2*d.*
do	1 do	Fine palish scrap	... 5*s.* 3*d.*
L. & P. F. M. S.	7 do	Fine pale washed ribbon	... 6*s.* 2*d.*
do	1 do	do little darker	... 6*s.* 0¾*d.*
K. Y. S.	2 do	Fine pale sheet	... 5*s.* 10*d.*
do	1 bag	Fine pale scrap	... 5*s.*
M.	1 case	Fine large pale biscuits	... 6*s.* 2*d.*
do	6 do	do darker	... 6*s.* 2*d.*
do	1 do	Fine palish and dark pressed sheet & scrap	5*s.* 2¾*d.*
C. M. C. S.	3 do	Fine amber sheet and biscuits	6*s.* 2*d.* bid
W. F.	1 do	Good palish sheet	... 6*s.* 2*d.*
Highland Estate	17 cases	Fine palish to darkish scored sheet	... 6*s.* 2*d.*

ASSAM AND RANGOON.

These kinds were only represented by 12 packages, of which only a few inferior parcels changed hands from 2*s.* 5*d.* to 2*s.* 6*d.*

LONDON, February 16th.—At to-day's auction, 276 packages of Ceylon and Straits Settlements plantation grown rubber were offered, 238 of which were sold. The total weight amounted to 13¾ tons, Ceylon contributing about 4¼ tons and the Straits Settlements 9½ tons. This was the largest auction of plantation grown rubber that has yet been held, and included several very fine invoices weighing a ton and over. The largest sale previously being that held on the 10th November, 1905, which consisted of about 11½ tons. There was good competition at about last rates, fine Sheet selling from 6*s.* 1½*d.* to 6*s.* 2¼*d.*; Crêpe from 5*s.* 5*d.* for dark to 6*s.* 1¼*d.* for fine pale; Biscuits from 6*s.* 1¼*d.* for dull up to 6*s.* 2*d.* for fine; Scrap from 3*s.* 8*d.* for dark dirty up to 5*s.* 4*d.* for fine. There was also some nice clean red and dark Rambong which sold readily from 4*s.* 6¼*d.* up to 5*s.*

The popularity of the sheet form was again evidenced by a fine parcel of five cases from the Highlands Estate bringing 6*s.* 2¼*d.* per lb., highest price in the auction. Another fine parcel of very large sheet from Bukit Rajah sold at 6*s.* 2*d.* Average price of Ceylon and Straits Settlements Plantation Rubber.—238 packages at 5*s.* 11¼*d.* per lb., against 148 packages at 5*s.* 10¾*d.* per lb. at last auction. Particulars and prices as follows:—

CEYLON.

Wiharagama	2 cases	Good pale biscuits	... 6*s.* 1½*d.*
do	1 do	Good rough darkish biscuits	... 6*s.* 1¼*d.*
do	1 do	Fair ball scrap	... 4*s.* 5*d.*
do	1 do	Pale Ceara biscuits	... 6*s.* 1¼*d.*

MARK.	QUANTITY.	DESCRIPTION.	PRICE PER LB.
T. T. (C.T. in diamond)	1 box	Good pale sheet and scrap	6*s.* 1½*d.* and 5*s.*
Culloden	5 cases	Fine palish amber biscuits	... 6*s.* 2*d.*
do	1 do	Good cuttings	... 5*s.* 2¾*d.*
do	4 do	Fine palish scrap	... 5*s.* 3¼*d.*
do	1 do	Dark scrap	... 3*s.* 8*d.*
Nikakotua	2 do	Fine palish biscuits	... 6*s.* 1¾*d.*
do	1 do	Good dull darkish biscuits	... 6*s.* 1½*d.*
do	2 do	Darkish scrap	... 5*s.* 1¼*d.*
Arapolakande	9 do	Fine dark biscuits	... 6*s.* 1¼*d.*
do	3 do	Fine dark scrap	... 4*s.* 11*d.*
Tallagala	2 do	Good large dark cloudy biscuits	... 6*s.* 1¾*d.*
do	1 do	Good palish scrap	... 5*s.* 3*d.*
Dolahena	2 do	Fine amber sheet	... 6*s.* 1¾*d.*
do	2 do	Fine dark sheet	... 6*s.* 1¾*d.*
do	1 do	Good scrap and rejections	... 5*s.* 1*d.*
Baddegama	1 do	Fine palish scrap	... 5*s.* 2*d.*
D.C.	1 do	Good pale to dark cloudy biscuits	... 6*s.* 1¾*d.*
Aberdeen	1 do	Thick scrappy sheet, whitish inside	... 5*s.* 0½*d.*
do	3 do	Fine palish scrap	... 5*s.* 3*d.*
Weoya	8 do	Fine small biscuits pale to dark	... 6*s.* 1¾*d.*
do	1 do	do	... 6*s.* 2*d.*
Polatagama	7 do	Fine small dark biscuits	... 6*s.* 1¾*d.*
		STRAITS SETTLEMENTS.	
S.K.A.	12 cases	Fine palish sheet	6*s.* 1¾*d.* bid
S.K.B.	1 do	Scrappy sheet	... 5*s.* 1¼*d.*
S.K.	1 do	Scrap and sheet	... 5*s.* 3*d.*
do	1 do	do	... 5*s.* 3*d.*
H. & S.B.	1 do	Pressed scrap and sheet	... 5*s.* 1*d.*
F. & Co.	1 do	Rambong sheet and scrap	... 5*s.*
P.R. S.B.	3 do	Fine darkish sheet	... 6*s.* 1¾*d.*
do	1 do	Darkish sheet and rejections	... 4*s.* 11½*d.*
G. U. L. A.	1 bag	Fine pale pressd sheet	... 6*s.* 1*d.*
K.P. & Co., Ld.	6 cases	Good large pale to dark biscuits	... 6*s.* 1½*d.*
do	2 do	Rejected do	... 5*s.* 4¾*d.*
do	1 do	Good palish scrap	... 5*s.* 4*d.*
do	1 do	Fine pressed Rambong sheet and scrap	... 4*s.* 8½*d.*
V.R. Co. Ld. F.M.S. (in triangle)	7 do	Fine amber sheet	... 6*s.* 1½*d.*
do	6 do	Fine scored sheet	... 6*s.* 2*d.*
do	6 do	do	... 6*s.* 1¾*d.*
do	2 do	Fine palish crêpe	... 6*s.* 1¼*d.*
do	9 do	Fine pale pressed crêpe	... 5*s.* 8¼*d.*
do	6 do	Fine dark do	... 5*s.* 5*d.*
S.R. L. (in triangle	6 do	Good large darkish biscuits	... 6*s.* 1¾*d.*
do	20 do	Fine palish to darkish biscuits	... 6*s.* 1¾*d.*
D. K.P.C.L.	2 do	Good palish pressed sheet	... 5*s.* 7¼*d.*
B.R.R.C.	2 do	Good scrappy sheet	... 5*s.* 7¼*d.*
Tiger Asahan	8 do	Fine palish to darkish biscuits	... 6*s.* 1¾*d.*
do	1 do	Good pressed Rambong scrap	... 4*s.* 6¼*d.*
do	2 do	Fine palish rolled scrap	... 5*s.*
do	1 do	Darkish pressed Rambong scrap	... 5*s.*
do	1 bag	Pale and darkish scrap	... 5*s.* 1*d.*
do	1 do	Good rejections	... 5*s.* 1*d.*
do	3 do	Dark pressed Rambong scrap	... 4*s.* 11*d.*
Bukit Lintang	6 do	Fine amber biscuits	... 6*s.* 1¾*d.*
B. R. R. Co.	22 do	Very fine large amber sheet	... 6*s.* 2*d.*
do	4 do	Darkish scrappy sheet	... 5*s.* 3½*d.*
do	7 do	Fine palish scrap	... 5*s.* 3¼*d.*
do	5 bags	Fine dark pressed scrap	... 4*s.* 7*d.*
do	1 do	Fine Rambong scrap	... 4*s.* 7½*d.*
Highland	5 do	Fine amber scored sheet	... 6*s.* 2¼*d.*
do	3 do	do	... 6*s.* 2*d.*
do	4 do	Fine corrugated sheet	6*s.* 2*d.* offered

GOW, WILSON & STANTON, LTD.

OILS AND FATS.

BLEACHING AND CONCENTRATION OF VEGETABLE OILS.

Hitherto the bleaching of oils has been obtained by the "natural method," the oils being exposed in large metallic receivers for a certain lapse of time, usually several weeks, to the action of the open air and the light of the sun, or else by combining, for the purpose of accelerating the process, in special apparatus, the action of the air on the oil causing the heated oil to fall in drops in the form of rain in a dry or heated counter-current of air, the air being admitted into the heated oil in the lower part of receivers by means of steam, and then shaking the oil. However, in these two arrangements the bleaching of the oil is insufficient as compared with the time required. The apparatus also does not allow of obtaining high degrees of concentration without the addition of drying substances, like those employed for varnishes, in the preparation of printing and lithographic ink, or for the production of linoleum and other similar articles. M. Lewyak has established an apparatus capable of concentrating the oil to any degree of density desired without the addition of drying substances. This result is obtained in a double walled boiler capable of being closed hermetically; the oil is heated by means of steam, while the air is heated in the apparatus and introduced through the oil from the bottom to the top in bubbles or thin jets; the oil is kept in movement by means of an agitator constructed principally for securing an intimate mixture.

The kettle which serves for boiling the oil is mounted on a cast-iron frame, but may be established on a different foundation. The kettle is closed hermetically by a cover which is furnished eccentrically with an air tube and concentrically with an opening for the shaft of the agitator. The kettle is furnished with a bottom of special construction. This is provided centrally with a passage for the air tube, which is rendered tight by a collar; on its periphery is a discharge tube, for cases where the oil remains liquid after treatment. The kettle has two walls; in the space formed by these walls the return steam which heats the kettle is made to enter. The hollow space is furnished with a steel index tube and a discharge tube for the condensing water. The air tube, which penetrates into the space mentioned above and which surrounds the kettle several times in the form of a worm, comes out below and afterwards penetrates into the kettle only at the bottom. It is evident that all the tubular connections on the inside of the said space must be strong, because the space is heated by steam at about 100 deg. C., and they must support an inside pressure of air of from 2 to 4 atmospheres. On the bottom of the kettle the central support is arranged. This rests on several strips of metal arrayed in a half circle, crossing each other and connected together at the upper part. In a socket turns the extremity of the shaft, worked by a bevel wheel, arranged on a motor shaft. On the shaft are fixed three groups of paddles furnished with holes. Each group is composed of four paddles, arranged crosswise at right angles to each other and worked toward the right. A bevel toothed wheel is connected also with a second bevel toothed wheel, which slides on a tube, so that this turns in the direction opposite the shaft worked by another toothed wheel.

On the tube four arms are fixed at right angles to each other. The extremities of these arms are furnished with a flat piece of iron. These irons extend along the walls of the kettle to the bottom, and on these walls are arranged paddles, which are similar to those of the motive shaft and also perforated; these paddles occupy the place between the other paddles and the bottom. The paddles arranged, some opposite to the others, are connected in the middle in such a way that these connec-

tions on the shaft form a prolongation of the tube. It is evident that the paddles ought to turn in opposite directions, so as to produce a uniform and energetic agitation of the oil. When the paddles are turning, the oil is subjected to a strong agitation and froths very freely, the froth having of course the tendency to escape by the air tube; to avoid this, while giving to the gases formed the possibility of escaping freely, a ventilator of special form is connected with the apparatus. This consists of a box which communicates with the air tube and which is furnished with a shaft. This receives its movement by means of the toothed wheel and another toothed wheel mounted on the principal motive shaft. The shaft is furnished radially with several wings, at the extremities of which are fixed the small movable paddles. By means of this arrangement the air and gases formed, which penetrate into the air tube, may escape freely to the open air, while the froth is broken up in the box and forced back to the inside of the kettle. Below the socket of the shaft a sieve is arranged, a metallic cap, which in its upper part has notches around it; these serve for obtaining a better distribution of the air passing through the oil. The extremity of the worm air tube penetrates this cap, the air is forced back into the kettle under a pressure always constant, by means of an air pump or other suitable arrangement. The air tube may be surrounded with a metallic jacket; the admission of air into the worm and under the cap is regulated by means of the tap, which is furnished with a scale and an indicator, and may, if needed, be arrested completely.

The working of the apparatus takes place as follows:—The kettle is about two-thirds filled with linseed or other vegetable oil to be treated, steam is admitted into the chamber and the oil is heated to at least 100 deg. C. The paddles are then submitted to an active movement in such a way that the contents of the kettle are stirred very energetically. The agitation is continued for about three hours, that is, until the wished-for degree of decolouration is secured. During this period the tap may remain closed and the compressing arrangement be stopped. When the decolouration has been secured its concentration commences, keeping the agitator in movement but applying the compression and gradually opening the air tap. The air heated by the worm enters the cap and is forced back into the oil in the form of bubbles or small jets, so as to facilitate the vapourization and escape of the particles of air contained in the oil. The complete elimination of all these particles of water is secured by the high temperature, at least 100 deg. C., and by the action of the paddles, which divide the air admitted with the oil very finely. The air and the vapour formed escape by the air tube while the froth is always brought back into the interior of the kettle by the action of the ventilator. This operation continues for about 11 hours, according to the degree of concentration desired, after which the prepared oil is drawn off by a tube into corresponding receivers. After an operation of about 14 hours there is in the kettle a tenacious elastic matter (oil caoutchouc), which cannot be drawn off by the exit tube; for removing it, it is necessary to open the apparatus and remove the agitator, when the matter can be taken from the paddles and walls of the apparatus; it may be easily raked off. The oil which has been submitted to this operation is completely decoloured and exhibits great lustre and elasticity, which it preserves indefinitely; at the same time it has the property of absorbing large quantities of liquid with which it may be diluted. This method is much less expensive than the ordinary process and also economizes the time. In a few hours, instead of several days and even weeks, the operation is terminated. For accelerating the drying of the concentrated oil, the compression tube can be passed, if desired, though a retort filled with manganese oxide or other substance restoring oxygen readily, so that the oxygen is forced back by the tube into the kettle, and the oil is dried rapidly. For causing the longer sojourn of the air and for distributing it more regularly in the mass of oil, perforated horizontal disks can be arranged on the mixer.—*La Revue de Chimie Industrielle.*

FIBRES.

COTTON CULTIVATION IN DELFT, CEYLON.

No one knows at present when or by whom cotton was first introduced into the Island of Delft. The centenarians of the place, of whom there are about half-a-dozen at the present day, assert that they were growing the "Oor-Parutti" (indigenous cotton) till the time when Mr. Atherton introduced a new variety from Colombo, which came to be known as the "Colombo Cotton." The cotton grown here in the early years of British rule is now almost extinct. I am trying to procure a specimen of the plant to be sent up for identification. The "Colombo Cotton" has been identified as the "Sea Island Cotton." Cotton was at one time cultivated very extensively in Delft, and the people used to manufacture their own cloth till the sixties, when the introduction of cheap English goods and the fall in the price of cotton made the people abandon their industry. All the weavers turned farmers, and the present generation knows nothing of weaving. Only a very few grow cotton now, and they sell the staple locally to fishermen for making nets or to the weavers of Chunnakam who generally make a kind of coarse canvas largely used by the Jaffna boatmen for sails. In the 'eighties Sir William Twynam introduced a third variety, probably the New Orleans species which gave a crop in five months and died soon after. The villagers, as they had no faith in the rotation of crops, did not take a liking to this variety. It might almost be said that the cotton raised at Delft is a wild product, since the only care bestowed on the cultivation is seeing that the plants are not eaten up by cattle. The plants are kept on for from five to six years at a stretch and no pruning is done. The fields know neither weeding nor manuring.

The cultivation begins in September when the field is first sown with some dry grain, generally "chamy" or "varaku," and on the third day before the soil is turned with the plough, cotton seeds rolled in cow dung (to keep them loose and single) are strewn over the field at distances of from 3 to 4 feet and then the soil is turned. The seeds germinate in about eight days and the plants grow up along with the dry grain which is reaped in its own time. The cotton plants take a whole year to blossom, and it is not till full two years have elapsed that any picking is done. There are two crops in the year, the gathering in of the first taking place between March and May, and the second between August and October. The first crop is, as a rule, twice as large as the second. The picking is done every other day.

Plants are not known to have ever suffered from any pest or disease Too heavy rains make the plants drop, but this is not a circumstance that people have often to complain of. When the plants are cleared away after they have yielded all they could, the land is allowed to lie fallow for a couple of years, and then the cotton is grown again in the manner described. It is difficult to make anything like an exact estimate of the amount of cotton produced in a season or of the expenses incurred, as no system is followed in the cultivation.

Two men, who have grown cotton on their lands (about 3 acres in extent) for the last fifty years, have re-planted their lands every seventh year—allowing them, as a rule, to lie fallow for one and sometimes two years; and the following are the results attained by them. One of them, who took some pains in keeping the land clear of weeds and seeing that there was no overgrowth, has had better

results than the other. The first crop gave one man 690 lbs. and the other 2,925 lbs. of seed cotton; in other words, 230 lbs. and 975 lbs. per acre, which would amount to 60 lbs. ginned (lint) cotton and 165 lb. cotton seeds and 279 lb. lint and 696 lb. seeds respectively. These results compare very favourably with the figures given by Dr. H. M. Fernando in the *Tropical Agriculturist* of June last, viz., 200 lb. lint cotton and 500 lb. seeds per acre. Such being the results of cultivation when so scanty are the attention and pains bestowed on it, it goes without saying that the soil of Delft is well adapted for cotton, and that its cultivation under improved and scientific methods with the advantages now so liberally placed at the very door of the poorest of villagers by the Ceylon Agricultural Society, must be very profitable indeed.

DR. THOMATIS AND HIS CARAVONICA COTTON.

Dr. Thomatis, Queensland, writes the following to us:—"My Caravonica is being introduced in French Congo and Dahomey, and in Central America is already in great favour. One planter in Brazil has ordered no less than one ton of seed of Caravonica, one wool, and one quarter ton of each of the silk and kidney. He intends to grow over 10,000 hectares at once or 25,000 acres. In Colombia, Mexico and Guatemala it is being grown largely, so Caravonica revisits the country of its parents.

"From several parts of India I have been asked to come over and act as adviser, consulting or visiting inspector of Caravonica cotton plantations. As I wish for a change after thirty years of Australian residence, and as the labour conditions are now much against expanding tropical agriculture in Australia, and also as one of my nephews is willing to come out and act as manager for me here, I would be ready to come to India and do above work provided a competent annual remuneration were guaranteed me for at least three years to start with' To make the suggestion practical and easily carried out, I would say that each Native State Government, each Local District or Municipal authority, or Board or Association, and each individual Caravonica cotton grower, should submit and contribute a quota to this fund of my remuneration, say from £10 to £100 according to importance, size of district, and to the area under Caravonica cotton. In fact, it would be based at so much an acre planted, or to be planted, with Caravonica. This would be for all India, Burma, Ceylon. I would travel continually, to and fro. Of course I should have a free pass on all railways. I could easily attend to the wants and requirements of every planter throughout the year. If £2,000 were guaranteed me yearly for three years, I would arrange to come at once and commence my work. Of course a kind of committee should be appointed by the subscribers to guide me in my movements and duties, as I should not like the arrangements to be left at my discretion and entire responsibility. It should be also understood that if new subscribers should come in I should get the additional income from the additional subscriptions above the £2,000.

"In this way I would have the opportunity of studying and making researches for the improvement and culture of my Caravonica exactly *in loco* so as to adapt it to the climatic conditions and also as to soil and position. I feel sure my suggestion. if properly considered, could be of great advantage and help, and by the way of subscription according to acreage it would become very light to all Caravonica growers, who would hardly feel the voluntary tax. I have been desired to go on a similar basis to Africa, but I should prefer India."

DRUGS AND MEDICINAL PLANTS.

THE CULTIVATION OF TOBACCO IN THE HIRIYALA HATPATTU.

By M. Madapola.

The period when the cultivation of tobacco was first introduced into Hiriyala Hatpattu it is difficult to find out. There is, however, evidence to prove that the cultivation of this plant has been going on for over a hundred years. And it is astonishing that during this long period from 75 to 100 acres only should be cultivated in this plant. The laxity on the part of the villagers in respect of the cultivation of this product may be due to many causes; I would attribute it mainly to the enormous time and labour which the successful cultivation of a small plot of ground with tobacco seems to require. And even after the expenditure of so much time and toil it very often happens that an acre which would, if properly grown, yield something like Rs. 700 is totally devastated and rendered useless by being infected with two or three species of pestilential worms before the plants begin their third month of existence. With the native cultivator the successful growth of the plant seems to be a matter of chance, and his mind has entirely failed to understand and arrest this sinful waste of human labour. The tobacco grown in this Hatpattu, which is the only part of the Kurunegala district where the plant seems to be systematically grown as an article of commerce, is of a very superior quality. And even in the Hatpattu it is confined to small plots situated in Hetahaye, Tittaweligandahe, Ihala Otota, Ihala Visideka, Mahagalboda, Divigandahe, and Nikawa Gampahe Korales. In the last mentioned Korale tobacco cultivation has but recently begun, while in Hetahaye and Tillaweligandahe Korales the plant is grown on a more extensive scale.

The period of the South-West monsoon or the Yala season is best suited to the cultivation of the plant, while the Maha season, owing to the heavy rainfall during that period, is unfavourable. The tobacco grown in Hiriyala may be divided into seven divisions according to the price which each quality commands. It is accepted on all hands that the quality known as Mahabadali or the broad tobacco fetches the highest price owing to its superiority to the rest in size and in taste. Very near to the above quality may be mentioned the kind known as Siribadali, the difference between the two being that the latter is only smaller in size. Kalutoppu or Kadumberiya which is almost similar to the Siribadali in value is supposed to be a species introduced into Hiriyala from Toppoo a village in the Chilaw district. Kolimuringan which, too, may be classed as a second-class tobacco seems to be derived from some Tamil words which I have not been able to find out. Orudunkala, which perhaps derives its name from its boat-like shape, is a tobacco of an inferior quality, and is also small in size. Keheldunkela or Waldunkela is about the most inferior kind of tobacco grown in Hiriyala. It is termed *kehel* because when it is cured it resembles the dried plantain leaf and is therefore of no value whatever. Netidunkela is so called because the petiole or the leaf stalk is much longer than in the other species of tobacco. It is more suited to be wrapped into a graceful cigar than to be used in any other form. A species of Netidunkala is, I think, grown in the Dumbara district which is fast becoming a cigar manufacturing centre. After offering these few preliminary remarks, I propose to divide the subject into three principal heads.

HOW THE PLANT IS GROWN.

Like many other plants the seed is first grown in a nursery and then replanted in beds in a well cleared plot of ground at the rate of 4,000 plants for each acre. These plots are selected in places where water can be easily procured, and of which the soil is what is known as gurupas or a reddish kind of soil. They are carefully fenced round, and from May to April of the following year cattle are daily put into these enclosures to provide manure of the kind which seems to be most essential for the growth of the tobacco plant. In the months of November and December the soil is turned over to render it more fertile, and soon afterwards the daily introduction of cattle into it goes on apace. In March of the following year any form of foreign weed which may have grown since the last turning over of the soil is removed. In April and May again the soil is turned over and rendered fine before the beds are prepared which are to receive the young plants from the nursery As soon as they are put into the beds, each of the plants is carefully covered over with coconut husks or with some branches of trees if the former cannot be obtained. The plants in the absence of rain have to be watered twice every day. A month after planting the soil round each plant has to be rendered loose with a pointed stake. At this time any remaining grass, too, may be removed. After another month the whole ground is turned over, and the beds, which had disappeared in consequence of the turning over are again formed as before. At this stage the plant is full of green tobacco leaves, some of which are removed so as to cause the remaining leaves which are about twelve in number to expand in size. This is done during the latter part of June. In August the stipules are removed weekly from the leaf-stalks. Then when the leaves are properly seasoned they are severed from the plants for the purpose of being cured.

DISEASES.

What is most regretable in the cultivation of the tobacco plant, and often renders the toil of the cultivator entirely useless, is the many diseases to which unfortunately it is heir. Some of them affect single plants, while others seem to be highly contagious, rendering a large number of plants absolutely valueless. It would be a good act on the part of Government if an expert could be sent to examine into these diseases in order to see if some remedy could be found to prevent the occurrence of these maladies. The diseases, so far as I can gather, are five in number. They all seem to afflict the plants within three months of their being planted in beds. *Hitamarima,* a disease which comes when the plant is two or three months old, is supposed by the native cultivator to occur less frequently in a newly-cleared plot of ground. *Irimadaroge* is a disease which afflicts the plant after the tender leaves are cut off. Its symptoms are that it dries up the inside of the plant, and the leaves attain a yellowish colour before they are properly seasoned. The third disease is known as *Tanakuduroge.* Here the leaves before the lapse of one and a half months are thickly studded with a kind of little white worm. A horrid stench seems to proceed from the leaves thus afflicted, and they are absolutely useless for any purpose whatsoever. This disease is contagious, if the cultivator does not take the earliest precaution to remove the diseased plants. Another complaint is a worm disease, these plants being afflicted with a big species of worms a little over an inch in length and one-quarter in diameter. The mode in which the leaves are destroyed by these worms is rather interesting to note. From one to twenty worms seem to take possession of each plant during the night and to make a royal feast of the leaves. They are unable to bear the heat of the sun, so that before sunrise they descend from the plant and hide them-

selves beneath the loose soil at the bottom of the plant. When they have done with one plant, they make a nightly raid on another. The cultivator is sometimes wise enough to remove them before they hide themselves beneath the loose soil. There is no bad smell when these worms afflict the plants. *Kaberiroge* or *Kolaekilima* is a form of disease from which the leaves of the tobacco plant get curled up. Single plants are afflicted with this disease, and before it becomes a danger to the others, it should be immediately rooted up. *Pattaroge*, the last disease which I am able to mention, is a sort of paralytic complaint which seems to make one side of the plant wither away. The leaves on the diseased side are rendered useless. The disease first attacks the roots on one side and then mounts upward along the stem.

MODE OF CURING.

I do not propose in this paper to dwell at any length on the mode of curing the leaves. It deserves to be separately dealt with owing to the highly difficult and at the same time interesting manner in which the curing is proceeded with. I shall make only a few general observations. The curing of tobacco is done by a process of drying the leaves in the sun, which at each time ranges from 15 minutes to a whole day. A separate cadjan shed is put up for the purpose, where the leaves after being allowed to dry in the sun are daily stacked in bundles of 25 to 30 and placed lengthwise against the sides of the shed. This is done for a period which lasts from four to six weeks. The curing of the leaves of 4,000 plants could be done by four men during the above period. The chief curer is generally paid Rs. 20 per mensem exclusive of his diet, the other three are paid less. The cost of planting up an acre of tobacco containing 4,000 plants varies from Rs. 160 to 200. The tobacco if properly grown would sell for Rs. 400 before curing. After curing, the tobacco would be worth Rs. 700. The different sorts of tobacco which may be gathered are as follows:— Dunkale, Tuniya, Hondaketiya, Balaketiya, Sivala, Kalaviya, Bala Kalaviya and Alagu. The term Alagu is applied to a quantity of the best tobacco, each leaf large in size and well cured. They are said to cost Rs. 16 per 100 leaves.

CULTIVATION OF CINCHONAS ON THE PACIFIC COAST.

We make the following extracts from a paper read before the Lewis and Clark Pharmaceutical Congress, Portland, U.S.A., by Mr. Albert Schneider, M.D :—

The object of this paper is to review very briefly the subject of the cultivation of cinchonas in Java, India, South America, West Indies and other countries, and to discuss more fully the possible successful introduction of the more hardy varieties of cinchona into the immediate coast ranges of portions of California. The more important literature on the subject is cited for the benefit of those who may be interested. It is hoped that the paper will aid in promulgating thorough and scientifically conducted co-operative efforts to introduce cinchonas into the United States.

HISTORY OF CINCHONA CULTIVATION.

The history of the establishment of cinchona plantations is full of interest. It records the usual difficulties and obstacles in the way of progress. There was open opposition, shortsightedness and the usual lethargy. The voice of authority was often ignored and the momentary flicker of interest died as suddenly as it was stirred into life. From 1792, when Ruiz first advanced the idea of cultivating cinchonas out of their native homes, until 1850, when the first seeds were germinated in the Jardin des Plantes in Paris is a long time to produce so slight a result. As with many other plant-culture industries, the Dutch were the first to establish

successful cinchona plantations. In 1854 the botanist Hasskarl was sent to Peru for the purpose of obtaining seeds and plants. Only a comparatively small number of plants arrived in good condition in Java, where the first cultural efforts were made. In 1856 Hasskarl had 156 young plants out of the 400 which he secured. The efforts prospered, and as early as 1862 there were over 1,360,000 seedlings and young trees, mostly of *Cinchona calisaya*, *C. lancifolia*, *C. micrantha* and *C. succirubra*. *Cinchona paludiana*, a species of doubtful utility, grew very rapidly.

About 1852 the British Government began to take active interest in cinchona culture, due in a large measure to a report by Royle, addressed to the East India Company, in which it was set forth that the Government of India was then spending about £30,000 annually for cinchona bark and quinine. After some hesitation and discussion it was decided to make attempts to secure seeds and plants from Bolivia. The Bolivian Government, however, was and still is very jealous of its cinchonas, native and cultivated, and has done everything possible in the way of preventing or hindering their introduction into other countries. The government has either refused to allow seeds and plants to leave the country or has insisted on prohibitory prices. In spite of all obstacles, seeds and plants were secured. In 1860 Markham, through the influence of R. Spruce, obtained some 450 plants of *C. calisaya*, *var josephiana*, *C. ovata*, *C. micrantha* and *C. pubescens*. G. J. Pritchett, under Markham's direction, also secured numerous plants and seeds of *C. micrantha* and *C. nitida*. Plants and seeds were also obtained from the Dutch plantations of Java, and seeds of *C. lancifolia* from New Granada through Dr. Karsten. The British Government undertook these operations on a large scale, sparing no pains or expense. After careful consideration it was decided that the most suitable area for possible successful cinchona culture in British India was on the south-west coast in the Madras presidency, among the Nilgiri (Neilgherry) hills. The first plantations were established at an elevation of 7,000 feet above sea level. Propagation was rapid, and in 1866 nearly 2,000,000 plants were well established in the Nilgiri hills alone, to say nothing of various isolated private plantations. Of the different species attempted, *C. officinalis* did best. Since that time the India cinchona plantations have increased rapidly, other areas being planted in different parts of India. The bark began to appear in the London market in 1867, and since then has continued to be shipped in increasing quantities.

Both the Dutch and British efforts with cinchona culture have proven successful in every way. More or less extensive plantations are found in Bolivia and other South American countries, in Central America, West Indies, Mexico, Africa and a few other countries. None of these, however, has the importance of the Dutch and English plantations.

CLIMATIC CONDITIONS IN THE ANDES.

The average altitude of the Andean natural habitat of the cinchonas ranges from 5,000 to 8,000 feet above sea level. The highest altitude, as noted by Karsten, is 11,000 feet, and *C. succirubra* is occasionally found as low as 2,500 feet. In a general way it may be stated that the altitude of the cinchona zone decreases with the recession from the equator, and the most valuable sorts are not found lower than 5,000 feet. None has ever been found in the lowlands and river valleys. The climate of this region is said to be very variable, sunshine, showers, storms, thick fogs and mists alternating with rapid succession, yet with no great range in temperature. According to Fluckiger a transient depression of the thermometer even to the freezing point and not infrequent hailstorms may be borne without detriment by the more hardy species. The mean temperature most favourable to the growth of the majority of species appears to be 12 degrees to 20 degrees C. (54 degrees to 68 degrees F.). It is very evident that the native cinchonas have

in the course of time gradually become more and more limited in their distribution, adapting themselves to the soil and climatic conditions which prevail in the rather limited areas in which they are now found. They are very rarely found to extend slightly over into the western slopes of the Andes. In their natural haunts climatic conditions seem to influence the growth of cinchonas more than the composition of the soil. They occur, for example, in a great variety of geological formations which seem in no wise to affect their growth or the chemical constituents of the bark. This does not appear to hold good in cultivation, since rich soil, for example, does certainly increase the alkaloidal yield considerably. Above all, cinchonas require good soil drainage; a checking, clogging or retardation in the soil seepage is very injurious to the growth of cinchonas. While they thrive in regions of heavy and prolonged annual rainfall, it is found that some species and varieties do fully as well or even better in areas of comparatively slight rainfall. They do, however, require considerable atmospheric moisture.

In their natural haunts the cinchonas are associated with the cocas (*Erythroxylon coca*) and coffee trees (*Caffea arabica*) and tree ferns, in sheltered declivities with rich, well-drained soil. There is a Peruvian proverb to the effect that the "cinchonas like to be within sight of snow." A hot climate is fatal, which is no doubt the chief reason why they are not found in the lowlands of the tropics. On the other hand, it is equally evident that a temperature below 27 degrees F. is quite uniformly fatal to the great majority of native species and varieties.

CLIMATIC CONDITIONS IN CALIFORNIA.

A brief review of the climatic conditions of California will give some idea of the similarity to the climatic conditions of the natural home of the cinchonas. The coast line of California, nearly 1,000 miles in extent, shows but a difference of 10 degrees F. in mean annual temperature. At Eureka (Humboldt county), the temperature is 51 degrees F., at San Francisco, 56 degrees F., and at San Diego, the extreme southern limit, 61 degrees F. At Eureka the mean monthly departure for January is only 5 degrees from the annual mean; at San Francisco, 6 degrees F., and at San Diego, 7 degrees F. The difference in mean annual temperature between the extreme north and south of California is slight, yet sufficient to modify the character of the vegetation to some degree. The difference in annual rainfall is more marked, with seventy-five or more inches at Eureka, fifty-six inches at San Francisco, and about five or six inches at San Diego. Of special interest to cinchona culture are the records of absolute minimum and maximum temperatures. The records as given in the Climatology of California (1903) show that in San Francisco the temperature has dropped as low as 22 degrees F. (January 28, 1862); there are several records of 25 degrees F. (January 20, 1854, and January 31, 1862), and several of 27 degrees and 28 degrees. These records were made by Mr. Thomas Tennent and extended over a period of twenty years (1849 to 1870). To the south of San Francisco along the coast, the temperature increases very gradually and slightly; to the north it is similarly lowered. At Los Angeles there is an occasional record as low as 28 degrees F.; at San Diego an occasional drop to 32 degrees F.; at Eureka there are records as low as 20 degrees. F.

The question of importance, in the light of the previous rather inconclusive experiences and tests and the ascertainable facts regarding climatology, etc. Is it likely that renewed and properly conducted efforts to introduce cinchonas would succeed? Similitude or similarity of vegetation is not a conclusive guide. For example, the tree ferns do well in San Francisco, but the coffee tree does not survive in the open, and the coca (*Erythroxylon coca*) has apparently not been attempted. The experiments made by the college of agriculture show quite conclusively that the less hardy species of cinchonas cannot survive the frosts of the middle California

coast region, this in spite of the fact that the plants grown in Golden Gate Park, San Francisco, are closely similar to those grown in the Nilgiri hills of British India, where the cinchonas do well. This would indicate that, although there may be close similarity of the vegetation of two different countries, there are certain plants so delicately constituted that a variation in temperature of only one or two degrees will bar them from one country while they will thrive well in the other. It is, however, well-known that plant ranges can be extended by artificial methods, a fact familiar to all plant growers. As a good illustration may be mentioned the extension northward of orange growing in the Sacramento Valley, California. Many tropical and sub-tropical plants of which it was predicted that they would not grow in the central portions of California do well, though some do not develop or ripen fruit. With regard to the possible successful growing of cinchonas, there always has been considerable difference of opinion. On the one hand, so eminent an authority as the late Baron F. von Muller (in 1881) expressed it as his opinion that they may be readily and profitably grown in the southern part of the State, while Dr. H. H. Rusby states unhesitatingly that in all probability the cinchonas cannot be cultivated successfully anywhere within the limits of the United States. Without entering into a discussion of the reasons given by these various authorities for and against the successful introduction of cinchonas into the State of California, we shall briefly summarize the facts as they actually exist.

SOME FACTS SUMMARIZED.

1. Cinchonas require a uniform temperature, having a mean of about 52 degrees F., rarely falling below the freezing point and rarely exceeding 90 degrees F. The majority of species may resist an occasional drop to 28 degrees F., and a rise to 100 degrees F. Such conditions prevail in the southern coast counties of California.

2. In their natural homes the cinchonas exist in a heavy annual rainfall, extending over eight to ten months of the year. Culture observations have, however, shown that heavy prolonged seasonal rainfalls are not essential, in fact are detrimental to some species and varieties. This is also well borne out by the tests made at the California College of Agriculture. *C. succirubra* resists droughts as well as the majority of mesophytic trees and shrubs. No doubt the rainfall of the California counties indicated would be adequate. Irrigation or watering would perhaps be necessary during the dry season, at least until the trees are well rooted.

3. Cinchonas require a moist atmosphere and fogs, alternating with sunny days. Such conditions are quite prevalent in the counties indicated, especially northward. Prolonged dry winds are pernicious. In San Francisco and northward there are the so-called "northers" which have a very injurious effect upon all vegetation, but according to reports the cinchonas are not excessively susceptible. In Los Angeles and southward the similar dry wind, the so-called "santa ana" is injurious to vegetation. The coast counties indicated experience these dry winds to a lesser degree, and in all probability they would not prove injurious to cinchonas.

4. It has been established that cinchonas do not require the shade of other trees as was once generally believed. In fact they thrive much better in the open. This is certainly true of the plants that are two or more years old.

5. Above all, cinchonas require rich soil with deep and free drainage. Soil with stagnating water is very pernicious, especially to young plants in which it encourages the development of root rot.

SUGGESTIONS FOR FURTHER EXPERIMENTS.

Based upon previous tests, and experiments regarding the cultivation of cinchonas in California, and the thus far ascertainable habits and peculiarities of the cinchonas it may be stated that the more valuable species and varieties will thrive in certain localities of Santa Barbara county, inclusive of the various islands in Santa Barbara bay. Attempts should be made with the most hardy of the valuable species and varieties. While the previous attempts with *C. calisaya* and variety were almost complete failures, and it appeared that they were especially susceptible to frost, it is nevertheless advisable to make further attempts. According to von Muller, this species is unusually rich in the alkaloid quinine and is the most valuable species in cultivation in Bengal, where it is said to brave occasional night frosts. *C. cordifolia*, Mut., is said to require high and constant atmospheric moisture, for which reason it would perhaps not do well in most of the possibly suitable localities in California. *C. nitida*, R. et P., is said to be one of the most hardy species and should therefore be tried. *C. officinalis* is said to be the hardiest of all, and it is especially adopted to a moderately dry climate. A variety of this species known as the crispilla cinchona will endure an occasional temperature as low as 27 degrees F. According to F. von Muller *C. condaminea*, Humb., is the same as *C. officinalis*. *C. succirubra*, Poa., which is the most exclusively grown cinchona in the Bengal mountains, is especially rich in quinine and cinchonidine. It is quite sensitive to cold, but will resist occasional slight frosts (a little below 32 degrees F.). *C. lancifolia* is somewhat more hardy than *succirubra*, but not quite as hardy as *C. officinalis* and its varieties.

The following is an outline of the plan which should be followed in order to make the experiments a success. Large quantities of fresh seeds of the more hardy and more valuable species and varieties of cinchona should be obtained from Java, India and Jamaica. These should be sown in mat-covered or glass-covered cold frames, filled with a compost of a mixture of turfy loam and fibrous peat (to which has been added a little sand and charcoal). The bottom temperature should be kept at about 60 degrees F. Experience has taught that they will not germinate as readily in hot-beds. The soil should be kept well moistened, not wet. The seedlings should be pricked into beds of suitable size and should be kept under glass for two or three years, at a temperature of about 50 degrees to 60 degrees F., with moist air and adequate soil moisture. The soil should be rich and well drained. The plants should be protected against frost and excessive heat. They should not be kept in the hot-house, exposed to a maximum temperature, as that renders them undesirably delicate and susceptible to the lower temperatures to which they are to be exposed later.

From what has already been said it is evident that the major attention should be given to the most hardy species and varieties; for example, the so-called crispilla variety of *C. officinalis*. Less hardy varieties would be largely for purely experimental purposes, though it is evident that *C. nitida*, *C. ledgeriana* and *C. lancifolia* would succeed in southern California. Testing, at the outset, with the less hardy varieties would only result in failure and cause discouragement.

During the summer of the third year (after sowing) the cinchonas (kept in the frames into which they had been pricked) should be kept in the open. If the tests are made in San Francisco, they should be protected against severe "northers." In the fall of the third year, at the beginning of the rainy season, the most thrifty of the plants should be transferred to their permanent localities, properly packed, shipped and handled.

The selection of permanent localities is prime importance. To this end some one sufficiently competent should visit the coast regions of Santa Barbara county and the Santa Barbara bay islands and select some six or seven localities meeting the following conditions:—(1) Most suitably protected against dry winds; (2) a maximum of annual rainfall; (3) comparative absence of frost or frostiness and freedom from very hot weather; (4) free and deep soil drainage; (5) rich soil; and (6) possible facilities for irrigation. The plants should be taken to these localities, by the quickest and shortest route, and should be transplanted at once under the direction of the one who selected the localities. They should be planted about eight feet apart and the soil kept free from weeds and frequently cultivated. The various plantations should be in charge of responsible and competent gardeners. Of course the thousand and one details, every one of which is of vital importanee, eannot be mentioned in this paper. But, if the suggestions herein given are followed, there is no reason whatever why the enterprise should not succeed.

Since the atmospheric condition, moisture, rainfall, etc., are more suitable northward of the area mentioned, it is desirable to make attempts to develop hardy varieties. This may be done as follows:—Seleet the area farthest north at which the most hardy variety will survive (for example, the crispilla variety of *C. officinalis*), which is approximately San Francisco. Germinate the seeds as already suggested. During the summer of the third year transplant in permanent localities in the open, meeting all the requirements, with the possible exception of frosts and northers. The frosts and northers may or may not kill some, depending upon the severity of the speeial winters to which they are exposed. The survivors are presumably more hardy than those which were killed. From the plants which develop to maturity, seeds and cuttings should be taken and similarly tested, and efforts be made to extend the station still further north. Whether the range could be extended up to Eureka in Humboldt county is highly improbable. It is, however, very likely that the range could be extended from San Diego or Santa Barbara county northward to points in the vicinity of San Francisco bay. A drought-resisting variety could no doubt be extended southward to some distanee below San Diego. The writer does not at this time presume to explain the most suitable methods of developing frost-resisting, dry-wind-resisting and dry-soil-resisting varieties. The above are mere suggestions which will of necessity be amended as the tests progress.

ALKALOIDAL STRENGTH.

Although it cannot be foretold what the alkaloidal value may be of the cinchonas which may be grown in California, it is nevertheless reasonable to assume that the species and varieties successfully grown in other countries, having a high percentage of desirable alkaloids, would also have a relatively high percentage of the same alkaloids if grown in California. To experiment with worthless varieties would only be a waste of time and energy.

The alkaloidal strength of cinchonas is increased greatly by cultivation, some species as *C. ledgeriana* containing as much as 13 to 26 per cent. It is however, also true that while the majority of cultivated cinchonas are much richer in alkaloids than the same wild growing plants, they are also very variable in that respect, dependent, no doubt, upon richness of soil, methods of cultivation and many other causes, many of which are as yet not well understood.

In conclusion, it may be stated that it is essential that the experiments should be carefully and consistently carried out. Illy timed and illy conducted experiments on a small scale will in all probability lead to nothing. To send

five or six plants to each of a dozen or more random localities, placing them in the hands of wholly irresponsible parties is not a conclusive test. Several hundred cinchonas should be transplanted in each locality chosen as already suggested.

APPENDIX.

According to Willis Weaver, *C. cordifolia*, Mut., is found in Peru and New Granada at between 6,000 and 8,000 feet, up to the frost regions of 9,000 feet (probably under shelter of forest). It is of robust constitution and grows with rapidity and vigour. This is evidently a hardy species and is worthy of a trial in California.

According to Cross the temperature of the best natural cinchona region fluctuates between 35 degrees and 60 degrees F. The optimum temperature is from 53 degrees to 66 degrees F. In open places they will endure a minimum of 32 degrees F. In the botanic gardens of Melbourne, where cinchonas have been grown for many years, they have resisted a temperature several degrees below 32 degrees and as high as 100 degrees F. *C. succirubra* is most easily raised from seed, best under some cover as mats. They produce seeds copiously several years after planting. F. von Muller states that *C. succirubra* was first introduced into California by himself, presumably about 1879 or 1880, together with the principal other varieties, and that they thrive well in the lower coast ranges as far north as San Francisco. According to the late Dr. H. H. Behr, *C. succirubra* does much better in California than *C. calisaya*.

The Dutch cinchona plantations are undoubtedly the most successful, financially and in every other way. The income from the enterprise is more than double the expense of culture and shipment. The enterprise can in all probability be made a success in California, and perhaps other portions of the United States, as Florida. The attempts should be made carefully. A suitable fund should be available for the purpose. Some competent botanist should be sent to the Dutch (Java) and British (India) plantations to study methods of propagation, culture, removal and drying of bark, etc. This would prove profitable in the end. The State of California should have sufficient interest and insight into the development of its great possible resources to make a suitable appropriation.

A CONSULAR DOCUMENT.

The following very interesting extract is taken from the United States Daily Consular Reports (May 19, 1905) and explains itself :—

Under date of March 8th, 1905, United States Consul R. M. Bartleman, Seville, Spain, transmits the following translation of an article from the "Kolnische Zeitung" of March 1st on the cultivation of the cinchona tree, which he thinks should be of interest to tree planters in certain parts of the United States. The article was supplied by a planter in Dutch India :—

The seed utilized is obtained from a peculiar species, producing no bark, and consisting only of parent trees, which are the result of numerous crossings and of much labour and patience. Their successful improvement is expressed by the fact that the bark of some of the trees is now capable of a yield of 20 per cent. or more of quinine against a former production of only 2 per cent. The improvement is not limited to the action of pollen, grafting being likewise resorted to. The seed is obtainable at from $1·43 to $11·90 per gram (15·432 grains) and a small improved tree of abundant bearing is purchasable at $4·05. A gram of the seeds contains about 2,500 seed corns, so light in substance as to be moved by the gentlest breath of air.

A small, oblong-shaped house is constructed from bamboo, open on one side, wherein is deposited the richest earth procurable, previously thoroughly boiled so as to exterminate all insects and weed germs. About forty days after seed has been

scattered, a slight green covering of the bed indicates that it has sprouted. As soon as the young plants have developed to the height of about three fingers (one and one-half to two inches) they are replanted in rows in large beds, and thence, after a year's time, during which they grow to a height of one foot, are transplanted into gardens, where holes are dug, some time previously, in rows four feet square. Shortly before transplanting the holes are closed up and the young trees set out by women, each of whom is capable within ten hours of daily work (from 6 a.m. to 3 p.m.) of planting 200. Above all, the period following exacts scrupulous cleanliness of the gardens and rigorous cultivation of the soil. It becomes absolutely necessary to ward off a certain species of mosquito, which deprives the leaves of moist cellulose; to guard against the attack of borers, which penetrate the stem and destroy its vitality; and to exterminate caterpillars and butterflies. In the third year the trees measure nine and one-half feet in height and are trimmed by sawing off the lower branches, which in turn are stripped of their bark by blows from a wooden hammer.

The bark is conveyed to the factory and there dried either by exposure to the sun or in large furnaces, a process by which it loses one-third of its weight. When thoroughly dry the bark is removed to a water mill, where it is reduced almost to a powder. In this state it is packed in sacks of from 176 to 220 pounds and shipped to Europe, where the quinine is extracted. A similar harvest may be reaped every year thereafter until the twelfth, in which the tree is cut down and used, even the bark from the root being removed. Large plantations gather about 2,000,000 pounds of dried bark annually, worth from ten to thirteen cents per pound.

In conclusion, reference may be made to a recent letter from Dr. F. Franceschi, of the Southern California Acclimating Association, Santa Barbara, Cal., in which he states that in his opinion the climate of Southern California is too dry for most cinchonas, whereas Northern California is too cold, which would be in harmony with the suggestions made in this paper. It may also be stated that some efforts toward the introduction of cinchonas into California are now being made at the San Francisco Garden of Medicinal Plants, concerning which a report will be made latter.—*The Druggists' Circular.*

THE ALKALOIDS OF DATURA ALBA.

In the flowers of *Datura alba*, Nees, a plant indigenous to China, Browne found 0·485 and Hesse 0·51 per cent. of scopolamine, while from seed gathered in Japan Shimoyama and Koshima, in 1892, isolated only hyoscyamine with the exception of a very little atropine. In the course of his work upon the mydriatic alkaloids of the *Solanaceæ*, Professor Ernest Schmidt, of Marburg, has had occasion to re-examine this member of the order, the results of his observations being briefly as here described. *Datura alba* is stated by Dragendorff and other authorities to be identical with *D. fastuosa*, and under the latter name Professor E. Schmidt procured from Erfurt seed, of both the double blue and double white flowered varieties, each of which was examined separately. The method of treatment consisted in extraction of the crushed seed with alcohol at 30 to 40° C., evaporation of the alcohol at gentle heat, solution in water, removal of fat by shaking with petroleum ether, extraction of the bases from the aqueous solution, after addition of sodium bicarbonate, by shaking with ether-chloroform, and their withdrawal from the latter fluid by agitation with water acidulated with hydrogen chloride. The alkaloids thus separated were nearly colourless and in a suitable condition for precipitation as double gold salt, in which form they could be identified. The small quantity of alkaloid taken up with the fat by petroleum ether was recovered by extraction with dilute acid, and the main aqueous fluid from which the bulk of the bases had been removed was further treated with ether and chloroform,

after adding potash, but only yielded very small quantities of hyoscyamine and atropine salt in too small amount for further investigation. Operating in this manner upon the seeds of *Datura fastuosa, flor. cœrul. plen.* he obtained, from 230 grammes of seed, rather more than a gramme of a crystalline auriehloride having all the properties of scopolamine gold chloride $C_{17}H_{21}NO_4$, $HCl{\cdot}AuCl_3$, M.P. 207 to 209° C., Au 30·52 per cent. (theory requiring 30·57). From the filtrate and mother liquors resulting from crystallisations of the first precipitate there were successively isolated hyoscyamine aurichloride $C_{17}H_{23}NO_3$, $HCl{\cdot}AuCl_3$, M.P. 161—162° C., Au 31·21 per cent. (theory 31·30), and atropine aurichloride, M.P. 136—138° C., the net result being approximately equivalent to 0·216 per cent. scopolamine, 0·034 per cent. hyoscyamine, traces of atropine, together with a trifling amount of amorphous bases unidentified. From a similar quantity of seed of *Datura fastuosa flor. alb. plen.* there were separated in like manner about 0·20 per cent. scopolamine, 0·023 per cent. hyoscyamine, and traces of atropine.

Scopoline, a base derived from scopolamine by decomposition, was the object of an investigation by Professor Schmidt three years ago, and has since that time been repeatedly under his observation. In the last issue of the *Apoth. Zeit.* he reports some further provisional results. Among the products of the action of chromic and sulphuric acids upon scopoline is a base free from oxygen containing six carbon atoms in the molecule. The double gold salt at first obtained therefrom melts at 220° to 222°, but after freeing from gold by hydrogen sulphide, removal of excess of the latter, and then again precipitating as aurichloride, a salt isomeric with the first is formed which melts at 248° to 250° C., and yields a platinichloride, melting at 211° C. These properties coincide with the corresponding salts of pyridinemethyl chloride $C_5H_5N{\cdot}CH_3Cl$—*British & Colonial Druggist.*

EDIBLE PRODUCTS.

Banana Flour.

By C. Drieberg.

Introduction.—The idea of a local industry in banana flour has occupied my attention since 1898 when I submitted two reports on the subject which were issued as Government Circulars (227 of December 9th, and 150 of August 5th). My attention was first drawn to this matter by Mr. Chas. Stouter, the Head Clerk of the Anuradhapura Kachcheri, at present of the Audit Office, who submitted a sample through the Government Agent. (I may mention in passing that Mr. Stouter was in 1900 awarded a gold medal for his exhibit at the Paris Exposition.)

Name.—In view of certain important considerations, it is necessary to distinguish between Bananas and Plantains. The popular distinction is based on the fact that the banana is eaten raw and the plantain cooked. In this way the banana might be termed a "fruit" in the popular sense of the term, and the plantain a vegetable. But as Dr. Watt remarks, the two terms are very loosely used—some apply the name banana to the round plump, thin-skinned variety, while others employ it in referring only to the small-fruited kinds. Watt recommends that the name banana should be discarded and only the word plantain used. In Ceylon this is the case, but it would be difficult to entirely eliminate the term banana, which should however always refer to the "table-plantain."

In the manufacture of flour it is the banana and not the plantain that should be used, and for the following reason:—(1) Because the former is more extensively cultivated. (2) Because its yield is larger. (3) Because the quantity of raw material required for producing a given quantity of flour is much less.

Uses.—Banana flour is at a decided disadvantage when competing with cereal flours which are much more cheaply produced. Its chief importance is as a diet for invalids and infants, for which there is no question as to its value. H. M. Stanley has spoken in high terms of its efficacy in gastritis, and the testimony of physicians in India and the West Indies is forthcoming to prove its value as a food for those suffering from dyspepsia, dysentry, and similar ailments. In a report made in a sample sent to the Paris Exposition special reference was made to its suitability in cases of diabetes.

Manufacture.—According to Herr Leuscher, who apparently has had considerable experience in this matter, 10 bunches of 30–40 lbs. each will make 1 cwt. flour—calculating that 20 % goes away as peel or skin and 55 % out of the balance as water. This calculation, however, does not make any allowance for wastage, and is greatly in excess of yields in Indian and Ceylon experiments.

According to Herr Leuscher $2\frac{3}{4}$ cwt. fruit will yield 1 cwt. flour. According to Indian experiments conducted by the Director of Saharanpur Botanic Gardens who used Ryder's American evaporator $8\frac{3}{4}$ cwt. of fruit are required to produce 1 cwt. flour, *i.e.*, only about 12 %.

In Mr. Stouter's experiments the yield was almost indentical with the last; but 12 % seems a very poor yield, and I am inclined from my own experience to put down the average weight of fruit required to produce 1 cwt. flour at 5 cwt., the percentage of flour to fruit working out 20 %. One way of accounting for

the high percentage given by Herr Leuscher is that he was dealing with comparatively large fruits, for he takes the average weight of one as 5½ oz., so that only three fruits would go to the pound, while with our ordinary small plantains about ten go to make up a pound, and as a result a larger proportion goes away as peel.

The method of manufacture shortly stated consists of drying and reducing to powder. The desiccation may be by sun heat or with the aid of a dryer or evaporator, while the reduction to powder can be done by means of a mortar and pestle or a grinding machine.

Cost.—I have not been able to get at any reliable figures as to cost of production in the West, but Indian experiments show it as nearly 40 cents per lb. that is nearly Rs. 900 or £60 per ton! According to Mr. Stouter the cost per lb. was 16 cents, *i.e.*, Rs. 360 or £24 per ton. These figures represent cost of production at the places of manufacture, at Sharanpur in India and Anuradhapura in Ceylon, respectively, so that cost of packing, rail freight, shipping charges and what not have to be added.

Sale Price.—Taking £27 as the maximum price—which a London firm is said to have offered to give per ton—there is still little prospect of a remunerative trade in banana flour, but when we hear of £8 and £5, the figures given in Prof. Dunstan's report, there can be no hope whatever of a paying industry being established in Ceylon. Among enquiries I received from abroad was one from the manufacturers of a well-known brand of infant's food, who made the magnanimous offer of 70*s.* to 75*s.* per ton. *c.i.f.*, which works out at something less than ½*d.* per lb.

Buyer v. Seller.—It would interest you to hear what has been said from the Buyers' as well as the Sellers' point of view.

The following is taken from a letter written by a West Indian manufacturer:—"With reference to banana meal there is really no market or outlet for it, and I have been working the thing for all it is worth and have spent £300 over it, trying to get a satisfactory market, but all to no purpose. Quotations have been made by a London firm of £27 per ton, ex Warehouse and Docks, London. I have offered to supply at these rates—they were simply booming it. I have sent tons of meal to various countries, all to no purpose, as the market seems to want it to compete with wheat or rice."

On the other hand a leading London firm writes:—"The position of the article is that the present supply is more than sufficient to meet the demand. Two years ago we had small buyers at 30*s.* to 35*s.* per cwt., but we found that the planters then were only able to supply it in spasmodic quantities and we dropped the matter . . . . Within the last few months we have had enquiries from planters said to be able to produce in regular quantities, but the trade here is so very small that it is not worth our while to bother about it, particularly after the time and money we have spent in trying to find a market. We are not inclined to waste further time and money on the article, until we see a regular demand for the flour as well as a regular supply."

But before a regular supply could be assumed a satisfactory market rate must be established.

With the present steady demand for bananas and plantains as fruits and vegetables, and the facilities that are being afforded for rapid transport by rail, I am not sanguine of a local trade in banana flour being started.

The following is a letter on the subject received from Professor Dunstan of the Imperial Institute :—

Imperial Institute Road, London, November 24th, 1905.

SIR,—I have to acknowledge the receipt of your letter, No. 2,851/J, dated the 5th October, 1905, inquiring for information regarding the present market for banana or plantain flour. The Imperial Institute has received a number of enquiries upon this subject from various Colonies, and samples of the flour have been forwarded for examination from Fiji and Seychelles. Within recent years banana flour has been introduced into this country from the West Indies, and a limited demand for the product has been created. It is used in conjunction with other materials for the preparation of bread, invalid foods and other dietetic specialities. The present consumption for these purposes appears to be only small, though it is difficult to ascertain the exact amount, as the material is imported direct by the firms interested and the quantity is too small for separate mention in the trade returns. The Imperial Institute has been informed recently by a firm dealing in banana preparations that the present consumption in this country does not exceed 50 tons per annum. Larger quantities are said to be used in the United States, but the importations into that country cannot be ascertained from the official statistics. It appears to be generally agreed that these banana preparations, flour, foods, etc., will require extensive advertising if any large demand is to be created, and at the moment very little is being done in this direction. At the present time £20 per ton is being paid for supplies of banana flour suitable for the purposes already indicated, but it is doubtful whether this price could be maintained in the event of large consignments being placed upon the market, unless the demand for the products could be correspondingly extended. The use of banana flour is at present restricted to these special preparations, but there is little doubt that it could be sold for many other manufacturing purposes if it could be placed on the market at a cheap rate. It would have to compete in this case with other farinaceous material selling in London at from £6 to £12 per ton, and it is a question for local consideration whether a trade upon these terms would be remunerative. Brokers, who were consulted upon this point, stated that if consignments of 50 tons or so per month could be regularly supplied, they thought the material would meet with a ready sale and quoted provisional prices of from £5 10*s.* to £8 per ton *c.i.f.* in London according to quality. They stated, however, that the only way to make the material more widely known amongst manufacturers who might be able to use it would be to forward a small trial shipment of 20 to 30 bags of about ½ cwt. each which could be distributed to likely buyers for practical trials. By this means the possibilities of the material would be determined and its commercial value definitely ascertained. If further action is considered desirable, samples of desiccated bananas and banana flour prepared in Ceylon should be forwarded to the Imperial Institute for examination and comparison with the products upon the market. The Imperial Institute will be glad to be kept informed of any developments which may occur in Ceylon in reference to this matter.

I am, etc.,

(Signed) WYNDHAM R. DUNSTAN.

THE AVOCADO: A SALAD FRUIT FROM THE TROPICS.

PART II.—*Conclusion.*

CULTURE.

The avocado was in all probability planted and more or less cared for by the natives of America before the advent of the Spaniards, for although Oviedo in his first account of the fruit in the northern part of Colombia says that the Indians apply no work to these trees, he later adds that "in the province of Nicaragua they are placed by hand in the gardens of the Indians and cultivated by them." Their culture, however, must have been of the crudest sort, limited probably to the mere planting of the seeds, perhaps of the more desirable kinds, near their houses and affording the young plants some slight protection. Nothing that corresponds to culture in the modern sense was applied to the avocado until the fruit was taken hold of by the planters of Florida.

PROPAGATION BY SEED.

The avocado tree is propagated almost entirely by means of seed, the uniformity of the fruit in many localities indicating that certain forms, at least, come true. Like most tropical fruits, the seed of the avocado, if dried, will not retain its vitality for any length of time, and should be planted as soon as possible after it is removed from the fruit. If carefully packed so as to conserve the moisture, the seeds can, however, be kept alive long enough to permit of their being sent to any part of the world. A very successful method of accomplishing this is to pack them in slightly moistened charcoal placed in a closed receptacle, such as a wooden or tin box. It is recommended that the avocado be planted where it is to remain, as the long tap root makes it difficult to transplant. If transplanted when small this will, however, be no great obstacle. The spacing will depend largely on the variety and the location, but should be from 15 to 30 feet.

ASEXUAL PROPAGATION.

The avocado is ordinarily considered a refractory subject for grafting or budding. Grafting is, indeed, seldom practised, but the practicabilty of budding is now fully demonstrated. Rolfs gives an account of the methods practised in Florida, where the matter has received the most attention. The chief difficulty there is in causing the buds to start after they have taken. It may be that this difficulty is on account of unfavourable climatic conditions, for at the Hope Gardens, in Jamaica, Mr. T. J. Harris, under the direction of Hon. William Fawcett, has budded the avocados in large numbers with the loss of hardly a bud. The operation is successfully performed, not only by experienced hands, but students who are budding for the first time are quite as successful with the avocado as with the orange or other plants which are usually considered easy to bud. Mr. Harris's method is practically the same as that recommended by Rolfs. The only difference that could seem of any importance is that the bud is simply tied with raffia instead of being wrapped with waxed cloth. Mr. George W. Oliver, of the United States Department of Agriculture, states that the avocado is by no means a difficult plant to bud. A healthy stock is considered by him the prime essential, and this is not often secured in the greenhouses of the North. If the method of patch-budding with old wood that has been found successful with the mango can be used with the avocado it would greatly facilitate the introduction of desirable varieties.

SOIL.

Like a great many tropical plants, the avocado is less exacting in regard to soil than it is with respect to climatic and other conditions. The drainage and the amount of protection that the soil receives from the heat of the sun are probably the

most important factors. Trees can be seen growing in a great variety of soils, but always in localities with good drainage. On the other hand, they are seldom, if ever, found in perfectly open places, with the bare ground around the roots exposed to the sun. The heavy clay soil common in Porto Rico seems well adapted to their culture, provided the trees are placed on ground sufficiently sloping to secure good drainage. The avocado is at present absent from the low, flat lands of the island and it is extremely doubtful whether it would succeed in such localities.

CLIMATE.

The avocado in its native state is a strictly tropical plant, and none of the varieties thus far recorded is able to stand any but the lightest frosts. Although requiring tropical conditions, it thrives best in a somewhat more moderate climate than the mango, and it will seldom be seen in the extremely hot localities where the mango often luxuriates. This may, however, be due to a lack of sufficient moisture, as well as to the high temperature. On the other hand, the avocado will be found growing at much higher altitudes, and here again it is not plain whether the reduced temperature or the increased moisture is the determining element. To be successfully grown, the tree must be planted in protected situations if the locality is at all subject to high winds; for the wood is not strong enough to withstand any severe strain, while the large fruit would, of course, be beaten off by any high wind occurring when it was reaching maturity. In Guam, according to Mr. W. E. Safford, although repeatedly introduced, the avocado has never succeeded, owing to the hurricanes, which invariably kill the trees that otherwise do well. The injury in this case is due to the excessive rainfall as well as to the high wind, a wet situation being fatal to this plant.

CULTIVATION.

The avocado is seldom regularly cultivated, so that little can be said of it in this connection except in the way of conjecture. The best fruit now produced is probably from trees that receive little or no care. This may, however, be due to the fact that the countries where such fruit is grown possess superior varieties, or that the natural conditions are more favourable, and should not be taken as indicating that the fruit cannot be improved by cultivation. In Porto Rico the trees in their wild state are such prolific bearers that there seems little to be desired in this direction.

The avocado would probably receive little or no benefit from having the ground about its roots stirred, as it is almost impossible to do this and prevent washing from the severe rains, and it is much better to secure protection from some low-growing plant that will not exhaust the soil. Leguminous plants would doubtless be the most satisfactory, and in Porto Rico there are several that could be so utilized. Some useful plant belonging to this group might serve as a catch crop and at the same time afford the necessary protection to the soil. In France it has been recommended that grafted plants be grown on fruit walls, in the same manner as citrus trees.

IMPROVEMENT.

If experiments in improving avocados through breeding have been tried the results seem never to have been published. Individual growers must have done more or less selecting, and accounts of their results would doubtless be of considerable value to breeders. The points to be kept in mind in any attempt to improve the avocado are:—(1) Shipping qualities, (2) uniformity, (3) extension of season, (4) seed reduction, (5) texture, (6) flavour, (7) yield, (8) size, (9) resistance to cold.

SHIPPING QUALITIES.—To the growing of avocados in other than sub-tropical regions there is perhaps no obstacle so great as the difficulty of placing the fruit on the northern markets in good condition. To overcome this, more can be expected from the introduction of new varieties and improved methods of packing and shipping than from any changes brought about by cultural means. Any advance, however, that can be made in the keeping and shipping qualities will be of the greatest importance.

Under the head of varieties are discussed the thick-skinned forms grown in Guatemala, and their introduction into Porto Rico bids fair to be a distinct advance. The improvement of the existing forms in this respect by hybridisation and selection is, as with all other characteristics, an untried field. The chief drawback is, of course, the length of time that must elapse before the young plants reach fruiting age. The tree can, however, be grown with little care; and with the experiments carefully outlined, so that the desired results may be kept in view, the trouble and expense would not be great, and in time some really valuable results might be expected.

Uniformity.—With the avocado, as with other fruits, a regular market can only be expected when there is a regular supply of a uniform product. In Porto Rico the fruit varies in form from almost spherical to those that have a long, curved neck. The extremes probably represent distinct wild strains, but the fruit seems to come true to seed to only a limited extent, and anything like perfect uniformity can only be expected with asexually propagated plants. Rolfs shows that the varieties in Florida do not come true to seed.

Extension of Season.—Extension of season is an important desideratum, especially in the direction of later fruiting forms, the desirability of which is considered farther on. Advance in this direction is likely to be made by the introduction of new varieties and, perhaps, by extending the cultivation of the trees to regions of more continuous moisture where the season of flowering can be to some extent controlled. The tree flourishes in many localities where it fails to bear fruit, and, as with the mango, this sterility is usually found in localities of almost continuous humidity. Under such conditions an artificial check, such as root pruning, has been found to induce flowering and the setting of fruit. This can easily be overdone, however, in which case the trees will bear one large crop and then die. Some of the most prolific trees are those grown in small depressions of porous rock in Southern Florida, where the plants are, in a manner, root bound, while the porous nature of the rock affords good drainage. There are a number of ways in which the growth may be checked and the yield increased. The baring of the roots to the sun would appear a very satisfactory method. A custom of hacking the trees to make them bear is practised by the Indians of Mexico. In any case where the fruiting is induced by artificial means the season will be more or less under control.

Seed Reduction.—In most forms of avocado the seed forms a considerable proportion of the bulk of the fruit, and its reduction is to be desired. As pointed out by Rolfs, it is important that the seed should fill the cavity, as otherwise the movement of the seed during shipment damages the pulp. Modern discoveries in evolution and plant breeding make it evident that the character of seedlessness in a fruit, though rarely secured, may be sought in either of two ways: (1) If the plant is normally open fertilised, self-fertilisation and selection for a number of generations will in many cases produce sterility, and consequently seedlessness. (2) By artificially pollinating the flowers with pollen from a variety or species so far removed that the fertilisation is imperfect, the exocarp or other parts of the fruit that are entirely the product of the female parent may develop, while the seed, which is the result of the union of the male and female elements, remains small or is aborted entirely. As the avocado is open fertilised, the first method mentioned is perhaps more simple, but will take more time, and this is, of course, a great disadvantage with fruits that are so long in coming to bearing.

The second method necessitates sufficient skill to effect hybridisation, and this of the most difficult kind, but has the advantage of securing much quicker

returns. The element of time is of so much importance that, if possible, all methods should be tried simultaneously. Rolfs states that a seedless avocado has been discovered in Florida, but does not say whether the fruit is otherwise desirable or not.

TEXTURE.—The fine, creamy texture of the avocado plays an important part in winning admirers of this fruit. If free from fibre, the texture is usually not unlike that of very soft cheese. Lack of uniformity is the greatest danger, for if the flesh is uniform and free from fibre it leaves little to be desired, The manner in which the fruit is ripened probably has more to do with the uniformity and nature of the texture than does the variety. Poorly formed fruit, or fruit that has been picked too green, will often have the flesh soft and discolored in some places, usually near the skin, while the remainder is hard and unripe. Careless packing, so that the fruit is subjected to pressure at some point, will also bring about this undesirable condition. For shipping, the fruit must, of course, be picked green, and to insure uniformity in ripening it must be packed with the greatest care.

FLAVOUR.—So far as observed, the most delicious and highly-flavoured avocados are some of the small, thick-skinned, and thin-fleshed forms of southern Mexico and Central America. The advantage, however, is slight, there being much more uniformity in the flavour of the different forms of the avocado than in most fruits. A really poor or disagreeable flavour has never been noted, except, perhaps, in cases where the fruit ripened unevenly, and then it is usually due to the part eaten being either green or overripe. Improvement in this character might slowly be brought about by selection, or perhaps by crossing with some of the small and more highly-flavoured forms.

YIELD.—Avocados have been subjected to careful cultivation for such a short time that little is known concerning the conditions that influence yield. As with most tropical plants, climate has probably a greater influence than soil, and judging from the fact that in nature the trees frequently drop their leaves before the fruit matures, it may be expected that a rather decided alternation of wet and dry seasons is an essential. In Hawaii it appears that several fruits in the same cluster mature. This has never been observed in Central America or the West Indies, where large numbers of the fruits set, but all but one of each cluster drop while still young. If commercial fertilisers are applied, it would seem that the proper time is immediately after the young fruits have set.

SIZE.—The largest avocados that have come to our immediate notice are those in Porto Rico. Travellers in Colombia, however, report much larger fruit, and both Hawaii and Florida probably produce fruit as large or larger than any in Porto Rico. Large size in the avocado is not such a prime essential as with many fruits. Even a medium-sized fruit is usually large enough for two people, and large samples might with a certain class of buyers be less desirable. Of course, this should not be taken to mean that a tree that bears large fruit is less desirable than one that bears small fruit, but only that it might not be well to go to much trouble or expense to secure varieties that excel only in size. With improved cultivation the size of the fruit will doubtless be increased to some extent without the introduction of new forms.

RESISTENCE TO COLD.—An avocado able to withstand slight frosts would place the industry in Florida and California on a much more secure footing. Forms having this quality are likely to be found in the highlands of Central America and Mexico. A form from Monterey that withstands light frosts has already been introduced into California and Florida. With this form the blossoming season is so early that in California the cold weather frequently destroys the

crop. The importance of the more hardy forms is apparent from the statement of certain California growers that, if relieved of the danger and loss from frosts, the avocado would be the most profitable fruit to grow, there being a ready market and good prices.

DISEASES.

The only diseases of the avocado thus far reported are those mentioned by Rolfs as occurring in Florida. Similar diseases doubtless exist in other localities and will be reported as soon as the culture receives the same attention that has been given it in Florida. Trees of the round thick-skinned form growing in Guatemala were found to have their leaves badly infested with galls, and also were eaten by a caterpillar. Apparently the same galls were here found growing on the wild relative of the avocado—the "coyo." D. L. Van Dine figures an avocado leaf infested with mealy bug. So far as known the flesh of the fruit is never troubled with insect pests, a remarkable fact if true, for the flesh would seem to form an ideal medium for their depredations. The seeds of some of the smallest forms in the City of Mexico were found infested with the larvae of an insect, and at Tapachula, Mexico, the cotyledons frequently showed large, black excrescences, the nature of which could not be determined. Neither of these troubles appeared to injure the fresh fruit, but if the fruit was kept for any length of time they might become sources of decay. In Jamaica a fungous disease that affects coffee trees is said to be definitely associated with the roots of the dying avocado trees. It is described in the following extract:—

A coffee planter suffered serious losses from the sudden dying out of trees on certain fields. As guano had been employed as a fertiliser on these lands some years before, the planter attributed the mischief to the fertiliser. On visiting the cultivation, I found that the damage was caused by a root fungus, and that there was a definite connection between the roots of dying or dead avocado pear trees and the affected coffee. Microscopic examination confirmed this view. I have examined similar samples from other parts of the island which confirm the view that the pear should not be grown on any lands intended for subsequent cultivation.

THE AVOCADO IN PORTO RICO.

With the possible exception of the pineapple, the avocado is perhaps the only fruit which Porto Rico is at present producing of sufficiently high quality to enable it to compete successfully with the fruits furnished by the more highly developed tropical regions. The quantity is also sufficient, although the season is at present short, to warrant the opening of a trade with the United States. First among the difficulties is the fact, already noted, that the public is at present little acquainted with this rather unusual form of fruit. There is however, already demand enough to show that it is likely to suit the American taste. Again, the fruit reaches our public in such small quantities that few have a chance to test it. That Porto Rico does not participate in the small consignments that are now received in the United States is largely owing to the difficulty in shipping the fruit, so that it will reach its destination in a marketable condition. With the varieties now in Porto Rico it seems doubtful whether this can be done except by shipment in cold storage. There are numerous other difficulties with the present conditions which would have to be taken into account before success can be assured. The trees, though numerous in the aggregate, are so scattered—there being no plantations—that it is difficult to secure anything like uniformity in the shipments. The natives allow the fruit to become nearly ripe before it is gathered, in which condition it will probably not ship well even in cold storage. The fruit is not carefully gathered, but is knocked off the trees, a method which completely destroys the keeping qualities of the varieties now growing in Porto Rico. The shortness of the season

is another obstacle in the way of making the shipping profitable. This can probably be lengthened to a considerable extent by the introduction of new varieties and the proper selection of the localities where the fruit is grown. Shipments made from Porto Rico would, however, fare much better if they could be supplemented by shipments from other countries in which the fruit ripens at a different season. Porto Rico, Mexico, Central America, Hawaii, Florida and California can probably supply the United States with avocados throughout the entire year. By placing the fruit in cold storage it would doubtless reach New York in a saleable condition. This would be, however, a continuous expense, even if it were found that the fruit was uninjured, and a variety that will ship at ordinary temperatures would have decided advantages. That such varieties exist is demonstrated by the successful shipment of Cuban fruit. It is furthermore believed that the thick-skinned varieties of Guatemala will prove even better keepers than those of Cuba. In establishing the industry in Porto Rico the first step is, consequently, the introduction of better shipping varieties.

THE AVOCADO IN HAWAII.

Very fine avocados are grown in the Hawaiian Islands, particularly on Oahu, in the vicinity of Honolulu. The chief difficulty here is the danger from high winds, confining the industry to sheltered localities. Prices in Hawaii are low in comparison with most regions where the fruit is grown, and San Francisco affords a ready market. On page 151 (*T.A.*) is a short account of an experimental shipment in cold storage, showing that by this means the fruit can be shipped not only to San Francisco, but to points as distant as New York.

THE AVOCADO IN FLORIDA.

The culture and propagation of the avocado have recently received greater attention in Florida than in any other locality. A special bulletin on the subject by Mr. P. H. Rolfs, pathologist in charge of the Subtropical Laboratory at Miami, gives the status of the culture in that region, together with directions for cultivation, asexual methods of propagation, descriptions of forms, etc. In spite of the fact that nearly all of the avocados north of the southern end of Merritts Island were killed to the ground by the freeze of 1894-95, showing the avocado to be no more hardy than the mango, planters have been by no means discouraged. Orchards of considerable size exist and the asexual propagation of the better forms is being rapidly pushed. There seem, however, to be but two, or possibly three, well-marked types in Florida, and the chances of securing desirable varieties for asexual propagation might be greatly increased by the introduction of some of the better forms from Central and South America. In Florida the shipping quality of the fruit is not of such prime importance as in Porto Rico, and consequently the choice of varieties should differ in the two localities.

THE AVOCADO IN CALIFORNIA.

The growing of avocados in California is at present restricted to the very limited frost-free areas. In many localities where the frosts are very light they will do little or no damage did they not occur at the time of blossoming, thus destroying the crop. A slightly later flowering variety would avoid this and considerably extend the range of culture. There is a good local market for avocados in California, prices being fully as high and the fruit as popular in San Francisco as in the eastern cities.

BEARING AGE AND LIFE OF THE TREE.

In favourable localities avocado trees will come into bearing about the fourth year from the seed. In more temperate regions, like Southern Europe, it requires six or seven years. Budded or grafted trees should come into bearing somewhat earlier. If the tree makes a good growth, the yield should continue to increase until the tenth or twelfth year.

The next point to be considered is the probable life of the tree. Ramon de la Sagra gives this as about 80 years. This is probably not a high estimate, for very old trees are common in most tropical countries. In the opinion of Mr. Henry Davis trees are still growing in the northern part of Peru which antedate the advent of the Spanish settlers. Some of these trees are fully three feet in diameter. Neither do old trees appear to become less productive.

YIELD AND HARVESTING.

The yield of an avocado tree when in full bearing is quoted as ranging from 50 to 500 fruits. In Hawaii the yield is said to be from 50 to 250 fruits, being larger in alternate years. There is an actual record of a tree in California that yielded 500 fruits in its eighteenth year. In Porto Rico, while none were actually counted, the average yield of a full-grown tree would surely seem to be about 100. Rolfs states that the yield is usually over-estimated owing to the fact that trees with few or no fruit are overlooked. An orchard of 110 trees of bearing age, near Buenavista, Fla., was found in 1903 to yield an average of only ten fruits per tree. The most prolific tree bore 385 fruits.

TIME TO PICK.—The degree of maturity which the fruit should attain before it is picked depends, of course, on the length of time it must be kept. There is, however, no evidence that the quality is improved by fully ripening on the trees, and in countries where the fruit is gathered for local consumption it is customary to pick and store it several days before eating. In most varieties when the fruit is fully ripe the seed does not entirely fill the central cavity, but whether it should reach this stage before picking has not been definitely determined. This failure of the seed to fill the cavity is probably due to a slight shrinking of the flesh, the result, possibly, of evaporation after the fruit has ceased to receive nourishment from the tree. The beginning of this process would seem to indicate the maturity of the fruit. In the absence of definite information it seems probable that the best results will be obtained with fruit picked when fully grown, but before it has begun to ripen. Dybowski recommends that the red varieties be picked as soon as they begin to colour, and the green ones when the colour begins to become lighter. Many of the green varieties, however, do not change colour appreciably on ripening.

METHOD OF GATHERING.—The picking of the fruit, although a matter of prime importance, is one that has been given no consideration. In Florida, where the avocado has received the most careful attention, the trees seldom reach a height at which it is impracticable to use step-ladders, but in the Tropics, if the trees are at all luxuriant, they place most of the fruit beyond this method of access. In these countries the fruit is usually knocked from the trees with long poles, or the tree is climbed and the fruit shaken to the ground, which, of course, ruins its keeping qualities and causes it to ripen unevenly. Until some satisfactory method is devised for gathering the fruit without bruising and with the stems attached, the shipping qualities of the fruit from tall trees are likely to prove unsatisfactory. The wood of the avocado tree is so brittle as to make the use of ladders impracticable, and this, together with the fact that the fruit is borne far out on the end of the branches, also makes it impossible to gather the fruit by climbing the trees.

It would seem that the most feasible method of gathering avocados would be the using of some form of mechanical fruit picker, mounted on a slender pole. Numerous styles of this implement are to be found on the market, but perhaps none will answer the purpose without alteration. The fruit picker that seems best adapted is one that has a cloth tube along the side of the pole, into the upper end of which the fruit drops and down which it slides into a basket attached to the waist of the operator. Most of the pickers of this type, however, have merely claws to pull the fruit from the trees, and it may be necessary to combine this

cloth tube with one of the long pruning instruments that are on the market, that the fruit may be cut and not pulled from the trees. Fruit pickers so constructed as to pick the fruit by cutting the stem are on the market, but these for the most part catch the fruit in a little basket or bag at the end of the pole and necessitate the lowering of the picker from the tree after two or three fruits are picked, whereas the arrangement first described need not be lowered. C. Riviere calls attention to the fact that the avocados common on the south side of the Mediterranean and in Madeira and the Canary Islands are very short stemmed or sessile whereas the American forms, so far as known, all have comparatively long stems though varying greatly in this regard. The writer also calls attention to the fact that the long-stemmed forms are more desirable, it being difficult to pick those that are nearly sessile without pulling the fruit from the stem and thus injuring the keeping qualities of the fruit.

PACKING AND SHIPPING.

The lack of good shipping qualities in the avocado is probably the most serious obstacle to the rapid development of the industry in the West Indies, and is certainly the chief reason why Porto Rico does not participate in the small shipments that are now made to New York. That it is possible without cold storage to ship avocados from Cuba, while all experiments with the Porto Rican fruit have proved failures, makes it evident that a study of the causes of this difference is of prime importance. It is believed that the better keeping and shipping qualities of the Cuban avocados are due to characteristics of the fruit rather than to differences in gathering or packing. Indeed, this might be inferred from the appearance of the fruit, that of Cuba having a thicker and harder skin than the Porto Rican forms. The introduction of the thick-skinned varieties from Guatemala should give Porto Rico a decided advantage, for it is believed that the Guatemalan forms will prove even better shippers than those of Cuba. Though avocados are successfully shipped from Cuba, Florida, Mexico, and other places to northern cities, and many different styles of packing are employed, little can be learned from these experiments as to the best method, since no account is taken of the variety of the fruit, which is undoubtedly a more important factor than the method of packing. The avocados from Cuba, wrapped in newspaper and packed in large crates, have come through in better shape than those from Porto Rico, wrapped in tissue paper and packed in crates only one layer deep, does not necessarily indicate that the former method of packing was superior, but it may mean that the Cuban fruit was such a good shipper that it kept in spite of the inferior method of packing.

From a comparison of the different methods of packing that are practised, taking into consideration as far as possible the nature of the fruit, it seems however, that the avocado, like most tropical fruits, keeps best when packed in such a manner as to be protected from jars or any undue pressure, and in such a way that the fruit is well ventilated. Another important consideration with the thin-skinned forms is that they be packed so that the individual fruits do not come in contact with each other, for, even with the greatest care, bruised fruits will frequently be included. These will rapidly decay, and if not isolated will induce decay in those with which they come in contact. This danger is much less with the thick-skinned forms. These conditions are very satisfactorily met by packing the fruits in fine excelsior or some similar substance in rather open cases that are not so large as to prevent those on the inside from being ventilated. If the fruits be wrapped, it should be with some porous paper, but where they are separated from each other this precaution would seem unnecessary or even detrimental. The amount of ventilation the fruit should receive undoubtedly depends on the variety, and still more directly on the temperature, fruit in cold

storage requiring little or no ventilation. The best results in the shipments to New York of avocados from Cuba have been obtained with the fruit wrapped in newspaper and packed in open crates but one layer deep. Tissue paper was tried, but it was said not to offer sufficient support and did not prove as satisfactory as the newspaper.

Florida growers report that they experience no difficulty in packing their fruit so that it reaches the nothern market in good condition. The more careful shippers, however, packed the wrapped fruit in excelsior. The few experiments that have been tried in shipping Porto Rican avocados, other than in cold storage, have, so far as can be learned, resulted in every case in almost complete failure. Little could be learned as to methods of packing that were employed. In one case, however, the fruit after being wrapped in tissue paper was again wrapped in oiled paper. In this instance the fruit was practically all rotten when it reached New York. It seems more than probable that the fruit would have shipped better without the oiled paper, as this packing would very effectually prevent all ventilation, a necessity at all ordinary temperatures. A very important consideration in the keeping qualities of fruit, brought to the writer's attention by Mr. William A. Taylor, of the Department of Agriculture, is the climatic conditions that prevail at the time the fruit is packed. Fruit packed in a dry climate has been found to keep much better than the same fruit packed when the atmosphere is moist. This is doubtless true of the avocado, and may explain the successful shipment from southern Mexico to New York of varieties that appear to differ but slightly from those of Porto Rico.

Cold Storage.—In co-operation with Mr. William A. Taylor, pomologist in charge of field investigations, and Mr. Jared G. Smith, Director of the Hawaii Agricultural Experiment Station, an experiment was tried of shipping avocados in cold storage from Hawaii to New York City. Five crates of avocados was packed and shipped in cold storage from Honolulu about September 25th, reaching San Francisco on October 4th. From San Francisco they were expressed to Lodi, Cal., and during this transfer they were exposed to air temperatures from six to eight hours. At Lodi they were again placed in iced cars and sent directly to New York City, where they arrived on October 20th. The fruit was consigned to Messrs. Lane and Son, who forwarded samples to Washington. It will thus be seen that the fruit was thirty days in transit. Although the majority of the samples were found to have suffered from the long trip, some of the lots were in good condition, thus demonstrating that, with a knowledge of how to handle the fruit, even the more delicate forms can be successfully shipped in cold storage, provided the fruit is not more than three or four weeks in transit. That this experimental shipment was hardly a fair test is shown by the statements of Mr. J. E. Higgins, who superintended the shipping of the fruit at Honolulu. In a letter to Mr. Taylor he says:—Most of the pears were by no means representative. The pear season was about over when we learned from you that there was an opportunity to make the experimental shipment. The fruits were inferior in size, only those marked F. 13 being first-class specimens in this respect. It being the end of the season, the fruits, though hard, were of course quite fully matured. The fruit was picked several days before the sailing of the steamer, and was held in cold storage until it could be received at the ship.

Shipments of avocados, made at air temparatures, are frequently placed in cold storage as soon as they reach New York. This process is resorted to in the effort to hold the fruit for the fall trade, and, even though the loss be heavy, the increased price still makes it a profitable procedure. There is a very uncertain element involved in this, for with fruit that appears uniform when

placed in cold storage some comes out in perfectly sound condition, while the remainder will be completely decayed. This lack of uniformity in the keeping qualities is probably due to the different degrees of maturity at which the fruit is picked, and to the conditions to which it has been subjected in transit, it being very difficult to detect such differences from the outward appearance of the fruit. As to the best temparatnre, amount of ventilation, method of packing, etc., little is known. Dybowski states that shipments have been made in cold storage from the Antilles to France, and that a temperature of 2° C. (35 5° F.) was found the most satisfactory. He recommends that the fruit be wrapped in paper and packed in excelsior. Shipments made in this way are said to reach France in good condition.

MARKETING.

The market for avocados is at present a limited one, the fruit being still somewhat of a novelty. It is, however, steadily increasing, and from present indications will keep pace with the supply. The fruit is already fashionable, and if uniformity in the supply both as regards quantity and quality could be secured and the prices somewhat reduced, as could well be the case were large quantities of the fruit handled, its popularity would rapidly increase. Lack of classification is perhaps the greatest hindrance to the development of a regular market. Fruits more widely different than "Ben Davis" and "Northern Spy" apples are all classed as avocados without further distinction. This lack of classification is accompanied with a corresponding lack of uniformity, and must seriously hinder the growth of the trade. Not only may two shipments of avocados be totally unlike, but the individual shipments often contain distinct forms of a widely different character. Plates VI and VII (not reproduced) show two samples from the same box. These fruits, so distinct in form, were no less different in flavour, and both were very inferior. The size and external appearance, as well as the price (35 cents a piece), would lead one to expect that he was purchasing fair specimens of the fruit, but if an opinion was formed from such specimens as these, it could hardly be other than that the fruit was insipid and in no way worth the price asked. In sections where the fruit is unknown a demand is more rapidly created by inducing hotels, clubs, etc., to include this article in their menus than by merely exhibiting the fruits in the markets, for while many might be led to purchase samples of this strange fruit if seen in the market, they would frequently be ignorant of its use as a salad, in which case they would probably pronounce it insipid and might be deterred from further trials. On the contrary, anyone tasting for the first time the prepared salad would usually be pleased and would be likely to investigate the source of the new dish.

In Washington this fruit has sufficient admirers to warrant the frequent insertion of a notice in the papers, by dealers, to the effect that a shipment of avocados is on hand. The shipments, though small, are fairly regular, and there are one or two places where the fruit can usually be found during the season. In the present state of the market there is nothing like a fixed price for avocados. In New York and Washington the usual retail price may be said to be about 25 cents for good fruit; 60 cents is, however, frequently asked for fine fruit, and fair specimens can sometimes be purchased as low as 10 cents. This low figure is, however, never reached except in cases where large shipments have failed to be disposed of and the fruit is in serious danger of spoiling.

With reference to the San Francisco market, Alexander Craw states:— Sound "avocado pears" always meet with a ready market in San Francisco, and at good prices, at times ranging from $2 to $5 per dozen retail, for good fruit. Occasionally there is a heavy drop, owing to the arrival of overripe or badly packed fruit. In selecting avocado pears for distant markets see that they

are as nearly full grown as possible, but hard. On no account should the fruit be plucked from the tree, but clipped with pruning shears, leaving but a very short portion of the stem—not over half an inch in length. On no account must any leaves be packed with the fruit, or the horticultural quarantine officers of the Pacific ports will demand the unpacking of such consignments, as occasionally a few scales are found on the foliage, but not on the fruit.

The following, taken from the Crop Reporter of the Department of Agriculture, January, 1903, gives some indication of the prices in England:—

With regard to the newer fruits which are attracting attention in the English markets, there are several which call for special reference. Among such are the avocado pears. These pears are high priced, selling from 1*s.* to 1*s.* 3*d.* (24 to 30 cents) each, retail.

MARKET SEASON.

The regular season for avocados is in the summer and the early autumn, the bulk of the fruit being received during the months of August and September. This is the most unfavorable time for a tropical fruit of this kind to be placed on the market, for not only does it come in competition with the fall fruits, but at this time large numbers of the admirers of this fruit are away from the cities at summer resorts, and in order to reach the best class of customers the fruit must be reshipped. This feature of the trade is so important that commission merchants can afford to hold the fruit in cold storage for this class of customers until they return to the cities, and this in spite of the fact that the fruit reaches them in such an advanced stage that but a very small percentage is saleable when taken from cold storage. In cities like New York the Cuban and Spanish populations are always ready to purchase avocados, but this class will buy only at a comparatively low price, which under present conditions serves merely to protect the merchants from total loss. Florida growers say that for fruit that they can hold until the latter part of September or into October they can ask their own price. It will thus be seen that it is of the greatest importance to secure late-maturing sorts.

With the improvement of transportation facilities and good shipping varieties the northern markets can probably be supplied with avocados every month in the year. In fact, February is probably the only month during which no avocados are received in New York. Outside of the regular season, however, the shipments consist of a few fruits brought in the ships' ice boxes. Of these, the earliest are said to come from Colombia and the latest from Santo Domingo. A possible schedule would be as follows: Florida, Porto Rico, and Cuba, June to November; Hawaii, September to December; Mexico, December to March; Central America, March to June. To dealers familar only with the West Indian type of fruit the shipping of avocados from such distant points as Central America will seem entirely impracticable. The keeping qualities of the thick-skinned forms of Central America make this, however, not at all impossible provided the picking, packing, and shipping be handled in an intelligent manner. Indeed, small shipments have already been made from the City of Mexico to New York via Los Angeles, where the fruit was repacked, and this with a comparatively thin-skinned variety. Viewed from the standpoint of the producer, however, the question is not how can the market be supplied throughout the entire year, but how can avocados be produced in our own possessions at a time to command the best prices. Too great confidence should not be placed in the introduction of early or late fruting varieties from other countries, for the season of fruiting is to a great extent the result of climatic conditions, and an early fruiting form in Guatemala if transferred to Porto Rico might soon become no earlier than the native kinds. In a general way the fruiting season is found to be about the

beginning of the rains. In Porto Rico different parts of the island exhibit considerable disparity as to the time that the rains begin, and by carefully selecting localities with this in mind the season might be materially extended. Selection for this character would probably be well repaid, as it has been with so many other fruits, but unless asexual methods of propagation are practised, too much confidence should not be placed in the ability to hold this or any other character obtained through close selection. In localities with comparatively uniform climatic conditions the growing of avocados under irrigation might have important advantages, for if any method of artificially inducing the plants to bear should be successful, it would be possible to control the season by checking growth at the proper time.

METHODS OF EATING.

By far the most common method of eating the avocado is in the form of a salad. As such it is eaten raw with a great variety of dressings and condiments. Few salads are so easily prepared as the avocado. Usually the fruit is simply cut in half by passing a knife through the skin and flesh until it comes in contact with the seed. It will then separate into two cups, forming convenient receptacles for the seasoning, which is added a little at a time to suit the taste, and the flesh is scooped from the inside of the cup with a spoon. One-half of the fruit is usually sufficient for a person at a meal. The most common dressing is salt, pepper, and vinegar. Oil is often added, but unless the oil and vinegar are beaten into a mayonnaise this would seem superfluous, as the fruit is itself very oily. Lime or lemon juice is often substituted for vinegar. While the novice usually considers some form of acid necessary to add piquancy, those better acquainted with the fruit frequently eat it with salt alone, and many think that even salt tends to mask the delicious nutty flavour, and prefer it in its natural state without any seasoning whatever. There are a few people, probably of New England origin, who eat the fruit with sugar and vinegar, and some even profess a fondness for it with a dressing of sugar and cream. If it be desired to more thoroughly incorporate the dressing, the flesh can be removed from the skin, and, after mixing the whole, can be returned to the skins for convenience in serving. This is more neatly accomplished with the thicker skinned forms.

In Guatemala, Porto Rico, parts of Mexico, and doubtless elsewhere, the avocado is sliced raw and added to soups. Even a small piece of the soft pulp crushed in a plate of soup imparts a delicate flavour, and during the season of avocados the baskets of people returning from market are seldom without specimens of this fruit. In the market at Cordova the little piles laid out for individual purchasers consisted of three or four little fruits no larger than walnuts, with flesh not more than one-fourth of an inch. As better fruit was not to be had, even these met with very ready sale, so indispensable is this article of diet considered. In French countries the avocado is customarily served as an "hors d'oeuvre." E. Roul states that an exquisite desert is made by covering the fruit with dressing of cherry brandy, sugar, and cream beaten almost to an emulsion. In St. Thomas the fruit is eaten with Port or Maderia wine and lemon or orange juice. In Brazil the fruit is made into a sort of custard pudding.

The following methods of preparing the fruit, as well as that for extracting the oil, were kindly furnished by Mrs. William Owen, of Sepacuite, Guatemala :—

No. 1.—Divide in half and serve in the shell, as many prefer them without the addition of salt.

No. 2.—Cut the meat into cubes, mix with sufficient mayonnaise to coat it well, put in a platter, pile high in the centre, and sprinkle over hard-boiled egg chopped fine.

No. 3.—Divide in half and carefully remove the meat. Add the yolk of a hard-boiled egg and one tablespoonfull of French dressing for each fruit. Press

through a sieve and pile in the half shells. Garnish the tops with the white of the eggs chopped fine, a sprig of parsley, and small red pepper.

SANDWICHES.—Use thin slices of bread buttered thinly; spread on a paste prepared of mashed avocado mixed with a dressing of oil, salt, tarragon vinegar, and a little nutmeg.

AVOCADO OIL.—Divide the fruit in half and remove the seed. Place the two halves together again and lay them in a large basket. Cover with a cloth and keep in a cool, dark place until the meat turns black; then put them into a coarse cotton bag. Sew up well and put into a press. The oil is very clear, and all the Ladinos say it will never become rancid. They never use it in cooking, though it has a pleasant flavour, but say it is fine for the hair.

SALAD.—The following method of preparing a salad with avocados is given by Janet M. Hill:—Cut three ripe aguacates in halves, take out the stone or seed, and scoop the pulp from the skin. Add three tomatoes first removing the skin and core and half a green pepper pod cut in fine shreds. Crush and pound the whole to a smooth mixture, then drain off the liquid. To the pulp add a teaspoonful or more of onion juice, a generous teaspoonful of salt, and about a tablespoonful of lemon juice or vinegar. Mix thoroughly and serve at once. This salad may be served at breakfast, luncheon, or dinner.

In a report of Mr. John R. Jackson it is stated that "it is either cooked or served as a vegetable with sauce," as well as eaten as a salad. This is the first account noted of cooking the avocado.

FOOD VALUE.

The results of the chemical analyses given below show the comparative value of the avocado for food purposes. For the following table and the statements concerning it the writer is indebted to Dr. C. F. Langworthy, of the Office of Experiment Stations of the Department of Agriculture. Analyses of the avocado have been recently made at the Maine and the Florida Agricultural Experiment Stations. The following table shows the results of these analyses and includes, for purposes of comparison, similar data regarding a number of common food products:—

COMPOSITION OF THE EDIBLE PORTION OF THE AVOCADO AND OTHER FOODS.

	Water.	Protein	Fat.	Carbohydrates		Ash.	Fuel Value per pound.
				Nitrogen-free Extract.	Crude Fibre.		
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories.
Avocado (analysed at the Maine Station)	81.1	1.0	10.2	6.8		0.9	512
Avocado (analyzed at the Florida Station	72.8	2.2	17.3	4.4	1.9	1.4	854
Pickled ripe olives	65.1	5.7	25.5	3.7		...	1,201
Pickled green olives	78.4	6 9	12.9	1.8		...	680
Apples	84.6	.4	.5	13.0	1.2	.3	290
Bananas	75.3	1.3	.6	21.0	1.0	.8	460
Pears	84.4	.6	.5	11.4	2.7	.4	295
Coconuts	14.1	5.7	50.6	27.9		1.7	2,760
Chestnuts, fresh	45.0	6.2	5.4	40.3	1.8	1.3	1,125
Potatoes	78.3	2.2	.1	18.0	.4	1.0	385
Wheat flour	12.0	11.4	1.0	74.8	.3	.5	1,650

In the avocados analysed at the Maine station the edible portion or pulp constituted on an average 71 per cent of the total weight of the fruit, the seed 20 per cent, and the skin 9 per cent. Prinsen-Geerligs, in an extended study of tropical

fruits, reports similar values for the avocado—*i.e.*, flesh 67 per cent, seed 15 per cent and skin 8 per cent. As the avocado contains about 75 to 80 per cent water and consequently 20 to 25 per cent total nutritive material, it is apparent that t is more directly comparable with succulent fruits and vegetables than with such foods as bread. As regards the proportion of the water, protein, crude fibre, and ash, the avocado is similar to common fruits like the apple, pear and banana. In the case of nitrogen-free extract (sugar, starches, etc.) the proportion reported in the avocado was smaller than in the other fruits mentioned. The high percentage of fat in the flesh of the avocado is noteworthy, a large proportion of this constituent in succulent edible fruit being very unusual. In this respect the avocado suggests the olive, which is, of course, very rich in this constituent, the flesh containing, according to recent analyses made at the California Experiment Station, from 13 to 88 per cent. Generally speaking, a higher percentage of fat is found in nut and oil-bearing seeds than in succulent fruits, the high fat content being accompanied by a low water content, as in the case of cocoanuts, cited in the table on page 155 (*T.A.*)

Avocado fat is solid or semi-liquid at ordinary temperatures and has been separated, being known as alligator pear oil, Persea fat, and avocado oil. According to Andés, it has at present no commercial importance. Wright and Mitchell state that avocado oil is very similar to laurel butter or bayberry fat, from *Laurus nobilis*, which consists largely of glycerid of lauric acid, together with a little myristin and other homologues and some olein. Olive oil is quite different in chemical character, consisting of about 25 per cent. glycerids of solid saturated fatty acids (palmitic, etc.) and 75 per cent. liquid glycerids, mostly olein. Olive oil is known to be a valuable food product and quite thoroughly digested. It is presumable that the avocado fat is also quite thoroughly assimilated, although little can be said definitely concerning its nutritive value, as apparently few, if any, investigations have been reported which bear upon this question. Prinsen-Geerligs studied the carbohydrate constituents of the avocado and reports 1·72 per cent. total sugar, which is made up of 0·4 per cent. glucose, 0·46 per cent. fructose, and 0·86 per cent. saccharose. These figures, taken in connection with the data reported by the Florida experiment station for the total nitrogen-free extract (sugar and starch), would indicate that the starch content is not far from 3 per cent. Considering all the available data, it seems fair to conclude that the avocado has a fairly high food value as compared with other succulent fruits, especially when its fat content and consequently rather high energy value is considered, closely resembling pickled olives in this respect.

COST OF PRODUCTION.

In calculating the cost of production, the following are the chief factors to be considered. Cost of land, cost of preparing the land, seed and planting, cost of culture, age at which trees bear, life of trees, yield, cost of gathering and marketing the fruit, price and extent of the market. The cost of land in tropical countries is governed very largely by its position with reference to transportation facilities. In Porto Rico, for example, land located along the main roads and valued at $100 an acre could apparently be duplicated in localities 5 or 10 miles distant for $2 to $4 an acre. Thus, the bulk of a crop and its adaptability to transportation over country roads are very important factors. With avocados at anything like the present prices they would constitute a very concentrated product, probably exceeding coffee in pound for pound value. On the other hand the fruit must be delayed as little as possible after picking, which, of course, militates against the selection of land too remote from a shipping point. The cost of preparing the land varies in different localities, but in most countries this item can be estimated with considerable accuracy, as land is usually cleared by measure.

With labour at a reasonable price the seed and planting ought to cost not more than 10 cents per tree, and this with trees 20 feet each way, making 109 to the acre, would aggregate to $10·90 an acre. The cost of culture would also vary greatly in different localities, but this again can in each locality be reckoned with considerable accuracy, together with the rebate to be allowed for catch crops. Where orchards are started from choice varieties by asexual method of propagation an additional allowance will have to be made for budding or grafting. Trees may be expected to come into bearing about the fourth or fifth year, and may yield crops for fifty or seventy-five years. The average yield per tree may be reckoned at one hundred fruits, and should come nearer five hundred. With a crop of great value like the avocado the cost of gathering and marketing is relatively small, although the fruit must be handled with considerable care, especially the thinner skinned forms. In the present state of the market, the small shipments of avocados that are received usually retail at from 25 to 50 cents apiece.

SUMMARY.

The avocado is a tropical fruit little known in the United States but rapidly growing in popularity. Its appreciation by the northern public is doubtless retarded by a misunderstanding of its true character as a food, since it is in reality a salad, being very generally eaten with condiments, This usual role, however, removes it from direct competition with other fruits and tends to make its popularity permanent.

This fruit is undoubtedly of American origin, but appears to have been introduced into the West Indies after their discovery. It was an important article of food among the Indians of the continent from Mexico to Peru. It is not yet certain whether the cultivated trees belong to one or more species, botanical writers have given little attention to the many cultivated sorts. There are many wild species of Persea in this region.

Though few varieties have been described, the diversity of form is very great. In general this diversity seems to follow geographical lines, the forms of any particular region being more or less closely related. A very distinct type, with thick, hard skin, was found in Guatemala, which promises to surpass in shipping qualities the better known forms.

The avocados now found in the markets come largely from Cuba, and the chief commercial difficulty is occasioned by the poor shipping qualities of the fruit and the failures to distinguish the different varieties, the whole industry having suffered from the shortcomings of the poorer forms. Efforts to ship the delicate-skinned Porto Rican fruits have thus far failed. For this island it is recommended that the hard-skinned sorts of Guatemala be introduced. These, it is believed, will stand shipping even better than those from Cuba. Experiments have demonstrated that avocados can be successfully shipped in cold storage.

At present the season for avocados in the markets of the United States is the late summer and early autumn. By importing from different countries, however, the season could be extended throughout the entire year.

The plant requires a strictly tropical climate, with the possible exception of some of the hardy varieties of the Mexican table-lands, and to be prolific there should be a distinct dry season.

Young plants are readily propagated from seed, and budding and grafting can be accomplished, the former method being in common use in Florida.

As far as can be judged from the limited and irregular supply, the market is good, especially in the latter part of the season. Prices range from 10 to 60 cents apiece. Uniformity as regards both quantity and quality is the prime requisite for sustaining the market.

If anything like the present prices can be maintained, the growing of avocados of good shipping varieties ought to become a very remunerative industry.—*U. S. Department of Agriculture, Bureau of Plant Industry.—Bulletin No.* 77, pp. 9/49.

The Cultivation of the Grape Vine in the Experimental Garden, Anuradhapura, Ceylon.

By D. F. De Silva Gunaratne.

The cultivation of grape vines has been totally neglected in this Province, although there are so many Jaffnese who have a thorough knowledge of the plant. It thrives well in Jaffna, Puttalam, Chilaw and Calpentyn along the sea shore. But I have seen it growing fairly well and bringing forth fruits abundantly in the Kandy district too.

I learn from the natives of Jaffna that a full-grown creeper of this kind pays them Rs. 50 to Rs. 200 twice a year.

A small slip of the Jaffna grown variety (the green vine) was presented to me about five years ago by Dr. Bartholomeusz, who accidently met his death by drowning in the Tissa Tank. I planted this with the necessary care, and after three years the vine was pruned, but no sign of success was seen; after that again I pruned at four different times of the year, but only the June pruning gave a few bunches. Now I have found out the real time of the year in this climate after three years' trial, and also the necessary manure which should be used on them. All cultivation should be tried in this climate in the eighth month of the year.

Manuring.—The manuring of the grape vine should be done one month before the pruning. In Jaffna they carry out both the processes together, but according to my experiments in this climate it ought to be done as stated above. The roots of the vine should be excavated, taking care not to destroy the main and the other big roots round about, and left exposed to the light for about three days, when the small hair like roots should be chopped off and the plant manured with a mixture of salt fish and goat manure. (It is very important to use the salt fish manure as the vine always requires saltish soil). After covering the roots well with this manure, the watering must be carried on regularly once or twice daily. A fortnight after the signs of new leaves will appear, when the watering must cease for a few days; and then the pruning commenced.

Pruning.—All the unnecessary shoots must be taken out leaving the long healthy shoots. The long cross shoots should be trimmed leaving three to four joints in the main stem, and the long healthy shoots should be trimmed only in the top part. After this process, at least six days, the watering should cease until the cut portion is dried. The watering after this must have special attention; it is very much better if the whole root keep under water until it blossoms. A fortnight after this process the signs of new shoots and flowering will appear on every healthy branch. This is the season in which most of the other fruit trees also will show signs of blossoming. The fruit takes four months to ripen, and a pound of grapes can easily be sold at the rate of 50 cts to 60 cts. The second pruning should be taken up in March. The manuring should be done once a year, if necessary twice.

This is a very simple and paying cultivation, and it is a common cultivation among the Jaffnese. A single plant should be planted in the back compound, as this is paying and also gives a cooling shade to the house during the hot weather; if planted close to the bath-room the watering will be easily done. Dimension of holes to be dug out for first planting is 2 feet by 3 feet deep.

Excavating for manuring; leave 1½ feet around the root and excavate soil 2 ft., then build a small wall with soil round the pit to hold about six to ten gallons of water.

THE MANGOSTEEN.

The species included in the genus *Garcinia* are a comparatively small but valuable group of oriental tropical economic plants. For, not only are the timbers furnished by the *Garcinias* well adapted for building-construction and furniture, but some of the tamarinds, the gamboge of commerce, as well as the much esteemed mangosteen of Malaya are among the products yielded by them. Of all these products, the luscious mangosteen, which, by universal consent, has been admitted to be the most delicious of oriental fruits, is perhaps the best-known to the layman. In the sunny regions of the Malayan sea-board where, for the major portion of the year, sunshine and shower regularly alternate to result in a truly marvellous equability of climate, the *Garcinia mangostana* grows to perfection. Its artificial cultivation in those regions as well as on the friable loams of the evergreen forests that follow the courses of the rivers of the Peninsula has always been attended with considerable success. For, within the favoured localities of its limited but indigenous distribution, few fruit-crops demand less attention in cultivation; while, after it survives the early stages of its growth, no operations of a cultural nature, beyond manuring, require to be done for the maintenance of the crop.

The method of cultivating the species is as follows. When the rounded capsules mature in the rains and their rinds become a deep purple in colour, they are carefully plucked off the trees by hand. The largest and most evenly-developed fruits are then selected and set apart to furnish the sowing material. A fruit consists of from six to eight divisions (locules), each of which is filled with a mass of white pulp that may or may not enclose a seed; for it frequently happens that even among the most perfectly grown mangosteen fruits, few contain more than two fertile seeds each. For purposes of sowing, the seed is best when it is detached from the fruit by hand and sown with the edible pulp adhering.

If the seeds are sucked prior to sowing them, the warmth of the mouth, as well as the scouring action of the tongue, exert an injurious influence upon their soft membranous seed-coats, which it is essential should be maintained in as unimpaired a condition as possible. Moreover, the decay through fermentation of the pulp surrounding the seed sets up a beneficent stimulative action not only upon the seed-coat itself but also upon the germinating embryo. The seeds ordinarily germinate in a fortnight from sowing, though some have been known to sprout in a week, while others again take a month or even more. They should be sown about a foot apart in nursery beds that are four feet wide and of the most convenient length. About 175 seedlings could be raised in a bed forty feet long and four feet wide. Throughout the one year during which the seedlings remain in the nursery, the beds should be daily watered as well as occasionally heavily manured with farm-yard manure or vegetable mould. The manure should be carefully raked in between the seedlings, which, by the bye, are extremely sensitive to bending, breakage or other injury.

Well-grown seedlings would be at least a foot in height at the close of the year and bear from four to six leaves each. At the commencement of the south-west monsoon, the seedlings should be removed from the nursery beds and planted out in pits previously prepared on the plantation. These pits are best excavated at distances of 20 ft. from one another, and should be located in open, well-drained loamy land. They should each be 3 ft. square and 3 ft. deep, and be filled in with surface soil, vegetable mould and cattle droppings worked up to a friable and fine degree of tilth. In planting, care should be taken to see that every transplant occupies the centre of the pit in which it is put out; for, the species being a surface feeder, the fullest facility should be afforded it for developing its feeding-roots

evenly around it. The plants should be shaded with light bamboo-and-grass tatties placed horizontally over each plot and supported upon bamboo uprights 6 ft. high. This shade should be given directly the transplants are put out, and be maintained for at least one year. The tatties may be removed when there is rain as well as at night and in the cooler parts of the day. The plants should also be copiously watered throughout the warmer months of the year for at least two years after they are put out.

The mangosteen plant has been known to bear fruit in the fifth year from planting out or in the sixth from germination. At this age it ordinarily attains to a height of 10 ft. and a basal girth of 1 ft., and its conical crown, which is formed low on the bole, casts a cover of about 10 ft. in diameter. The yield of fruit varies with locality as well as care in manuring and general cultivation; but it usually is small and continues to be poor until the plant reaches its tenth year. Again, the earlier fruits are small and irregularly developed and contain very few pulpy seeds. Thus, the number, size, shape and flavour of the fruit are improved only with advancing years; but, even in young crops, considerable improvement could be effected by heavy periodic manuring and watering. A healthy plant in its tenth year is capable of yielding from two to three hundred mangosteens valued at from Rs. 3 to Rs. 5 per hundred. An acre stocked with plants standing at distances of 20 ft. from one another would hold at least 100 plants. And if, at the end of the tenth year, they yield, on an average, 200 fruits each, valued at the rate of Rs. 4 per hundred, the plantation would yield an approximate income of Rs. 800. The species is well adapted for cultivation in all localities with heavy rainfall, a loamy soil, and enjoying freedom from frost. It luxuriates in bright and vigorous sunshine and demands plenty of light for its most perfect development. The soil, however, should be moist and well-drained. It would appear to be well suited for economic cultivation on the Malabar Coast, the low-lands of Ceylon, Assam, Lower Burma, as well as in such other regions of the East as spontaneously support evergreen forests of broad-leaved species. It is best grown as a pure crop, unmixed with species other than itself.—*Madras Mail.*

COCONUT CULTIVATION: MANURING.

The manuring problem must be met and solved by the best resources at our command. The writer has had pointed out hundreds of trees that, wholly guiltless of any direct application of manure, have borne excellent crops for many successive years; but he has also seen hundreds of others in their very prime, at thirty years, which once produced a hundred select nuts per year, now producing fluctuating and uncertain crops of fifteen to thirty inferior fruits. Time and again native growers have told me of the large and uniformly continuous crops of nuts from the trees immediately overshadowing their dwellings, and, although some have attributed this to a sentimental appreciation and gratitude on the part of the palm at being made one of the family of the owner, a few were sensible enough to realize that it came of the opportunity that those particular trees had to get the manurial benefit of the household sewage and waste. Yet, the lesson is still unlearned and, after much dilligent inquiry, I have yet to find a nut grower in the Philippines who at any time (except at planting) makes direct and systematic application of manure to his trees. In India, Ceylon, the Penang Peninsula, and Cochin China, where the tree has been cultivated for generations, the most that was ever attempted until very recently was to throw a little manure in the hole where the tree was planted, and for all future time to depend on the inferior, grass-made droppings of a few cattle tethered among the trees, to compensate for the half million or more nuts that a hectare of fairly productive trees should yield during their normal bearing life.

Upon suitable coconut soils—*i.e.*, those that are light and permeable—common salt is positively injurious. In support of this contention, I will state that salt in solution will break up and freely combine with lime, making equally soluble chlorids of lime which, of course, freely leach out in such a soil and carry down to unavailable depths these salts, invaluable as necessary bases to render assimilable most plant foods; and that, on this account, commercial manures containing large amounts of salt, are always to be used with much discretion, owing to the danger of impoverishing the supply of necessary lime in the soil. Finally, so injurious is the direct application of salt to the roots of most plants that the invariable custom of trained planters (who, for the sake of the potash contained, are compelled to use crude Stassfurt mineral manures, which contain large quantities of common salt) is to apply it a very considerable time before the crop is planted, in order that this deleterous agent should be well leached and washed away from the immediate field of root activity.

That the coconut is able to take up large quantites of salt may not be disputed. That the character of its root is such as to enable it to do so without the injury that would occur to most cultivated plants I have previously shown, while the history of the coconut's inland career, and the records of agricultural chemistry, both conclusively point to the fact that its presence is an incident that in no way contributes to the health, vigour, or fruitfulness of the tree.

Mr. Cochran's analysis, based upon the unit of 1,000 average nuts, weighing in the aggregate 3,125 pounds, discloses a drain upon soil fertility for that number, amounting in round numbers to—

	Pounds.
Nitrogen	8¼
Potash	17
Phosphoric acid	3

Reducing this to crop and area, and taking 60 fruits per annum per tree as a fair mean for the bearing groves in our coconut districts and on those rare estates where a systematic spacing of about 173 trees to the hectare has been made, we should have an annual harvest of 10,300 nuts, or, stated in round numbers, 10,000, which will exhaust each year from the soil a total of

	Pounds.
Nitrogen	82½
Potash	170
Phosphoric acid	30

The coconut, therefore, while a good feeder, may not be classed with the most depleting of field crops.

To make this clear I exhibit, by way of contrast, the drafts made by a relatively good crop of two notoriously soil-impoverishing crops—tobacco and corn—and, on the other hand, the drafts made by an equivalent average cotton crop, a product considered to make but light drains upon sources of soil fertility.

A proportionate tobacco crop of 1,000 kilos per hectare will withdraw from the soil (reduced to the same standard of weights adopted by Mr. Cochran)—

	Pounds.
Nitrogen	168
Potash	213
Phosphoric acid	23

An equivalent crop of shelled corn, say, of 125 bushels per hectare, will withdraw—

	Pounds.
Nitrogen	200
Potash	135
Phosphoric acid	75

while a relative crop of lint cotton of 237 kilos (700 pounds) per hectare will only exhaust, in round numbers—

	Pounds.
Nitrogen	... 114
Potash	... 70
Phosphoric acid	... 30

There is an analogy between these four products that makes them all comparable, in so far as all are largely surface feeders, and, as experience shows that there can be no continuing success with the last three that does not include both cultivation and manuring, we may use the analogy to infer a like indispensable necessity for the successful issue of the first. Cultivation as a manurial factor should, therefore, not be overlooked, and all the more strongly does it become emphasised by the very difficulties that for some years to come must beset the Philippine planter in the way of procuring direct manures.

When it comes to the specific application of manures and how to make the most of our resources, we shall have to turn back to the analysis of the nut and note that, relatively to other crops, it makes small demands for nitrogen. At the same time it must not be forgotten that these chemical determinations only refer to the fruit and that, with the present incomplete data and lack of investigation of the constituent parts of root, stem, leaf, and branch, we have nothing to guide us but what we may infer from the behaviour of the plant and its relationship to plants of long deferred fruition, whose manurial wants are well understood.

It is now the most approved orchard practice to encourage an early development of leaf and branch by the liberal application of nitrogen, whose stimulant actions upon growth are conceded as the best. In temperate regions, the exigencies of climate exact that this be done with discretion and care, in order that the unduly stimulated growths may be fully ripened and matured against the approach of an inclement season. In the tropics no such limitations exist, and the early growth of the tree may be profitably stimulated to the highest pitch. That this general treatment, as applied to young fruit trees, is specifically the one indicated in the early life of the coconut, may be quickly learned by him who will observe the avidity with which the fleshy roots of a young coconut will invade, embrace, and disintegrate a piece of stable manure.

Notwithstanding lack of chemical analysis, we may not question the fact that considerable supplies of both potash and phosphoric acid are withdrawn in the building up of leaf and stem; but these are found in sufficient quantity in soils of average quality to meet the early requirements of the plant. It is only when the fruiting age is reached that demands are made, especially upon the potash, which the planter is called upon to make good.

Good cultivation, the application of a generous supply of stimulating nitrogen during its early career, and the gradual substitution in later life of manures in which potash and phosphoric acid, particularly the former, predominate, are necessary. How, then, may we best apply the nitrogen requirements of its early life? Undoubtedly through the application of abundant supplies of stable manures, press cakes, tankage, or of such fertilizers as furnish nitrogen in combination with the large volume of humus necessary to minister to the gross appetite of the plant under consideration. But the chances are that none of these are available, and the planter must have recourse to some of the green, nitrogen-gathering manures that are always at his command.

He must sow and plow under crops of pease, beans, or other legumes that will furnish both humus and nitrogen in excess of what they remove. Incidentally, they will draw heavily upon the potash deposits of the soil and

they must all be turned back, or, if fed, every kilo of the resulting manure must be scrupulously returned. He must pay for the cultivation of the land, for the growing of crops that he turns back as manure (and that involves further expense for their growing and plowing under), and, in addition, he must be subject to such outlay for about seven years before he can begin to realize for the time and labour expended.

But there are expedients to which the planter may have recourse which, if utilized, may return every dollar of cultural outlay. By the use of a wise rotation he can not only maintain his land in a good productive condition, but realize a good biennial crop that will keep the plantation from being a financial drag. The rotation that occurs to me as most promising on the average cocoanut lands of these Islands would be, first, a green manure crop, followed by corn and legumes, succeeded by cotton, and then back to green manures. To make the first green crop effective as a manure, both lime and potash are essential the former to make available the nitrogen we hope to gather, and the potash in order to secure the largest and quickest growth of the pulse we are to raise for manurial purposes. Both these elements are generally in good supply in our coconut lands; but, if there is uncertainty upon this point, both should be supplied in some form. Fortunately, the former is cheap and abundant in most parts of the Archipelago, and, when well slaked, may be freely applied with benefit, at the rate of a ton or even more to the hectare. In default of the mineral potash salts, the grower must seek unleached wood ashes, either by burning his own unused jungle land to procure them or by purchasing them from the neighbour who has such land to burn over. If located on the littoral, he will carefully collect all the sea-weed that is blown in, although in our tropical waters the huge and abundant marine algae are mostly lacking. Such as are found, however, furnish a not inconsiderable amount of potash, and, in the extremities to which planters remote from commercial centres are driven, no source is too inconsiderable to be overlooked.

The first green crop selected will be one known to be of tropical origin which, with fair soil conditions, will not fail to give a good yield. He may with safety try any of the native rank-growing beans, cow-peas, soja, or velvet beans or, if these are not procurable, he has at command everywhere an unstinted seed supply of *Cajanus indicus*, or of *Clitorea ternatea*, which will as well effect the desired end, to wit, a great volume of humus and a new soil supply of nitrogen. It remains for the planter to determine if the crop thus grown is to be plowed under, or if he will use it to still better advantage by partially feeding it, subject, as previously stated, to an honest return to the land of all the manure resulting therefrom. He may utilize it in any way, even to selling the resulting seed crop, provided all the remaining brush is turned back to the land and a portion of the money he receives for the seed be reinvested in high-grade potash and phosphatic manures.

The plantation should now be in fair condition for a corn crop, and as a very slight shading is not prejudicial to the young palms, the corn can be planted close enough to the trees, leaving only sufficient space to admit of the free cultivation that both require. It must not be forgotten that corn makes the most serious inroads upon our soil fertility of any of the crops in our rotation, and, unless by this time the planter is prepared to feed all the grain produced to fatten swine or cattle, it had better be eliminated from the rotation and peanuts substituted. In addition to this, he must still make good whatever drains the corn will have made upon this element of soil fertility.

Cropping to corn attacks the coconut at a new and vulnerable point, against which the careful grower must make provision. It will be remembered that an average corn crop makes very considerable drafts upon the soil supply of phosphoric acid; but, if the grain is used for fattening swine, whose manure is much richer in phosphates than most farm manures, and the latter is restored to the land, serious soil impoverishment may be averted. The next step in our suggested rotation is the cotton crop. Here, too, limitations are imposed upon the planter who is without abundant manurial resources to maintain the future integrity of his grove. He may sell the lint from his cotton, but he cannot dispose of it (as is frequently done here) in the seed.

If the enterprise be not upon a scale that will justify the equipment of a mill and the manufacture of the oil, he has no alternative but to return the seed in lieu of the seed cake, wasteful and extravagant though such a process be. The oil so returned is without manurial value, and, if left in the seed, is so much money wasted. The rational process, of course, calls for the return of the press cake, either direct or in the form of manure after it has been fed. With this is also secured the hull, rich in both the potash and the phosphoric acid, which we now know is so essential to the future welfare of the grove. The above rotation is simply suggested as a tentative expedient.

The ground will now be so shaded that we cannot hope to raise more catch crops for harvesting, although it may be possible during the dry season to raise a partial stand of pulses of manure value only; but, from the fruiting stage on, this becomes a minor consideration. This stage of the cultural story brings us once more face to face with the principle contended for at the beginning of this paper, namely, that there can be no permanent prosperity in this branch of horticulture until the crop is so worked up into its ultimate products that none of the residue of manufacture goes to waste. At best the return of these side products is insufficient, and, despite their careful husbandry, we cannot ultimately evade a greater or less resort to inorganic manures of high cost and difficult procurement.

The residue from the press cake is rich in nitrogen and humus, which, in the ever-increasing shade of the grove, will become more and more difficult to produce there through nitrogen-making agencies; but the waste from the manufacture of coir and the ashes from the woody shell will go far toward supplying the needed potash. Such a system would, if closely followed, practically restrict the farmers' ultimate purchases to a small quantity of acid phosphates, or of bone dust, which, in conjunction with good tillage, should serve to maintain the grove in a highly productive condition for an indefinite term of years.

IRRIGATION.

As an auxiliary manurial agent of definite, well-proven value in this Archipelago, I will briefly recite some of the benefits that may be expected to follow occasional irrigation during the dry season. It strongly accelerates growth and early maturity. A few irrigated trees, reputed to be under five years from seed and already bearing fruit, were shown the writer on the Island of Jolo. The growth was remarkably strong and vigorous, notwithstanding that the water of irrigation had been applied in such a way that the tree could only hope to derive a minimum of benefit from its application. It had merely been turned on from a convenient ditch whenever the soil seemed baked and dry, at intervals of one to three weeks, as circumstances seemed to require.

Irrigation, but always in connection with subsequent cultivation, may be considered equal to a crop guaranty that is not afforded so effectually by any purely cultural system. Rarely has a better opportunity occurred to demonstrate

the unquestioned benefits that have inured to these few Jolo trees from the use of irrigating waters than the present season of 1902—3. From many sources reports came to this Bureau of trees failing, or dying outright, from lack of moisture. While it is true that the present dry season has had no parallel since 1885-86, that the rainfall during the dry season has been less than half the normal, yet it should not be forgotten that, during the eight months from October to May, inclusive, the average percipitation on the west coast, at the latitude of Manila, is only about 460 mm. and that, when the amount falls below this, the coconut is bound to suffer. Though it is true that the evil effects of drought may be modified if not altogether controlled, by cultivation, the assistance of irrigation places the cultivator in an impregnable position. If evidence in support of this statement were called for, it might be found to-day in the deplorable condition of those groves that have been permitted to run to pasture, as compared with those in which some attempts have been made to bolo out the encroaching weeds and grasses.

It is probably true that, except on very sandy soils, continued surface irrigation would aggravate the superficial root-developing tendency of the tree; and to what extent, if any, occasional laceration by deep shovel tooth cultivation would injure the tree remains to be seen. There are, however, few economic plants that so quickly repair root damage as the Palmae, and, unless the seat of injury extends over a very large area, it is probable that the resulting injury would be of no consequence, as compared with the general benefits that would result from irrigation.—*Philippine Bureau of Agriculture, Farmers' Bulletin, No. 8.*

CEYLON COCONUT PRODUCTS IN 1905.

Owing to a very short rainfall during the best blossoming season of 1904, the crops picked during the same period this year were unusually poor, not so in number of nuts, but in size and quality, and showed a very unusual deficiency. This and the very heavy shipments in 1904 in a great measure account for the serious shortfall in copra shipped during the past year, it being little over half that for 1904.

The year, therefore, was a bad one for estates, as also for copra driers and desiccating mills; but, strange to say, notwithstanding the very large percentage of small nuts, the shipment of nuts in shell was in excess of all previous years. Everything seemed to go against the growers and millers during the year; for, while the home and local prices were low, it took an unusually large number of nuts to produce a given quantity of copra and desiccated nut, the former running to 1300—1500; while well over three nuts were required to produce 1 lb. of desiccated. With this year's record shipment of desiccated nut, 20,072,905 lb.—or, 13,657,997 lb. over that of 1893, consumers were overfed, and so there was no life in the markets. Hence the very low prices, anything but commensurate with the high price and poor quality of nuts offered.

Now that oil mills are turning out pure white oil, and which it seems they are doing with any kind of copra, it points to increased make and shipments of cheap stuff; and a falling-off in the demand for first quality which should result in cheaper nuts in the future, so that if the demand for desiccated nut continues as at present, mills should do better and be able to work full time. This they cannot do just now owing to the great scarcity of nuts and high price of the same, as also the low offers for this product, shipments of which are bound to be very short for the first quarter. If buyers cannot offer millers something better than the miserable fraction of a cent per lb. profit as at present, the result will be they will have to shut down when prices are bound to rise.

Unlike the tea planter, the miller can stop everything, while the estate must be cultivated: so our Demon—over-production—can be grappled with by securing a little combination.

We did fairly well as far as quantity, but prices were miserable and some seem to be verging on over-production. If all would combine and so reduce shipments for a couple of months, we would soon get decent prices, for we have neither China nor India to fear as in the case of tea, and we can reduce expenditure to a mere nothing, and simply keep our machinery clean. I do not think there ever was such a year for small nuts ranging to over 20 per cent. The pickings at this season are as usual very poor, and the natives, too, are feeling the pinch very keenly.

Poonac shipped—262,229 cwts.—while in excess of the previous year has fallen short of its record year 1903, when we shipped no less than 295,125 cwts. Oil also shows an increase over 1904 of 12,922 cwts; while that of our Indian neighbour, Cochin, has practically ceased to be quoted in the weekly telegrams. In Coir there is very little change save in yarn and fibre, while rope is very little over 1904.—*Ceylon Observer.*

CEYLON COCONUT AND COPRA PROSPECTS DURING 1906.

After a season of short rainfall—as 1905 proved generally throughout our principal palm-growing districts—the expectation is usually of a comparatively poor crop of coconuts in the ensuing year. It takes about twelve months to mature the nut of the coco-palm, and consequently the effect of unseasonable drought is very manifest in the case of a crop so dependent on rainfall. We have been "circularising" a number of representative planters as to their expectations or opinions during the current year, and on the whole the result is to point to a smaller outturn than usual both in size and number of nuts. There are exceptions in the case of some estates—notably Mr. Wright's at Mirigama, which are expected to do better; and the effect of additional areas coming into full bearing must be allowed for But, on the whole, we fear the exports of coconut produce for 1906 can scarcely be anticipated to equal those of the past year. To begin with our returns and information: from the Northern Province, the belief is expressed that the coconut crop throughout the Peninsula will be a short one this year. "The failure of rain to a serious extent during the past three seasons has, at last, begun to tell severely on the trees. In village gardens, in many instances the palms have failed altogether, while from others, the crop is to be very small. Large estates have also suffered. One consequence is that petty traders have been buying up nuts on the estates and retailing them in the villages at 6, 7, 8 and 10 cents each." We are told of two estates from which as many as 100,000 nuts have been thus already purchased for retail purposes, and other plantations along the roadside have been freely drawn on for the same purpose. It is clear, therefore, that with short crops and this special local demand, the available produce for copra will be much smaller than in 1905. One good authority puts the copra outturn at not more than one-half or even one-third that of the past year. Coming to the North-Western Province, the indications are generally of a comparatively short crop: such is the opinion of a resident proprietor in the Chilaw district who reports the current harvesting—or first plucking of the year—as decidedly short. Coming a little further south, our correspondent "B." answering our enquiry a few weeks back, wrote:—

"Except on large estates owned by Sinhalese gentry, very little copra, as far as I am aware, is made in this district. All the nuts go either to the Lunuville or Horrekelle desiccating mills. I have not been about much, and so cannot speak with any authority on the crops for 1906. As far as I know, there will be no

material difference between the crops of 1905 and 1906. The rainfall has not been evenly distributed for the past two years. We have had too little and then too much rain. As "Miller" wrote in a recent issue of the *Ceylon Observer*, the outturns in 1905 have been woefully bad both as regards copra and desiccated nuts, but not so bad as in and around Negombo. This is the centre of perhaps the best coconut district in the Island, and that makes a great difference. The coconut plantations south of me are better than those north, yet in recent months the outturn of the nuts was better north than south. This is explicable. North of this, most of the lands are low-lying and the soil sandy. Moisture would have been within reach of the roots always and in spite of want of rain. The formation of the kernels would never have been checked. This exemplifies the importance of water to coconut plantations and a free soil."

Writing about the same, a very experienced Manager in the Negombo and Kurunegala divisions, tells us:—"I do not now travel much, so cannot speak with any confidence of any localities beyond parts of the Negombo district and Kurunegala district, and the crops in them will, I think, be pretty much what they were last year; and from what I can learn of other districts the crop is likely to be an ordinary one. We have had no rain, except a few drizzles, in these parts for quite six weeks, and that does not look promising, for if we do not get heavy rain soon it will mean a very severe drought in the early months, which will cause the dropping of many young nuts and also affect the size of the nuts. Rain, beyond an occasional shower, is not likely now." Another authority reports:—"As a rule up this side our best months for nut crops and copra-making (quantity) are July to November, while our very worst are November to April when an improvement sets in practically as regularly as the tides of the ocean. I cannot express any opinion or attempt to compare the 1st, 2nd, 3rd and 4th quarters of current year with those of 1905, but it is a well-known fact that for bad quality, *i.e.* size of nuts and thickness of kernel, last year was a record, and so say the oldest residents here. London advices point to a probable falling off in the trade requirements of *1st quality* of copra, crushers having discovered a process by which they are now able to turn out pure white oil from the very worst copra. While, therefore, the demand for copra (quantity) will, I conclude, be the same, the trade will pull down the price and driers will not be able to procure nuts at a figure that will enable them to produce copra and sell it at a low price. To give you an idea of variation in yield of nut trees here during the year, a dealer in nuts brought lately some *2,400* nuts in *one cart*—a good load, *1,500* being about the average for native husked nuts. The man laughed and said he had bought these nuts, being the *whole of a certain garden crop*, the owner's best crop being no less than *20,000* nuts. This is a typical case, and the worst crops during the year may be put at about 1-10th of the best, there being six pickings per annum. The short rainfall during September, October and November *1904* resulted in a *most wretched* yield of nuts as regards size and quality during the same months of 1905, the tree taking a year to mature each lot of blossoms. Estate owners drying their nuts into copra will hold their own, for, by drying less, *i.e.*, under-drying, they can get a larger yield which will make up for lower prices in the same way that a big yield of cheap tea pays better than a small yield of high-priced."

Coming to the Western Province, the general opinion is that a better crop cannot be expected than was gathered in 1905. In many parts it must be shorter, the poor heads of nuts on the palms seen along the roads and railway lines in many directions have been the subject of common remark. A Veyangoda planter replies to our enquiry:—"I am afraid the outturn of coconuts (and therefore of copra) this way will be short of last year. Though we had rain above the average, the distribution was bad—October and November having given 47 inches out of 106½

for the year. Fewer nuts have set and the prevailing drought (from middle of November-December having given only ½ an inch!) will bring down a good lot of immature nuts."

In regard to Mirigama division, Mr. Wright remarks:—"From the general appearance of the district from what I can see and hear the crops this year will be larger. This will all depend on the rains we get."

From the Southern Province the expectation is of an average crop, and a good deal is expected from additional trees coming into bearing, planting having extended greatly during the past decade. From the Eastern Province we are, so far, without exact information as to condition and prospects; but in reckoning the total outturn for the island, the North-Western, Western and Southern Provinces of the island have mainly to be taken into account, and on the whole, we think, so good a supply of copra as was experienced in 1905 can scarcely be hoped for during the current year, unless indeed the high prices tempt growers to divert to this purpose what usually goes to the desiccating mills or the local retail market. —*Ceylon Observer.*

OUR EXCESSIVE TEA CROP: AND HOW TO MANURE.

We seem to be once again face to face with an over-supply of Tea to the London market. For 1905 the Ceylon exports amount to 13 million pounds of tea in excess of the previous year. Under the stimulus of artificial manures, as usually applied, I presume we are likely to see a further increase this year, and, with the probability of a larger Indian crop, a disorganised Russian demand, further shipments from Java, and the rehabilitation of the Japanese tea industry after the war, the tea outlook for 1906 is not a particularly bright one for Ceylon. The higher rates ruling for common teas during 1905 are also bound to have an effect in inducing heavier imports to London of China teas during the coming season. Under these circumstances, is it not time that Ceylon should curtail shipments?—and instead of working for quantity, rather endeavour to manufacture a better quality of tea?

I have not the Customs figures by me; but I understand that for 1905 the imports of artificial manure are likely to show a considerable increase over those of 1904. During the present year a still further rise may reasonably be expected. There are now few estates in the Island that do not spend from 2 to 3 cents per lb. on manuring, while many allow from 6 to 8 cents per lb. This expenditure is moreover on the increase.

To maintain the stamina and vigour of the tea bushes, artificial manure is almost universally necessary, but the present system of working is rather to depend upon the increased crops to pay for the cost of the manure, than to so utilise the manure as to raise the quality of the tea. The system has many disadvantages, foremost among which is the fact that as a considerably larger crop has to be harvested, little improvement in the frames and growth of the tea is secured. This is especially the case with lightly manured estates.

The gradual drop in prices of many estates, formerly at the top of the market, is also remarkable, and it would seem that, as generally carried out, artificial manuring tends to lower, rather than to raise, the average quality of the crop.

Much experimental work has been undertaken with a view to improving quality, by applying one or more ingredients in excess. I have personally tried many mixtures of this class, and in certain instances special manures were imported into the island for the purpose. The results were throughout unsatis-

factory, though in one or two minor points certain benefits were obtained. The same negative results are again, I understand, being shown by the experimental plots, as far at least as the improvement of quality by the use of certain mixtures containing an excess of any one or two ingredients are concerned. Yet the process of manuring for quality is in principle a simple one. It consists firstly in the application of suitable manure mixtures, of a well compounded character, containing—in proper proportion—the more essential fertilising ingredients, as required by the tea bush. Secondly, in the application of such in sufficient quantity, and at the proper periods to induce a free and healthy growth of the tea, so as to enable a reasonable crop to be harvested from *large, well-grown and leafy bushes*, and to minimise as far as may be possible the percentage of useless tipping leaf, while building up and preserving the natural vigour of the trees.

The effect of such manuring is to increase enormously the natural dressing of organic matter given to the ground at each recurring pruning, to strengthen and develop the frames and the pruning wood of the tea, and to more than cover the cost of the application, not by a large increase in crop, but by a decided rise in prices, owing to the higher intrinsic quality of the leaf.

In certain cases difficulties do, of course, arise, which may entail manuring for quantity at first, especially where the frames of the trees have been allowed to get into a hardened or diseased condition; sufficient to necessitate "down pruning," or where the crop is so short that an economical limit in the cost of production cannot be attained without raising the yield; but for most well cultivated estates, where the bushes are healthy and properly developed, it would unquestionably be to their advantage to aim rather at improving the quality of their teas, under the system outlined above, by means of artificial manure than to manure so as to increase their total crop. This policy, if generally adopted, would have a most appreciable effect in minimising the danger of an oversupply of tea during the next few years, and thus by securing a stronger market for our staple, benefit the entire planting interest of the island.

HENRY M. ALLEYN.

—*Local Press.*

THE WORLD'S COCOA CROPS AND CONSUMPTION, 1901-04.

The 1904 cocoa crops in many countries, but especially in Ecuador, Trinidad, San Domingo, the Gold Coast, and Cameroons, proved to be the largest on record. In general, the crops of all countries which have only taken up the cultivation of cocoa in recent years, have increased in a far greater degree than those of the older producing countries, as is shown in the following table, which gives the crops of all countries during the four years 1901-04 :—

WORLD'S COCOA CROP.

—	1901.	1902.	1903.	1904.	Proportion of Increase or Decrease between 1904 and 1903.
	Tons.	Tons.	Tons.	Tons.	Per cent.
Ecuador	22,896	24,965	23,238	28,433	+ 22¼
Brazil	18,323	20,370	20,738	23,160	+ 11⅙
St. Thomas	16,982	17,969	21,450	20,526	— 4¼
Trinidad	11,942	15,955	14,885	18,574	+ 25
San Domingo	6,850	8,975	7,825	13,557	+ 74
Venezuela	7,860	9,925	12,550	13,048	+ 4
Grenada	4,865	5,975	6,150	6,226	+ 1¼
Gold Coast	996	2,436	2,297	5,687	+ 148
Cuba and Porto Rico ...	1,750	1,875	2,625	3,266	+ 15¾
Ceylon	2,697	2,673	3,075	3,254	+ 6
Haiti	1,950	1,994	2,175	2,531	+ 16½
Jamaica	1,352	1,525	1,650	1,650	0
Martinique and Guadeloupe ...	825	925	1,150	1,215	+ 5¾
Dutch East Indies	1,276	889	1,458	1,140	— 21¾
Cameroons, Samoa and Togo	528	648	805	1,109	+ 40
Surinam	3,163	2,355	2,224	854	— 61¾
St. Lucia	765	785	800	800	0
Dominica	—	—	—	485	—
Congo Free State	—	—	—	231	—
Other countries	700	700	800	806	—
	105,720	120,939	125,895	146,552	—
Percentage of increase against the previous year ...	+3½%	+14½%	+4%	+16%	—

The most noticeable increase, viz., 148 per cent., occurred in the Gold Coast, where every year more and more plantations are reaching the producing stage, which requires five to six years. The district of Accra alone produced 515 tons, and Lagos and Nigeria together 53 tons, most of which was shipped to Hamburg, and consumed in Germany. The Accra cocoa in particular, during the few years it has been obtainable in any quantity, has established for itself a ready market in Germany, and there are times when the supply is not sufficient to cope with the demand.

In San Domingo, where the next largest increase is shown, the plantations are mostly in the hands of small farmers, with the exception of a few large estates, the most important of which belongs to the Swiss chocolate firm Suchard, and is fitted out with extensive agricultural machinery and narrow gauge railways. Whereas in the Gold Coast, the cultivation is almost entirely in the hands of the natives, in San Domingo, in spite of the smallness of many of the plantations, they are often worked on scientific lines, and as suitable land is obtainable at a very low price, the crop may be expected to increase from year to year. Hamburg is the principal market for San Domingo cocoas. The quantities exported from the various parts are shown in the following table :—

Cocoa Exported from San Domingo Ports in 1904.

Port.	Tons.
San Domingo	1,800
San Pedro de Macous	577
Sanches	6,153
Samana	782
Puerto Plata	4,245

The third largest increase occurred in the German Colonies, but in spite of the fact that some German colonial enthusiasts have laid stress on this point, the amount of the crop, as shown in the following table, was not really of great importance, though at the same time larger amounts are to be expected from this quarter:—

Cocoa Shipped from German Colonies in 1904.

Colony.	Tons.
Cameroons	1,089
Samoa	19
Togoland	10

The Togo and Samoa cocoas are shipped exclusively to Germany, but a portion of the Cameroon crop is shipped to England. Togoland, in spite of its being situated so near the Gold Coast, is not so well adapted for the cultivation of cocoa as the latter colony, owing to the small area of its forest land, which is the most suitable land for this class of agriculture.

Trinidad, which comes next so far as increase is concerned, used formerly to ship the entire crop to London, but now sends large quantities direct to Hamburg, Havre, and New York, by German and other steamers.

In Ecuador, the largest cocoa producing country, also a very satisfactory increase occurred, namely 22¼ per cent., the crop having been divided amongst the various districts as shown in the subjoined table. As regards the exports it will be seen from the following table that 131 tons over the amount of the crop were shipped during 1904, this small quantity having been held back from the preceding year:—

Cocoa Crop and Exports of Ecuador in 1904.

Crop.		Exports.	
District.	Quantity.	Country.	Quantity.
Guayaquil	24,590	France	13,373
Manta	86	Germany	5,289
Bahia de Caráquez ...	2,384	United States ...	4,003
Esmeraldas	108	Great Britain ...	2,905
Puerto Bolivar ...	1,265	Spain	1,921
		Holland	573
		Argentina	220
		Other countries ...	280
Total	28,564	Total	28,564

A very large quantity is shipped to Havre, but this may be accounted for by the fact that cocoa is often shipped to that port with the option of delivery in several other ports. In any case the figures do not imply that the cocoa was actually consumed in France itself, where in the previous year (1903 only about 3,204 tons were used from this quarter. The fact also that Switzerland, where about 2,570 tons of Ecuador cocoa was used during the year in question, is not mentioned in the above table would probably be accounted for by the amount having been passed through Havre.

The last countries showing an increase of importance were Cuba and Porto Rico. The proportionately small increase shown in Brazil is to be wondered at, as the exports from Bahia alone, as will be seen from the following figures, were exceedingly high:—

COCOA EXPORTED FROM BRAZIL IN 1904.

Port.	Tons.
Bahia	17,969
Para, Manaos, Itacoatiara	5,190

With regard to Ceylon it is to be noted that more shipments were made to Hamburg than in former years.

The Venezuelan crop, which only showed a very slight improvement, was shipped from the following ports:—

COCOA EXPORTED FROM VENEZUELA IN 1904.

Port.	Tons.
La Guara	7,500
Carupano	4,479
Puerto Cabello	899

The remainder was divided between Ciudad Bolivar and Maracaibo.

Martinique and Guadeloupe shipped, as usual, practically their entire crops to France, whereas Great Britain received all the Grenada cocoa, which is always in demand on the London market, even when other sorts are unsaleable. A decrease occurred in the crops of St. Thomas, the Dutch East Indies, and Surinam, but in the two countries first named the falling off was not of importance. As far as Surinam is concerned, however, the decrease was enormous, and in view of the much higher crops of former years (as shown in the following table), can only be considered as most unsatisfactory, all endeavours that have been made to improve matters having failed entirely:—

COCOA EXPORTED FROM SURINAM.

Year.	Tons.
1895	4,456
1901	3,163
1904	854

World's Cocoa Consumption.

The following table shows the consumption of cocoa in the various countries of the world during the years 1901–04:—

	1901.	1902.	1903.	1904.	Percentage of Increase or Decrease between 1901 and 1903.
	Tons.	Tons.	Tons.	Tons.	Per cent.
United States	20,665	23,120	28,508	33,159	+ 16¼
Germany	18,410	20,601	21,491	27,101	+ 26
France...	17,916	19,343	20,638	21,799	+ 5½
United Kingdom	18,908	20,386	17,485	20,552	+ 17½
Holland	14,373	14,666	16,741	21,124	+ 26
Switzerland	4,363	5,707	5,856	6,839	+ 17
Spain	5,931	9,259	6,006	5,611	— 6½
Belgium	1,865	2,277	2,767	2,792	+ ¾
Austria-Hungary	1,685	1,820	2,034	2,510	+ 24½
Russia	1,757	1,818	1,900	2,055	+ 8¼
Denmark	762	802	1,150	996	— 13½
Sweden	455	591	774	870	+ 12½
Canada	459	312	585	650	+ 11
Australia	568	554	443	550	+ 24
Italy	563	466	468	479	+ 2¼
Norway	368	410	439	472	+ 7¼
Portugal	100	112	136	180	—
Finland	25	47	61	63	+ 3¼
Including Holland's exports ...	109,173	122,491	127,482	147,802	—
Percentage of increase against the previous year...	+ 8%	+ 12½%	+ 4½%	+ 16%	—
Without Holland's exports ...	?	116,998	121,471	138,864	—
Percentage of increase against the previous year...	+ 8%	+ 7%	+ 4%	+ 14½%	—

From the tables of production and consumption given it would be gathered that in 1904 the consumption was greater than the production, but this in reality was not the case. The error appearing in the totals in these tables is caused by the figures for Holland, where, for statistical purposes, the total amount of cocoa imported is also given as having been consumed, whereas in reality a large portion was re-exported, as is shown in the following table:—

Cocoa Imported and Exported from Holland.

	1902.	1903.	1904.
	Tons.	Tons.	Tons.
Imported	14,666	16,741	21,124
Exported	5,493	6,011	8,939
Amount actually consumed	9,173	10,730	12,185

On referring to the table of consumption, it will be seen that the most important increase occurred in Germany, viz., 26 per cent.; while among the other most important users, the United Kingdom increased 17½ per cent., and the United States 16¼ per cent. Amongst the smaller consumers Austria-Hungary increased 24½ per cent., and Switzerland 17 per cent. Taking into account the incorrect figures given for the consumption in Holland, it will be seen that whereas the crop in 1904 increased 16 per cent., the consumption only increased 14½ per cent. against the 1903 totals.

It is to be noticed that the planting of high-grade cocoas is not being carried on to the same extent as the cheaper varieties, which may be accounted for by the fact that cocoa is now no longer merely a luxury, but is becoming a staple article of food even amongst the working classes, this end having, in a great measure, been brought about by improved methods introduced in the process of manufacture, which has enabled the lower grades of cocoa to be handled to advantage.

In 1904 Hamburg became the leading centre of the cocoa trade, having far surpassed Havre and New York. London, however, is losing ground year by year in favour of both Hamburg and New York, as will be seen from the following tables :—

COCOA RECEIVED AT VARIOUS PORTS.

Port.	1902.	1903.	1904.
	Sacks.	Sacks.	Sacks.
London	227,025	183,362	210,395
Havre	515,291	504,167	446,751
Hamburg	371,100	409,435	645,136
New York ...	296,425	351,455	413,298

COCOA DISPOSED OF FOR EITHER HOME CONSUMPTION OR EXPORT.

Port.	1902.	1903.	1904.
	Sacks.	Sacks.	Sacks.
London	239,887	197,247	178,547
Havre	471,507	497,239	430,699
Hamburg	369,235	406,354	589,051
New York ...	304,861	350,086	408,824

COCOA ON HAND AT THE END OF EACH YEAR.

Port.	1902.	1903.	1904.
	Sacks.	Sacks.	Sacks.
London	64,197	50,340	83,092
Havre	114,345	121,252	137,304
Hamburg	17,772	20,853	77,038
New York ...	11,446	12,815	17,289

The proportion disposed of compared with the amount received differed considerably in the various ports, and was as follows :—

PERCENTAGE OF SACKS OFFERED WHICH REMAINED UNSOLD AT THE END OF THE YEAR.

Port.	1902.	1903.	1904.	Average of the Three Years.
	Per cent.	Per cent.	Per cent.	Per cent.
London	21	20	32	24½
Havre	19½	19½	24	21½
Hamburg	4½	5	11	7
New York	3½	3½	4	4

From the above it will be seen that cocoa remains longest unsold in London, and this is probably one of the reasons why Trinidad and Ceylon firms are shipping less to that port than formerly. The reason why such a large amount always remains on hand in Havre is that the consumers instead of taking the cocoa direct from the ship to their factories, prefer to keep it several months in bond, as in this way they are protected against sudden price fluctuations, and the cocoa besides becoming milder, also dries up to a certain extent, which of course causes a saving in the amount of duty to be paid. In Germany this plan is also adopted by some firms, but it is not nearly so general as in France.

Every year manufacturers are getting more into direct communication with the producers abroad, and now a considerable portion of the cocoa, which passes through Hamburg, Havre, and New York, goes straight to the manufacturer with-

out passing through the hands of any middleman. This condition of things is much less prevalent in London, where cocoa is largely sold at public auctions, a method which is rarely adopted at other centres with the exception of Amsterdam, where about eight auctions of Java cocoa are held annually.

The following table shows the quantity of cocoa remaining in stock in the various countries at the end of each year:—

STOCKS OF COCOA ON HAND AT THE END OF EACH YEAR.

	1900.	1901.	1902.	1903.	1904.
	Tons.	Tons.	Tons.	Tons.	Tons.
France	11,353	9,432	13,637	15,935	19,259
England	7,779	5,940	4,822	3,440	6,060
Germany...	1,651	1,075	1,362	1,538	5,519
United States	1,205	1,778	1,234	1,375	1,819
Other countries	300	275	300	400	600
Stocks { In ports of discharge	22,288	18,500	21,355	22,688	33,257
Stocks { Afloat	8,506	8,818	10,328	10,566	12,200
Total Stocks	30,794	27,318	31,683	33,254	45,457

From the foregoing table it will be seen that the stocks at the end of 1904 in the various ports of discharge amounted to 33,257 tons, namely, 10,000 tons more than the stocks in hand at the same ports at the end of 1900. In spite of the stock in question appearing somewhat large it is in reality considered to be satisfactory, as it is sufficient to insure the manufacturers against any sudden dearth, without being large enough to cause producers to be afraid that their crops in future will be unsaleable.—*Translated from the German Cocoa Trade Journal "Gordian," from Board of Trade Journal.*

SUGAR GROWING IN JAVA.

The following extract from a recent report of the Bureau of Labour of the Department of Commerce and Labour will be read with interest, showing as it does existing conditions on the island of Java, which has an area of about 49,000 square miles, and has a population of 29,000,000, of which 63,000* are Europeans. It says:—

Cane raising affords the most wage employment of any agricultural industry in Java. Sugar cultivation was first initiated by the Government under the system of forced culture, but has long since passed into private hands. Much of the land occupied by the plantations is leased from natives, in accordance with the regulations previously described. The plantations are entirely in eastern and middle Java, and in the former districts the workers are Madurese. They are paid usually on a day-wage basis. But around Passoerocan, in the extreme east, cultivation contracts are used to some extent, and two of the thirty-eight mills in that vicinity depend upon cane bought from local planters who are mostly natives. The custom of making a gang of men jointly responsible for all advances paid to its members is common. To a certain extent cheapness of labour is said to have discouraged introduction of machinery, especially for loading cane. The proportion of Europeans to natives employed on the plantations is very small. On one plantation visited near Surabaya, where in the mill alone 120 men were employed, or 60 to the watch, there were only seven

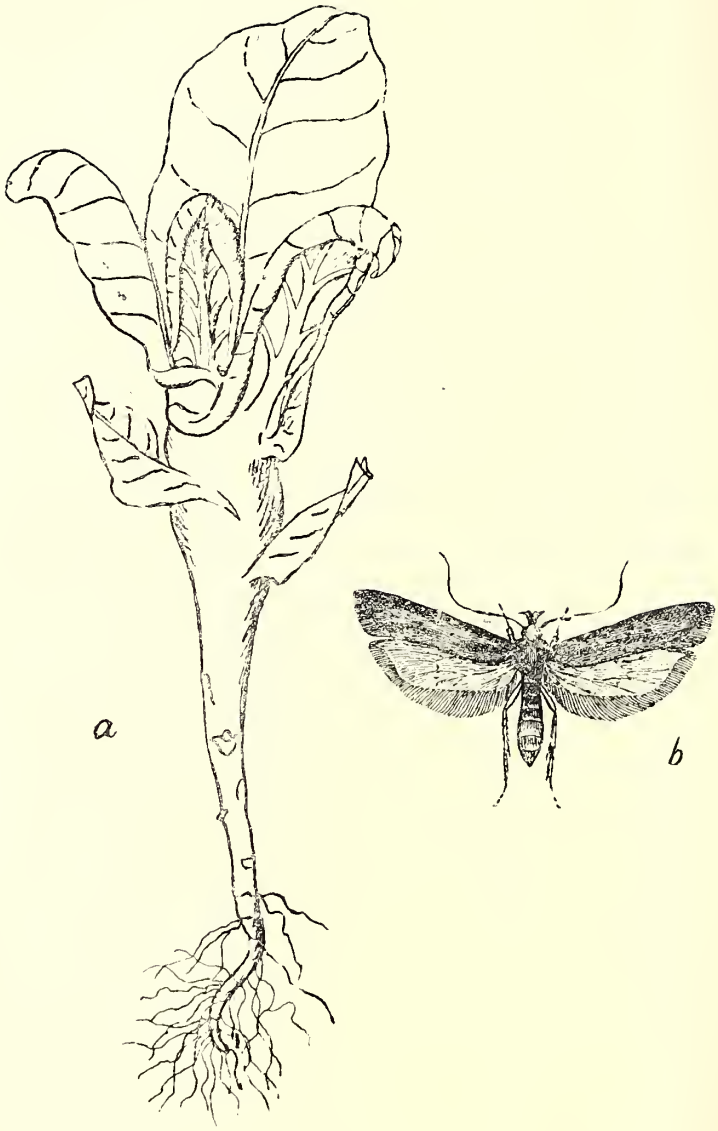
*All who have any European blood in them are counted as Europeans.—ED.

whites, including the manager, upon the pay rolls in both manufacturing and planting departments. Field hands are paid eight cents a day without rations in east Java, and get $2·7 an acre for cutting. In the province of Kadoe, in middle Java, the rate was about the same, varying from six to ten cents a day. In this district the more common method of paying for field labour is by the stint, but earnings average the sum just mentioned. Cane is stripped, but on the older plantations it is no longer possible to rattoon. Native overseers are employed almost exclusively for field supervision, though they are under the general direction of Europeans. One European to every 350 or 400 acres is considered sufficient, with a half-caste assistant during the busy season. Planting and cutting usually come together in Java.

The Madurese, who possess more typical Malay characteristics than the Javanese proper, give evidence of a lawless and probably revengeful disposition in their habit of burning the cane of planters against whom they have a grievance. Whether this is always a method of silently remedying real abuses is not clear. In several cases where offenders have been detected and punished, it appeared that they were not employees of the plantation where the fire occurred, and were actuated by little else than love of mischief and excitement in their incendiary undertakings. These fires are on the increase. Those occurring in a single district rose from 29 in 1889 to 218 in 1899, and to 616 in 1903. Mills have never been burned in this manner. The labourers will strive to destroy new and soft cane, especially seedling crops, which they find difficult or disagreeable to strip.

European employees are generally well paid, especially in comparison with the low salaries of white workers in other occupations in Java. Some managers receive $400 a month and 10 per cent. of the net profits of the plantation. Head engineers are paid up to $250 a month. In 1899 the average cost of making a short ton of sugar, including all expenses, except those for new machinery, improvements and new areas brought under cultivation, was $29·70, and on one plantation in 1903 it was $26 a short ton. For the plantations mentioned the former year, dividends averaged 15 per cent. Possibly the cost of production is falling on account of the growing competition for employment, but to an increasing population, for wages are said to be decreasing throughout the sugar districts of Java.

An average of about 12 per cent. sugar is obtained from the cane of the better Javanese plantations, and the yield per acre is about 4·5 short tons. Fertilization and intensive cultivation are practised, and attention is given to selected varieties and seedling cane.



STEM-BORER OF TOBACCO.

(*Gnorimoschema heliopa,* Lower.)

a. Young plant, showing swollen stem due to borer.

b. Moth, (magnified 3 ½ diameters).

PLANT SANITATION.

Entomological Notes.

By E. Ernest Green, *Government Entomologist.*

(Illustrated.)

The "Red Slug" (*Heterusia cingala*) is a tea pest that is constantly cropping up. I have just received specimens from two estates in the Kandy district, on one of which the caterpillars are apparently occurring in considerable numbers. This is one of those pests that should be taken in time. Before a large area can be involved there must have been several earlier small broods which would have been easily destroyed if observed. But when once the pest has been allowed to establish itself widely, nothing short of pruning and burning will have any effect. The full grown caterpillar spins a compact cocoon in the fold of a leaf. When burning the prunings, all fallen leaves and rubbish from below the bushes should be swept up and destroyed at the same time. This caterpillar is extensively parasitized by a fly (*Tachina sp.*) that looks something like an exaggerated housefly. It usually happens that these flies eventually get the upper hand, and after reaching a certain crisis the pest is wiped out for the time being. I have often bred as many as five or six large flies from a single caterpillar.

The "Red Borer" (*Zeuzera coffeæ*) has been reported from a tea estate in Rangalla. This pest is widely but sparsely distributed, and is seldom responsible for any serious injury.

In my annual report for 1900 (*vide* Administration Report, R. B. G., 1900, p. H. 8), I recorded the destruction of all the young tobacco plants in our experimental plots, by the caterpillar of a minute moth which bred in the succulent stems of the seedlings. I suggested that it might prove a serious enemy to tobacco cultivation in Ceylon. But no further reports of injury were recorded until last month (January)—after an interval of six years—when examples of this same pest were sent in from the Hanguranketta district. A large number of the diseased plants were received,—all of them characterised by the swollen stem (Fig. *a.*) which has earned for this disease, in Java (where it also occurs), the expressive name "dikbuikziekte" which means "pot-bellied sickness." The moth—which has been identified as *Gnorimoschema heliopa*, Lower—apparently lays its eggs in the bud of the seedling. The young larva bores into the stem and feeds in the succulent heart, forming extensive galleries and chambers. The irritation set up by the action of the insects results in the characteristic swollen condition of the stems. The full-grown larva pupates inside the diseased stem and finally emerges as a minute dull brown moth (Fig. *b.*) with a wing expanse of about half an inch. The only practicable treatment is to pull up and burn every affected plant on the earliest appearance of the disease. By these means the larvæ and pupæ are destroyed before the moth can emerge and infect other plants. I have been informed that the same disease has been observed in the Jaffna district.

There has been some correspondence, in the local press, about the supposed increase of the "Spotted Locust" (*Aularchus miliaris*) in the Matale district. Upon enquiry, it would appear that the scare is a somewhat exaggerated one; but at the same time it is a good thing that attention has been drawn to a possibly serious pest. As usual, at this time of the year, the "dadap" (*Erythrina*) trees have been partially defoliated by the insects; but this temporary lessening of the shade is regarded by many cacao planters as distinctly beneficial. The locusts

do not injure the cacao itself, and, though I should be sorry to assert that they will never attack Para rubber, what little evidence is available goes to show that they do not relish the foliage of this plant. Moreover, the habits of this particular locust render it specially amenable to treatment. I have shown, in my circular on the "Spotted Locust" (R.B.G. Circulars, Series I, No. 9), how the insects congregate in enormous numbers on limited areas where they await their turn to deposit their eggs. All that is required is to mark down these breeding grounds, collect and destroy the breeding locusts, and then fork up the soil with quick-lime. If any real good is to be done, concerted action is necessary, and, in this case, the treatment is so simple and inexpensive that there is no excuse for neglecting it. It will be necessary, on the first appearance of the fully-grown (winged) locusts, to put on a few smart boys to go over the whole estate and locate the breeding places. In districts where there are native holdings, search must be made in them also. As far as my experience goes, the locusts always breed in shady spots, so that patnas and low chena will not require attention. MacDougall's insecticide solution has been found effective as a spray for killing the young locusts; but by treating the pest as suggested above, it ought to be possible to prevent any hordes of these young hoppers.

The Superintendent of the Government Stock Garden sends me specimens of a cricket (*Gryllus* sp.) which is said to be injuring croquet lawns in Colombo. The Sinhalese name for the insect is said to be 'Polangetia.' The burrows of these crickets are usually very conspicuous by reason of the small heap of sand excavated and left beside the entrance. The insects may be killed by pouring dilute Phenyle or Jeyes' Fluid into the holes. If too numerous to make this plan practicable poisoned baits should be sprinkled over the grass. The mixture recommended for destruction of locusts (*vide Tropical Agriculturist*, November, 1905, pp. 628-9) should prove effective. Another useful bait is the 'bran-arsenic-mash' which is compounded of 1 lb. arsenic or Paris Green with 6 to 10 lb. of bran and enough water to thoroughly moisten the mass. Sugar may be added pound for pound with the arsenic, and is said to add to the attractiveness of the bait. It will be advisable to keep fowls away from the lawns while the poison is in use.

Specimens of the large Cockchafer (*Lepidiota pinguis*) have been received from the Gampola district, where they were reported to be defoliating "Dadap" (*Erythrina*) seedlings in a nursery. The beetles being large and conspicious, can be readily collected and destroyed. If necessary, the young plants could be protected by spraying with Paris Green. This insect was described and figured in the *Tropical Agriculturist* for October, 1905, p. 520.

The "Lantana Bug" (*Orthezia insignis*) is a pest that is always with us and one that is difficult or impossible to eradicate. Accidentally introduced in the year 1893, it has, in the ensuing twelve years, followed its principle food plant (the Lantana) all over the Island. If only confined to that weed, its presence might be ignored; but it has unfortunately cultivated a taste for various garden shrubs and plants—such as the *Duranta* (so largely utilized for hedging), *Coleus*, *Thunbergia*, *Ipomœa* and numerous other favourite garden flowers—which has rendered it most obnoxious to horticulturists. Happily, this pest has as yet shown no marked liking for any of our staple products, though there have been a few instances of partial infestation of tea. As an introduced insect, it arrived without its natural enemies, and, in spite of its lengthy sojourn with us, appears to be still immune. Spraying with MacDougall's Insecticide will kill the insects, but fresh infestation (probably from a few escapees) soon occurs. In the case of annuals it is best to pull up and burn the infested plants. Shrubs should be heavily pruned, the prunings burned, and the remnant sprayed and resprayed at the earliest reappearance of the pest. This same treatment

is applicable to hedges of Duranta when attacked by the bug. The Lantana bug is one of the most active of its family. It has proportionately larger legs than any other Coccid with which I am acquainted. It is also extremely prolific, a constant stream of larvæ emerging from the long tubular ovisac which gives the female insect such a peculiar appearance.

Further complaints of depredations by hornets (*Vespa cincta)* have been received from bee-cultivators in the Kurunegala district. My correspondent writes that the hornets "hover over the entrance to the hive and carry away the bees as they come out. They have already devastated twenty-two hives. I am killing them by hundreds by using pieces of meat soaked in arsenic." The nests of the hornets should be searched for and burnt. This is very easily done with a torch made of straw or rags soaked in kerosene on a long pole. When held below the nest the hornets fly into the flame and never think of attacking the person at the other end. The nest also catches fire and smoulders slowly away. In addition to this treatment, a small boy with a butterfly net might be stationed at the hives, to catch and kill any hornets that may be hovering about.

SCIENTIFIC AGRICULTURE.

THE LIMING OF SOILS.

PART II.—(*Concluded.*)

PLANTS USUALLY OR FREQUENTLY INJURED BY LIMING.

Among the plants which have shown slight injury from liming under certain conditions and which may under other circumstances be helped by it are the following:—Cotton, tomato, cowpea, zinnia, phlox (Drummondi), Concord grape, peach, apple, and pear. The plants that have quite persistently shown marked injury from liming are: Lupine, common sorrel, radish, velvet bean, flax, castor bean, blackberry, black-cap raspberry, cranberry, Norway spruce, and American white birch. Extensive European tests have also shown that lupine is injured by liming. Lime, though directly injurious to common sheep sorrel, aids in ridding land of it more by virtue of encouraging other plants than on account of the direct injury which it causes. It is claimed that the chestnut, azalea, and rhododendron are injured by lime, though they have not yet been tested at the Rhode Island Station.

The Rhode Island soil upon which the tests referred to were made is what has been termed a "silt loam," in which the water table is usually from 12 to 15 feet below the surface.

INFLUENCE OF LIME UPON SOME PLANT DISEASES.

POTATO SCAB.—It has been shown that carbonate of lime and such other compounds of lime as are changed into the carbonate by decomposition within the soil all tend to favor the production of potato scab, provided the germs of the disease are already in the soil or are introduced into it on the seed tubers. This seems to be due to the fact that the lime makes the soil alkaline, or to some influence which the combined carbonic acid of the carbonate of lime exerts upon the development of the fungus.

In view of this unfavorable action of lime caution should be observed in liming potato fields in the manner suggested on a previous page.

CLUB ROOT.—Many writers seem to agree that liming is capable of lessening materially the injury to turnips, cabbages, etc., caused by the disease known as "finger-and-toe" and "club root." English writers assert that by resort to liming excellent crops of turnips have been produced where without it the crop was a failure, owing to the attacks of the disease.

OTHER DISEASES.—The effect of different compounds of lime has been tested, with not entirely conclusive results, on various other diseases, including cranberry and sweet potato diseases, and a root disease of alfalfa (*Rhizoctonia medicaginis*). Slaked lime was found to be effective in reducing soil rot of sweet potatoes, and quicklime in checking or preventing the root disease of alfalfa.

HOW OFTEN SHOULD LIMING BE PRACTISED?

The frequency with which liming should be practised depends upon several conditions; for example, upon the character of the soil, the quantity of lime employed in each application, the number of years involved in a rotation, the plants to be grown and their order of succession. Formerly, in England, large quantities of lime were applied at somewhat rare intervals, but there and elsewhere at the present time the preferable practice seems to be to use small amounts and apply it more frequently. As a general rule it may be stated that from half a ton

to one and a half tons of lime per acre applied every five to six years is sufficient. There may exist extreme soils requiring either more or less than these amounts. If soils which are quite acid and have not previously been limed are to be seeded, with the intention of allowing them to remain in grass for several years, as much as two or three tons of lime per acre may sometimes be advisable. Only very extreme cases would call for larger applications. If in a rotation covering a considerable number of years two crops especially benefited by lime are introduced at about equidistant intervals of time, it may be advisable to lime twice in the course of the rotation, each time just prior to their introduction. In renovating acid pastures and meadows it is usually preferable to apply a fair amount of lime upon the furrows when they are first plowed, so that this may be thoroughly mixed with the soil by subsequent plowing and harrowing, and just prior to seeding to grass make another generous application. By such treatment, provided the other essential fertilizing ingredients are employed, a good stand of clover, Kentucky blue-grass, timothy, and other grasses may be obtained where in many instances they were formerly partial or total failures and where only redtop, Rhode Island bent, and grasses having similar soil adaptability could be grown. Where land is kept in grass for a number of consecutive years, top-dressing with lime or, preferably, wood ashes may possibly be advisable in some instances, particularly if ordinary commercial fertilizers are employed in lieu of stable manure. If home-mixed dressings containing basic slag meal or liberal amounts of bone are used with nitrate of soda or nitrate of potash, the need of liming is much less than under many other circumstances.

WHEN TO APPLY LIME.

Lime in the form of carbonate of lime, as in marl, wood ashes, etc., can usually be applied with safety in the spring or at any other season of the year, but autumn is always the safest time to apply caustic or slaked lime. The latter form upon further exposure to the air changes gradually into the mild carbonate of lime, but usually a considerable quantity has not reached that stage when applied, and it may in consequence act too energetically. This is particularly true if the soil is light and sandy, and if plants, which are but little helped by lime, are employed. On very acid soils, particularly such as contain much humus, there is little or no danger from applying reasonable quantities of lime in the spring. If caustic or slaked lime is applied in excessive amounts it may not only injure plants directly, but also indirectly by rendering the texture of the soil unfavourable; it may also make the soil temporarily so alkaline as to interfere with the activity of the organisms which transform ammonia into readily assimilable nitrates. Injury thus arising cannot ordinarily be of long duration, for the reason that the carbonic acid of the soil changes the caustic lime rapidly into carbonate of lime, and thus the alkalinity of the soil is soon reduced.

HOW TO APPLY LIME.

Some writers recommend that upon old mossy meadows and pastures lime should be applied to the surface before plowing, in order that it may help to quickly decompose the organic matter. The chief objection to this procedure is that the lime does not become well incorporated with the soil, and since some of it is turned to the bottom of the furrow and its tendency at all times is to work downward, it may be quickly carried not only away from the surface soil, but also from the reach of plants. The practise of liming such soils immediately after plowing and then thoroughly harrowing has been attended by excellent results. This is particularly the case provided a second application is made in a similar manner just previous to re-seeding. Under such a plan some lime becomes intimately mixed with the entire mass of soil by the operations of tillage, and finally a considerable amount is left near the surface, thus accomplishing two important objects.

In some sections where marl is used extensively it is spread upon the surface and plowed under, turning a furrow about 2 inches deep. The more common method where marling is practised is to plow the land and then cart on the marl, dumping it in heaps at such intervals that it can be spread conveniently with a shovel. If the marl is not sufficiently fine, but is of such a nature that it crumbles upon exposure to the air, the heaps may be allowed to remain for some time before spreading, and still further time may be allowed to elapse before the operation of harrowing is begun. Sometimes a "clod crusher" or "bush harrow" may be employed to advantage to break up the lumps before harrowing. A most important point to be observed in applying lime of all kinds is to mix it with the soil as thoroughly as possible, the finer the particles the better being the result.

PULVERIZED BURNED LIME or lime which is already slaked may be spread upon the soil directly from wagons or carts, or dumped in heaps and then spread with a shovel, though the most satisfactory plan in such cases is to employ an ordinary grain drill with fertilizer attachment or a lime spreader. In the use of such spreaders it is generally advisable to attach some burlap or old bagging to the sides and rear of the machine in such a way that it will trail upon the ground. If the machine is so equipped and the burlap is weighted with a piece of wood at the rear, much of the unpleasantness connected with spreading lime is avoided. For those familiar with the nature of lime and its use it is unnecessary to state that it is well, if possible, to apply it on a quiet day. The eyes may be protected by glasses and the nostrils and mouth by devices used by those who run thrashing machines.

The only other form of lime in connection with the application of which any particular difficulty might be encountered is quick or burned lime in lump form. Where only small quantities of such lime are to be used it is frequently immersed for a moment in water, in a basket, and emptied into a wagon body. The following day it will be slaked sufficiently for use. Where larger quantities are used, and a lime spreader is at hand, the lime is sometimes water slaked in large piles on the border of the field and then distributed. To accomplish the water slaking in a satisfactory manner, from 2 to $2\frac{1}{2}$ pails of water should be sprinkled over each cask of lime as it is emptied upon the pile, and finally the whole mass should be very thoroughly covered with soil. In a few days practically all of the lime will be in a fine condition suitable for spreading. In loading it into the spreader care should be taken to first remove the soil, so as to avoid its clogging the machine. If the lime spreader itself is not fitted with a screen, the lime should first be carefully screened for the purpose of removing any hard lumps which may remain, due to imperfect slaking or burning. These lumps may be further slaked by themselves.

A practise preferred by many, and probably the most feasible one where a lime spreader is not to be had, is to place the burnt lime in piles of from 35 to 40 pounds each at suitable intervals (heaps of this size 20 feet apart in each direction furnish about 2 tons per acre), and cover the piles with moist earth. In a few days the lime is so thoroughly slaked that it can be spread directly with a shovel. Provided the soil is dry, from one-fourth to half a pail of water (or in extreme cases even more) should be sprinkled over each pile immediately before it is covered with earth. In this case, as in all others where slaked lime is employed, it is important that it be harrowed into the soil immediately after spreading. In no case should it be exposed long to the air before harrowing, as it is liable to cake and form a sort of mortar to such an extent that it is impossible to mix it as thoroughly with the soil as before.

FORMS OF LIME USED FOR AGRICULTURAL PURPOSES.

CAUSTIC ("QUICK" OR "BURNT") LIME obtained by burning oyster shells, limestone, etc., is the most economical form in which lime can be bought, in all

cases where the distance of railway transportation or of cartage is great. One hundred pounds of such lime usually contain about 95 pounds of actual lime. Sometimes burned lime contains considerable magnesia, a point which has already been considered.

According to Roberts, "when first moved from the kiln, lime weighs about 75 pounds to the heaped bushel; that from shells weighs less than that from limestone. A ton of limestone converted into caustic lime (CaO) weighs between 1,100 and 1,200 pounds; hence it is economy to burn the lime near where the stones are quarried, since it weighs but three-fifths as much as limestone. In slaking, lime takes up considerable quantities of water; hence a ton of slaked or hydrated lime contains really but three-fourths as much lime as a ton unslaked. A heaped bushel of unslaked lime makes 1½ bushels of slaked lime;* therefore it should be transported before it is slaked. When caustic lime is exposed to the air for some time it absorbs both moisture and carbon dioxid from the atmosphere and becomes air-slaked lime. By still longer exposure it may all change into carbonate of lime, the same form as before burning. It is, however, much finer than ground limestone." Lime made from oyster shells and magnesian limestone weighs less per bushel than that made from the purer kinds of limestone.

Gypsum, or Land Plaster, is a combination of lime with sulphuric acid (oil of vitriol) and water. Upon heating, gypsum loses its water and is changed into plaster of Paris or calcined plaster, which is used in making casts and for many other industrial purposes.

In case a soil is seriously deficient in lime, gypsum may act as a direct manure; usually, however, its beneficial effect upon soils is attributed to its indirect action in liberating potash, and possibly other substances, which were locked up in the soil in such combinations that plants could not make use of them. Gypsum may be helpful to a limited extent on clayey soils by flocculating the fine particles, on account of which the soil is less likely to become "water-logged" and to cake, and hence interfere with the operations of tillage. In the last-mentioned respect water-slaked lime or the carbonate is said to be much more efficacious than gypsum, though as a liberator of potash gypsum is claimed to lead.

It is stated on good authority that, in the presence of decaying organic matter, gypsum may be changed into carbonate of lime. While this may be true under certain circumstances, in experiments at the Rhode Island Station on a soil exceptionally rich in humus and containing a moderate amount of plant residues which were undergoing decomposition, such a change did not result, if at all, to a practical extent. For this reason and on account of the fact that gypsum contains only about one-third as much lime as burned lime, and usually costs as much or more per ton, it cannot take the place of the latter for most of the purposes for which lime is applied to land.

For use in renovating "black alkali" (sodium carbonate) soils in the arid regions, gypsum, as already explained, performs a valuable function which can not be filled by any of the other compounds of lime.

Chalk is a naturally occurring form of carbonate of lime which is exceptionally pure. It is quite soft, and is frequently referred to as marl.

Marl is a name which is applied to earthy deposits usually more or less friable in their character and containing carbonate of lime in quantities ranging usually from 5 to 95 pounds per 100 pounds of the material. It must be evident, therefore, that if one intends to make use of a given deposit of marl for the lime contained in it, he should first have a sample of it analyzed.† If the material will

* A bushel of air-slaked lime is usually considered to weigh 50 pounds.

† The Experiment Stations in the different States would probably undertake to do this free of cost.

not effervesce upon the addition of either hot or cold vinegar, it probably contains but little carbonate of lime and may be of doubtful value. This test, however, should precede, and not be sustituted for, a careful chemical analysis.

On account of the varying chemical composition of marl, it must be obvious also that no definite rules as to the amounts which should be used in given cases can be stated. On a soil where one has reason to think a ton of burnt lime should be applied per acre, about 4 tons of a marl containing from 20 to 25 per cent of actua lime (calcium oxid) should be employed. If the marl is twice as rich the amount applied should be but 2 tons, etc.

Marls vary somewhat in their physical characteristics, depending upon the amounts and character of the earthy material associated with the carbonate of lime, If the marl is associated with clay it is exceptionally well adapted for use on sandy soils, since the clay and carbonate of lime both tend to make such soils more compact and rententive of manures and moisture. A marl containing sand would, on the other hand, be better suited to clayey soils. According to Heinrich, sand marl may be applied to the soil immediately, but clay marls sometimes contain injurious compounds of iron and sulphur, in which case it is not safe to use them until they have been composted for two or three years, or long enough to effect the decomposition of the iron compound.

Some so-called marls contain considerable quantities of phosphoric acid and potash in such forms as to greatly enhance their fertilizing value.

PHOSPHATE OF LIME is found as bone, guano, apatite, and in the form of the well-known South Carolina, Florida, and Tennessee phosphate rock. The better classes of phosphate rock contain but small quantities of carbonate of lime, while others contain large amounts. The latter are unfitted on this account for superphosphate manufacture. Both classes of phosphate when ground finely have been found to be more or less effective upon acid soils, particular attention having been devoted to their employment on acid muck or peat soils. These phosphates not only seem to materially reduce the acid character of such soils, but after having been in contact with them for some time the assimilability of the phosphoric acid seems to materially increase. The lower-grade phosphates containing considerable quantities of carbonate of lime are particularly effective upon acid soils.

In employing undissolved phosphate rock upon acid soils, certain authorities recommend following the application of the phosphate at an interval of some months, or, if possible, a year, with a dressing of lime. This seems to be a reasonable recommendation provided the plants to be grown are not injured by soil acidity.

SUPERPHOSPHATES, which are prepared by treating phosphate rock, bone, and boneblack with sulphuric acid, generally have about one-third of their lime combined with phosphoric acid and two-thirds with sulphuric acid. The lime combined with sulphuric acid is nothing more nor less than gypsum (land plaster). For this and other reasons superphosphates may not work as well on acid muck or peat soils as ordinary undissolved phosphate rock or ground bone, and if, as is sometimes the case, a slight excess of sulphuric acid is present they may even have a temporary injurious action upon upland soils which are deficient in carbonate of lime.

BASIC SLAG (THOMAS SLAG OR SLAG MEAL) is a waste product obtained in the manufacture of steel. It contains relatively more lime than the ordinary high-grade phosphates, and the phosphoric acid in most cases (a few works have put an inferior product on the European market) is possessed of a high degree of assimilability. This product is as yet too little known in this country, and if sold here as cheaply as it might be it would doubtless prove of great value to our

agriculture. It is an effective source of phosphoric acid for use upon all kinds of soils, and on account of its high percentage of lime it is of special promise in the reclamation not only of acid upland soils, particularly if rich in organic matter, but also of marsh or muck soils.

Unleached Wood Ashes contain about 35 pounds of actual lime (calcium oxid) in every hundred, 3 tons being, therefore, a little more than equivalent, in lime, to 1 ton of burned lime. They also contain from 5 to 7 per cent of potash, 1 to 2 per cent. of phosphoric acid, and from 3 to 5 per cent. of magnesia. This latter ingredient, though usually ignored, is of approximately as much value as lime on acid soil. Soils are sometimes deficient in magnesia, and when this is the case the magnesia applied in ashes has a direct manurial action.

Leached wood ashes contain usually less than 1 per cent. of potash and rather more lime than unleached ashes. Frequently they are sold in a wet condition, which of course lessens the quantity of actual lime present in a ton.

Limekiln Ashes often contain approximately 40 per cent of lime, and when wood is employed in the burning instead of coal they sometimes contain 2 per cent or more of potash.

Finely Ground Limestone and Oyster Shells can be used to advantage, if obtainable, especially upon sandy soils. They are not as efficacious as after burning upon heavy clay soils, and such soils, as are very acid and contain large amounts of sour humus. This is for the reason that they are not so active chemically, and they cannot be reduced to so fine a state before burning as afterwards.

Dye-house Lime usually contains only a small percentage of lime, and if moist cannot be transported long distances at a profit. A rule that applies well to this and all other waste products of a similar character is not to use them until they have been subjected to chemical analysis, for by changes in the processes of manufacture their value may be materially influenced and substances injurious to vegetation may have found access to them.

Gas-house Lime.—It is never safe to use this substance until it has first been allowed to weather for several months. On acid soils such lime is less effective than burned lime, wood ashes, and limekiln ashes. Owing to recent changes in the process of gas manufacture, lime is used less than formerly.

Waste Lime from Beet-sugar Factories may be effectively applied to soils after it has been allowed to dry. It contains some potash, phosphoric acid, and nitrogen, which still further increase its value. If this material is applied to the soil in a wet condition it tends to cake in the same manner as water-slaked lime does when not immediately worked into the soil. It is sometimes put in piles by itself and worked over every few weeks. It may also be dumped in the field during the winter in small piles, where it is allowed to remain until spring, when, after drying sufficiently, it may be spread and incorporated with the soil. According to Heinrich, this material contains: Water 35 to 60 per cent; nitrogen, 0.1 to 0.4; potash, 0.1 to 0.3; phosphoric acid, 0.5 to 1.5, and lime, 15 to 30 per cent. It is evident that this waste material in its moist condition could not be transported to any considerable distance at a profit, and in this country, where labor is such an important item, it would not pay to shovel it over much in order to get it into condition to use.

Waste Lime from Soda-ash Works usually contains considerable water, and can for this reason only be employed to advantage where the cost of transportation is small. If some economical means of drying it could be devised, the range of distance to which it could be profitably shipped would be much increased.

From the preceding statements regarding the different kinds of lime used for agricultural purposes. it is evident that it is impossible to state definitely for all locations and conditions which kind is most economical to employ. This is still more evident when one considers that the character of the soil and of the crop to be grown, as well as the market prices, must be taken into account. Caustic or quick lime is the most concentrated, and consequently the most economical to handle. Its caustic properties, however, render it more vigorous in its action than the milder sulphate (gypsum) or carbonates (limestone, chalk, wood ashes, marl, etc.), and thus better suited for application to soils which are rich in organic matter than to light soils deficient in this substance. It is also specially suited to correcting acidity in sour soils. There may be special reasons in particular cases why some of the other compounds of lime are preferable to quicklime. Gypsum has been used in agriculture to a considerable extent with very satisfactory results, On account of its peculiar composition it has been found especially valuable for neutralizing sodium carbonate (black alkali) in alkali soils. Wood ashes are used extensively in some localities, in many cases as much for the lime as for the potash which they contain. It is very doubtful, however, whether it would not be more economical at the present prices of wood ashes and caustic lime to employ the latter in many cases, supplementing the lime with potash salts and other fertilizing materials if the latter are required by the soil.* The item of transportation is also decidedly in favor of the use of lime and agricultural chemicals as substitutes for ashes.

SUMMARY.

The use of lime as a soil improver is very ancient, and its value for this purpose is generally recognized. Its action as a fertilizer is both direct and indirect.

There are many soils in which lime is deficient, notably such as are derived from granite, mica-schist, and certain sandstones, slates, and shales. On such soils lime is often of direct value in supplying a necessary element of plant food.

The indirect value of lime is perhaps more important than its direct action, because probably the majority of cultivated soils contain sufficient lime to meet the direct demands of plants for food. Lime is of indirect value in unlocking the unavailable potash, phosphoric acid, and nitrogen in the soil.

Lime exerts a decided influence on the mechanical condition of soils, rendering heavy compact soils looser in texture and tending to bind particles of loose leachy soils.

Lime is also beneficial in furnishing conditions in the soil favorable to the activity of the micro-organisms which convert the nitrogen of organic matter into nitrates which are readily assimilated by plants, which decompose organic matter, and which assist certain leguminous plants to assimilate the free nitrogen of the air.

Lime is also beneficial in furnishing conditions in the soil favourable to the activity of the micro-organisms which convert the nitrogen of organic matter into nitrates which are readily assimilated by plants, which decompose organic matter, and which assist certain leguminous plants to assimilate the free nitrogen of the air.

One form of lime, gypsum, has been shown to be a most effective corrective of black alkali, found in some of the soils of the arid portions of the United States.

The continued use of lime unaccompanied by other fertilizers may prove injurious, especially on poor soils, since it converts the insoluble nitrogen, potash, and phosphoric-acid compounds of the soil into such as can be rapidly taken up by plants or washed out in the drainage, thus hastening the exhaustion of the supply of these substances in the soil. As the German adage states, "The use of lime without manure makes both farm and farmer poor." If the soil is not abundantly

* U.S. Dept. Agr., Farmers' Bul, 65, p. 24.

supplied with organic matter, its retentive power for water and fertilizers may be seriously reduced on account of the destruction of the organic matter by the action of too much lime. Soils may sometimes be injured by applications of impure forms of lime, which harden like cement in the soil, or of those which contain an excessive amount of magnesia.

It has been shown that even upon many upland and naturally well-drained soils apparently in good condition otherwise, the sourness (acidity) is so great that most varieties of plants will not thrive. Lime is the most economical and effective substance thus far used for correcting this condition. According to experiments made by the Rhode Island Agricultural Experiment Station on acid soils in that State, the plants tested may be classified with regard to their behaviour toward lime as follows: *Plants benefited by liming*—spinach, lettuce (all kinds), beets (all kinds), okra (gumbo), salsify (vegetable oyster), celery, onion, parsnip, cauliflower, cucumber, eggplant, cantaloupe, asparagus, kohl-rabi, cabbage, dandelion, Swedish turnip, pepper, peanut, English or flat turnip, upland cress (pepper grass), martynia rhubarb, common pea, pumpkin, summer squash (scalloped), golden wax bean, red Valentine bean, horticultural pole bean, bush Lima bean, lentil, Hubbard squash, saltbush, hemp, tobacco, sorghum, alfalfa, clover (red, white, crimson, and alsike), barley, emmer, wheat, oats, timothy, Kentucky bluegrass, Canada pea, Cuthbert raspberry, gooseberry, currant (White Dutch), orange, quince, cherry, Burbank Japan plum, American linden, American elm, sweet alyssum, mignonette, nasturtium, balsam, pansy, poppy, and sweet pea; *plants but little benefited by liming*—Indian corn, spurry,* rye, carrot, chicory, Rhode Island bent, and redtop; *plants slightly injured by liming*—cotton, tomato, cowpea, zinnia, phlox (Drummondi), Concord grape, peach, apple, and pear; *plants distinctly injured by liming*—lupine, common sorrel (*Rumex acetosella*), radish, velvet bean, castor bean, flax, blackberry, black-cap raspberry, cranberry, Norway spruce, and American white birch. Other plants said to be injured are the chestnut, azalea, and rhododendron.

Many kinds of lime are available for agricultural use, among which are caustic or burnt lime, or quicklime, which should contain at least 90 per cent of actual lime (CaO) and is the most concentrated form of this material; gypsum, or land plaster, in which the lime is in the form of the mild sulphate; ground limestone and chalk, in which the lime is in the form of the mild carbonate; different kinds of marl, containing varying proportions of sand and clay and from 5 to 95 per cent of carbonate of lime; wood ashes, which contain from 30 to 35 per cent of lime in the form of carbonate; limekiln ashes, containing about 40 per cent of lime; and waste lime from gas houses, sugar-beet factories, etc., the composition of which varies with the process of manufacture.

It is impossible to state definitely for all locations and conditions what kind of lime is cheapest to use. Caustic or quick lime is the most concentrated and consequently the most economical to handle. On account of its caustic properties it is more vigorous in its action than the milder sulphate (gypsum) or carbonate (limestone, chalk, wood ashes, marl, etc). There may be special reasons, however, why some of the latter may be preferable. For instance, gypsum, on account of its peculiar composition, has been found to be a specially valuable corrective of black alkali.

The frequency with which liming should be practised depends, among other things, upon the character of the soil and the rate of application, the number of years involved in the rotation practised, the plants grown and their order of succession. As a general rule, it may be stated that from ½ to 1½ tons of lime per acre every five or six years is sufficient. Applications of 2 or 3 tons may, however, be

* It has been reported in England that spurry is injured by liming, but such results have not been obtained in Rhode Island.

advisable in cases of very acid soils which are to be seeded down and are to remain in grass for several years. The practice of applying small amounts of lime at somewhat frequent intervals is being generally accepted as preferable to the use of large amounts at rare intervals.

Lime combined as carbonate, as in marl, wood ashes, etc., can usually be applied with safety in the spring or at any other season of the year, but autumn is always the safest time to apply caustic or slaked lime. It is generally considered best to apply the lime to the soil immediately after plowing and harrow it in thoroughly. Lime which is already slaked may be spread upon the soil directly from wagons or carts, or dumped into heaps and then spread with a shovel, although the most satisfactory plan in such cases is to use a lime spreader or ordinary grain drill with a fertilizer attachment. Where a lime spreader or similar implement is not available the burnt lime may be placed on the soil in piles of from 40 to 50 pounds each, covered with moist earth, and allowed to slake before being spread with a shovel. Marls frequently contain injurious compounds and should therefore be allowed to weather for some time in the field before being incorporated with the soil. The same is true of gas-house lime, which is impregnated with sulphur compounds which are injurious to plants.

In conclusion it may be said, ascertain first whether lime is needed. If it is, apply it judiciously, and never depend upon lime alone to maintain the fertility of the soil, for all of the ingredients which plants need must be present in the soil to insure the profitable production of crops.

HORTICULTURE.

Seasonal Notes for March.

By H. F. Macmillan.

(Illustrated by the "Candle Tree:" *Parmentiera cereifera*, Seem.)

Rainfall in inches:—Peradeniya 4·49; Colombo 4·75; Ratnapura 8·96; Galle 4·27; Trincomalie 1·60; Jaffna .95.

At no other period of the year are gardens in the lowcountry subject to such apparent drawbacks as during the month of March. The oppressive weather prevalent then is not only unpleasant to ourselves, but also unfavourable to such horticultural pursuits as afford us most pleasure or profit. At the time of writing, middle of February, signs of the dry weather are already evident. The lawns are turning brown, and general foliage plants assume a parched and dusty appearance. With wonderful regularity various trees now assume distinct but unaccountably varied seasonal characteristics; some completely shed their leaves, others suddenly change their old for new foliage, whilst others drop their leaves, and at once burst forth into a profusion of blossom. The tall and stately Red Cotton trees (*Bombax malabaricum*), bare of leaves but covered with scarlet flowers, now become conspicuous objects in the landscape; the shuttlecock-like flowers, whose fleshy calyces are eaten by many people in India and Burma, form when they drop a beautiful red carpet under the trees. Ceara-rubber trees (*Manihot Glaziovii*) usually shed their leaves and remain bare for about three weeks, whilst many of the older Hevea (Para-rubber) trees also become almost defoliated before developing flowers.

Fruits in Season.—The season for most fruits is not yet commenced, but the following may be obtained in limited quantities: Pineapples, Pomegranates, Bullock-hearts, Bael-fruit and Wood-apple. Of less well-known fruits the West Indian "Star-apple" (*Chrysophyllum Cainito*), the South American "Mammee-apple" (*Mammea americana*) and the Coco-plum (*Chrysobalanus Icaco*) ripen their crops at this period.

Flowers in Season.—Some of the most beautiful of flowering trees confine their annual display of blossom to February and March. Conspicuous examples of these are *Tabebuia speclabilis*, a small shrubby tree of tropical America with masses of bright yellow funnel-shaped flowers; *Cassia grandis* or "Horse Cassia," also of South America, with a profusion of delicate pink blossoms; *Saracca declinata*, a Malayan tree with most handsome, large heads of orange-yellow flowers, produced on the stem and older branches. The *Jacaranda mimosaefolia*, a small tree with blue to violet flowers, *Amherstia nobilis* of Malaya (considered the most beautiful of flowering trees), and the gorgeous "Flamboyant" (*Poinciana regia*) are now in their full glory. Some of the Sterculia family also afford a striking floral display at this season, notably *Sterculia colorata*, an indigenous tree from the drier parts of Ceylon, said to be sacred to the Veddahs, and *Sterculia acerifolia*, known as the Australian "Flame Tree." *Myriocarpa longipes* is a shrubby tree from South America with very large handsome hispid leaves, which is now a striking object on account of its peculiar inflorescence: this consists of numerous delicate thread-like strands, 2½ to 3½ feet long, which hang gracefully from the branches, each strand bearing countless minute flowers. Amongst ornamental trees some are undoubtedly more attractive in fruit than in flower. Few objects for instance in the vegetable kingdom are more striking when in fruit than the curious "Candle Tree" (*Parmentiera cereifera*) introduced from tropical South America. The fruits resemble wax-candles so closely that the uninitiated may at first readily believe that the tree exists for the sole purpose

of producing these. According to *The Treasury of Botany*, "a person entering a forest of these trees almost fancies himself in a Chandler's shop." The fruits, which are very juicy but almost tasteless, are said to be eaten in their native country. The "Necklace Tree" is a name given to *Ormosia coccinia*, a tall leguminous tree which bears at this season fairly large and very pretty seeds which, when ripe and dry, are hard and of a bright red colour, blotched with black or brown, with a shiny surface. These are always appreciated as curios, and the natives make fancy buttons, necklaces and ornaments of them.

GENERAL.—Watering, mulching and judicious shading should be the order of the day. Artificial watering, which is now indispensable, will quickly crust the earth in beds and borders unless the soil is covered with mulch or stirred frequently. Always remember that keeping the surface soil loose is the surest means of lessening the evaporation. Needless to say watering as a rule should be done late in the afternoon, never when the sun is shining on the plants. Any renovation of plant-houses, shelves, &c., or repairs to paths and drives should now be undertaken.

Seasonal Gardening Notes for the Hill Districts.

BY. J. K. NOCK.

The routine work is much the same as that given for last month. Some of the annuals and other flowering plants will be ripening their seeds which should be collected and sown from next month onwards, for the upkeep and partial replanting of the beds and borders, which will become necessary after June if a good appearance is required during August to October.

April (next month) being about the most suitable month for sowing grass seed to form a lawn, those intending to do this should at once see to the final preparation of the ground. Taking for granted that the drainage has been made perfect—the most important matter, for a lawn cannot be made on ground where water does not run off freely—the soil levelled, and that it is in a good fertile condition, or has been made so by the addition of *well rotted manure* (fresh manure should on no account be used, for it tends to make the soil hollow) or one of the mixtures of artificial manures specially made up and prepared for the purpose by such a firm as Messrs. Freudenberg & Co., Colombo, the next thing to be considered is weeds. The only satisfactory way to rid the soil of weed seeds is to burn it. If this has been done the few that will invariably come up must be constantly pulled up by the roots until it is safe to assume the land is quite clean. It is useless to sow grass seed where weeds are likely to come up in numbers, for they rob the soil of its moisture and fertility and choke out the grasses which, it must be remembered, are to be a fixed crop and obtain their nourishment from a few inches near the surface only. Delay the sowing until the ground is clean, for it will pay in the end, though it may be annoying to see the season passing away. The soil must be thoroughly firm and the surface friable, as if covered by clods the seeds will not germinate; frequently using the rake to get out all stones from the top three or four inches, and after each raking put on the roller. There should be two sowings to ensure even distribution of the seed, making the second one cross the first at right angles. It must be done on a quiet day, keeping the hand low, as the seed is small and easily blown away in light wind. Rake the whole plot to lightly cover with soil as many seeds as possible, and then roll once each way. The quantity should not be stinted—three to four bushels are required for an acre, never less, as the crowding of the plants gives a desirable finer herbage. Keep the land

firm by frequent use of the roller. The month chosen should be showery, and artificial watering therefore unnecessary. Early cutting greatly benefits the grasses as it encourages the roots to tiller out. For the first few times a scythe should be used and then the mowing machine. Roll and mow, roll and mow, and a fine sward will be obtained. Constant mowing checks weeds, but any that may spring up should be rooted up.

VEGETABLE GARDEN.—Cabbage, *Brassica oleracea*, L. native of Europe and belonging to the natural order Cruciferæ, is the commonest English vegetable cultivated in the hills, and may be grown all the year round, but unfortunately results are now disheartening in the majority of the gardens on account of the prevalence of "Club Root," which often destroys more than fifty per cent. of the crop, and I would draw attention to the notes by the Government Mycologist on this subject which appeared in the January number of this Magazine. In some gardens this plague is happily unknown, and where this is the case every attempt should be made to keep it away by good cultivation of the soil, *i.e.*, deep digging, liberal applications of manure and lime, changing the crops to different spots as much as possible, and by avoiding the fatal step of getting young plants from a garden where it is known to exist. If it makes its appearance the best plan is to pull up and burn the plants, lime the land, and grow no more cabbages, turnips, &c., on the infected spot for several years. The use of a crucifer as a "trap crop" is given in the notes above referred to by the Government Mycologist. For general purposes ordinary soil with manure well worked in will grow good cabbages, but it can scarcely be made too rich for any of the cabbageworts. Sow the seeds monthly in a prepared bed and prick out as soon as possible, and when they begin to overcrowd each other lift carefully with a ball of earth attached to the roots and plant out in their intended situations. The distances at which they should be planted depends on the kind: for the smaller sorts one foot apart in rows fifteen inches apart will suffice, and for the larger two feet each way. Hoe the ground frequently. Liquid manure will greatly help the plants. The following good kinds are taken from Messrs. Sutton & Sons' catalogue:—"All Heart," "Imperial," "Summer Drumhead," and "Flower of Spring."

Poultry Notes.

By G. W. Sturgess, M.R.C.V.S.

DISEASES OF POULTRY.—(*Continued.*)

Apoplexy.—This disease sometimes occurs amongst very fat, overfed poultry, especially where exercise is limited.

Symptoms.—The principal symptoms are sudden giddiness—the bird turning round and round—or, it may be such a severe attack that the bird falls over and loses consciousness at once, and may die before any treatment can be adopted. Hens may be found dead on the nest, the attack probably being excited by the exertion of laying. It may also come on after being chased by a dog, or after a fight. The disease may be suspected when a bird in very good condition suddenly dies without apparent reason.

Treatment.—If there is a chance of treatment cold water or ice should be applied to the head and some blood abstracted by cutting the large vein under the wing, or, cutting a bit of the comb off. If consciousness returns a dose of physic should be given (Epsom salts) and the bird placed in a dark box and fasted for a day, giving only water to drink. The diet should then be light and laxative for some days. Attention should be given to the other poultry, the diet reduced and Epsom salts placed in the drinking water for a day or two and exercise and green food given.

Baldness.—This condition may be due to bad hygienic conditions or to parasites or feather-eating by one or more of the bird's companions. If due to unhealthy surroundings—light, air, good food and exercise are indicated. If insects, a mixture of kerosine oil and sweet oil or vaseline may be applied. In the case of feather-eating the culprit must be watched for and removed from the pen or killed.

Bronchitis, and Catarrh or Cold.—*Causes.*—Cold, change of weather or climate. The disease is common amongst newly-imported birds.

Symptoms.—Sneezing or cough, discharge of matter from the nostrils, more or less difficult breathing with a gurgling sound in the throat, caused by excess of mucus.

Treatment.—The affected birds must be placed in a warm box or in a room of even temperature and protected from draughts. Warm soft food should be given, such as the ordinary mash with boiled cabbage, bread damped with milk or soup. Grit should be provided and a little coarse oatmeal may be thrown down for the patients to pick up if they desire. A few drops of turpentine or eucalyptus oil, or both, may be placed on a piece of flannel in a cup, and boiling water poured on and the birds made to inhale the steam twice a day or a steam kettle used. The following medicines may be given:—

1. Tincture of Belladonna	1 drop
Eucalyptus Oil...	1 ,,
Camphor	1 grain
Salad Oil	½ teaspoonful

Mixed—given once or twice a day, or

2. Paregoric 5 or 10 drops twice or three times a day may give relief.

All discharges should be removed from the nostrils and mouth by sponging daily with warm water containing a little alum or boracic acid and a little iodoform dusted on the nostrils externally.

If recovery follows, care must be taken in letting out again in the fresh air to avoid a chill and relapse which would most likely end fatally.

Good nutritious food is necessary after recovery, and a little tonic medicine such as Parrish's Syrup or Sulphate of Iron may be given with great advantage.

The Literature of Economic Botany and Agriculture, II.

CACAO: GENERAL:

Het schaalgehalte van cacaozaaden van verschillende origine. Ind. Mercuur, 17 Dec. 1898.

Cacao in Trinidad. Plant. Opinion, 18 Mar. 1899. p. 212.

Cacao Analyses (by Cochran) Report P. A., Ceylon, 1899.

Analyses of Samples of Cacao. "T. A.," Jan. 1900, p. 467.

Johnson: Hints on the Cultivation and Preparation of Cacao. Ind. Gard. and Pl. Apr., 1900, p. 225.

L'Industrie agricole de Cacao (meeting of Trinidad Committee). Rev. d. Cult. Col. VI. 1900, p. 176.

Cacao in Trinidad. do. p. 331.

Export Figures for different Countries. Tropenpflanzer, 1900, p. 465.

Open Letter to a small Cultivator of Cacao. Jamaica Bull., 1900, p. 121.

Cacao Industry in Grenada &c. West Indian Bull. I. p. 415.

See Just's Jahresbericht, 1898, II., p. 94, 1899, II., p. 83 and later years.

Cacao Pods and their Seed. Carruthers in "T. A.," Apr., 1901, p. 655.

Some Conditions of Cacao attendant on the Growing of Suckers. "T. A.," July 1901, p. 39.

Cacao, Chocolate, &c. Trinidad Bull. 1901, p. 348.

Bulletins of Salatiga (Java) Procfstation voor Cacao.

Les Balais de sorcières du Cacao. Journ. d'Agr. Trop., I., p. 72.

L'Agriculture sur le côte est de Madagascar. Prudhomme. Library R. B. G., N. 6. p. 35.

Exports from Kamerun. Tropenpflanzer, 1902, p. 248.

Cacao and its Adulteration. "T. A.," July 1902, p. 68.

Cacao in Trinidad and Grenada. Jamaica Bull. 1903. p. 73.

Production et Consommation de Cacao. Rev. d. Cult. Col. Mai., 1903, p. 332.

U. S. A. Imports of Cacao. Plant Opinion, 1903, p. 690.

Packing seed for Travelling. L'Agr. Prat. des Pays Chauds. 1903, p. 232.

Cacao in Trinidad. do. p. 266.

Cacao Production and Consumption. Agr. News, Apr. 1904.

Cacao Planting in Samoa. Imp. Inst. Bull. Mar. 1904, p. 53.

Cacao Industry in the West Indies. Agr. News, Sept. 1904, p. 305.

The Cultivation of Cacao in Colombia. do. p. 311.

Cacao Industry in the West Indies. West Indian Bull., V., p. 172.

Productie en verbruik van Cacao in 1903-4. Ind. Mercuur 1905, p. 1.

On the varieties of Cacao existing in the Royal Botanic Gardens and Experiment Station at Peradeniya. Circ. R. B. G., II., p. 24, Oct. 1904 p. 385.

The Chemical and Physical Properties of the Soil from the Cacao Plots at the Experiment Station, Peradeniya. do. III. p. 3, July 1905, p. 29.

Le Cacao au Congo (Jard. d'Essai). Bull. Jard. Col. 4, 1904, p. 296.

Importance commerciale du Cacao pour la France et ses Colonies. Bull. Gard. Col. 6, 1906, p. 84.

Cacao at the Agricultural Conference, Trinidad. Jamaica Bull., 1905, p. 185.

Die Kakao-kultur und der Kakao-handel Niederlandisch-Indiens. Tropenpflanzer, 1904, p. 453.

Cacao on the Gold Coast. Grüner in do. Aug., Sept., Oct., 1904.

CACAO: CULTIVATION (& cf. GENERAL.)

Grafting Cacao. Hart in "T. A.," Dec. 1898, p. 432.
Grafting (details). Rev. d. Cult. Col., Oct. 1899, p. 205.
Cacao Culture in Ecuador. Plant. Opinion, Dec. 1899, p. 1018.
La culture du Cacaoyer à la Martinique. Rev. d. Cult. Col. VI. 1900, p. 137.
Grettage et varieties de Cacao. Do. 1900, p. 522.
Serpes à Cacao. Joun. d'Agr. Trop. I., p. 103.
Grafting Cacao (on Theobroma bicolor). Trinidad Bull., Jan. 1902, p. 413.
Mulching and effect of Earthworms. do. Apr., 1902, p. 419.
Grafting on Herrania Albiflora. do. do. p. 431.
Castilloa as Shade for Cacao. Agr. News I. p. 21.
La Fumure du Cacaoyer. Journ. d'Agr. Trop. Sept. 1903, p. 259.
Conseils Pratiques pour la culture du Cacaoyer. Rev. d. Cult. Col. Sept., 1903, p. 174.
Praktische Ratschläge für Das Kakaoban. Tropenpflanzer, 1903, p. 243.
Les abris artificiels. L'Agr. Plat. des Pays Chauds 1903, p. 300.
On the Budding of Cacao. Jamaica Bull., 1903, p. 255.
Culture pratique du Cacao. Bull. Jard. Col., 1905.
The Value of Mulching with Leaves, Grass, etc. Jamaica Bull., 1905. p. 270.
Etwas über das Schneiden der Kakaobäume. Tropenpflanzer, 1904, p. 305.
Zier Frage des Beschneiders des Kakaobäume in Kamerun. do. 1905, p. 308.

CACAO: HARVESTING AND PREPARATION (AND c.f. GENERAL.)

Fermentation etc., Tropenpflanzer IV., 1900, p. 227.
Die Schokoladen Fabrikation (2nd Ed.). Zipperer. Berlin, (Karayn) 1901.
Artificial Drying of Cacao. Smith in West Ind. Bull., II, p. 171.
Zur Kakao-fermentation. Schulte im Hoge; Tropenpflanzer, 5, 1901, p. 225.
Cacao-drier at the Botanic Station, Dominica. Agr. News I, p. 19.
Sur la Préparation des Graines du Cacao. Rev. d. Cult. Col. Mai 1903, p. 265.
Mechanical Treatment of Cacao from Pod to Sack. "*T.A.*" July 1903, p. 53.
Uber Kakao-trockenvorrichtungen in Kamerun. Preuss in Tropenpflanzer 7, 1903, p. 419.
L'ouverture des Cabosses du Cacao. Rev. d. Cult. Col. 1904, p. 278.
Claying and Polishing Cacao. Trinidad Bull. 1904, p. 113.
Fermenteeren van Cacao. Ind. Mercuur, September 1904, p. 661.
Le Séchage du Cacao à Temvo, de Wildeman, Notes sur des plantes utiles . . . . du Congo. II. p. 302.
Le Procédé de Fermentation du Cacao de M. Schulte im Hoge. Jour d'Ag. Trop. 1905, p. 297.

CACAO: DISEASES: *

The Cacao Canker. Circ. R.B.G., Perad. I, 2nd and 3, 1897.
Cacao Disease (Carruther's Reports) P.A. Report, Ceylon, 1899.
Les insectes qui attaquent le Cacao. Rev. d. Cult. Col. VI., 1900, p. 228.
Un Ennemi du Cacaoyer. do. 261.
Some Fungi of the Cacao Tree. Hart in West Ind. Bull. 1, p. 422.
Krullotenziekte in Suriname. Ind. Mercur, Jan. 1901, p. 21.
Ein Wurzelschäoling des Cacaobaumes. Tropenpflanzer, 1901, p. 288.
Cacao Canker in Ceylon. R. B. G. Circ. I, p. 23, Oct. 1901, p. 295.
Fungoid Diseases of Cacao. Jamaica Bulletin, VIII. 1901, 113.
Cacao Disease. Trinidad Bull. 1901. August extra number.
Insect Attacks on Cacao Trees in Grenada. Trinidad Bull., May 1901.
Un Nouvel Ennemi du Cacaoyer., Rev. d. Cult. Col., Nov. 1901, p. 358.

* Owing to the appointment on my staff of two officers to deal expressly with diseases, I have not in recent years kept this literature very carefully.

Black Pod (Phytophthora omnivora). Trinidad Bull., April 1904.
Ueber Einige in Kamerun anf Theobroma Cacao beobachteten Pilze. Centr. für Bakt. II. XI. 1904, p. 551. Bot. Centr. 96, p. 296.
Cacao Canker and Spraying in Ceylon. R. B. G. Circ., Perad., II, p. 21, p. 339.
Callistemon.—Timbers. Queensl. Agr. Jl., Feb. 1900, p. 126.
Calophyllum.—L'huile de Mu-ll (C. Inophyllum) Rev. d. Cult Col. VI. 1900, p. 280.
Calotropis.—C. gigantea (fibre). Agr. Ledger, Veg. Prod. Series, No. 47.

J. C. W.

Correspondence.

SINHALESE LEGEND *RE* POISONOUS PLANTS.

SIR,—Will you kindly tell me if there is any poisonous quality in the following plants:—

Erabodu (shade plants in cocoa plantations).
Watu sudu (flower plant, buttercup?).
Katuru murunga (well-known vegetable).

There is a great prejudice against planting them especially near buildings. Hence this couplet

Erabodu Watu sudu Katuru murunga
Hera yati Surindugewat Siri pumba,

meaning "to have these, even a god will be overtaken with misfortune."

Yours faithfully,
G. E. WEERAKOON.

Talangama, 1st February, 1906.

[I do not know of any poisonous qualities attaching to these plants, but perhaps some of our readers may be able to throw light on this subject.—ED.]

Ceylon Board of Agriculture.

The Sixteenth Meeting of the Board of Agriculture was held on Monday, the 12th February, at 12 noon, in the Council Chamber.

The Lieut.-Governor presided.

There were also present:—The Hon. Messrs. H. C. Nicolle, John Ferguson, C.M.G., S. C. Obeyesekere, F. C. Loos, and W. H. Jackson, Messrs H. T. S. Ward, W. D. Gibbon, C. P. Hayley, E. E. Green, C. Drieberg, G. W. Sturgess, Drs. J. C. Willis and H. M. Fernando, and the Secretary.

BUSINESS DONE.

1. The minutes of the previous meeting were read and confirmed.
2. List of new members was read.
3. Progress Report No. XV. was circulated.
4. Dr. Willis, Director, Royal Botanic Gardens, gave an address on "New Products." Messrs. Loos, Ferguson, Obeyesekere and Gibbon spoke.
5. A report received from Professor Dunstan on "Banana Flour and its Uses" was read. Mr. Drieberg spoke on the subject.
6. Dr. Willis moved "That the proposed Legislation for Agricultural Pests and Plant Sanitation, as recommended by the Commission appointed for this purpose, and as amended by the Committee of Agricultural Experiments be approved by the Board of Agriculture." Mr. W. D. Gibbon seconded the motion, which was carried.
7. The Financial Statement of the year was tabled.

The Board adjourned at 1-15 p.m.

Agricultural Society Progress Report. XVI.

The number of members on the Society's books is now 1,024, an increase of 23 since the last meeting.

A proposal is before the Board to elect life members on payment of a subscription of Rs. 50.

His Excellency the Governor has nominated Mr. K. U. Tampaiya, District Mudaliyar, Mullaittivu, to be a member of the Board for the Northern Province.

Mr. C. H. Bagot has been appointed a member of the Live Stock Committee

Members are reminded that their subscriptions for the Society's second year, from 1st November, 1905, to 31st December, 1906, are now due.

Local Societies.—Since the last meeting of the Board (12th February) I have visited the Branch Societies at Matara, Wellaboda pattu (Matara District), Tangalla, Hambantota, Telijjawila (Weligam korale), Kandaboda pattu (Matara District), and Kandy.

At Matara an interesting report on experiments made in the district during the past year was read by the Secretary, Mr. C. L. Meurling. Experiments are being made in rubber cultivation. It was decided to take steps to increase the membership of the Branch (at present only 15) with the object of starting an experimental garden at Matara, a proposal which is favoured by members.

The Wellaboda Pattu Branch has applied for a lease of three acres of Crown land in the teak garden at Kekanadura. The members have agreed to pay an annual subscription of Rs. 2—instead of Re. 1—to meet the cost of upkeep of the garden.

It was decided to offer prizes at the Dondra Fair to encourage different cultivations in this district. Rs. 50 was offered in prizes for best collections of vegetables and fruit, for yams, pineapples, plantains, and the largest bunch of coconuts.

The Tangalla Branch proposes to start an experimental garden. There is one at Weraketiya, ten miles from Tangalla, which I inspected. It would be more useful to have the pattu garden at the most important centre, and it is hoped that the site selected at Tangalla may be allowed for the purpose.

U. L. M. Marikar, Mudáliyar, undertook to experiment with a new plough. It is proposed to import a type used in Tanjore.

Offers to experiment with tobacco and lemon grass were made by members of the Branch.

The Hambantota Branch will experiment with cotton and rubber under irrigation. Mr. Doole, Gate Mudaliyar, offered a prize of Rs. 25 (or a medal costing that amount) for the best growth of cotton in the district.

The members of the Branch agreed to subscribe an extra rupee per annum for a prize for the best vegetable garden in Hambantota town.

Application was made for cotton, saltbush, and vegetable seed.

The Telijjawila Branch has extended its work through the Weligam korale through the efforts of the headmen; all the Vidane Arachchies and many of the Vidanes have opened gardens of English and native vegetables. I visited those on my way from Matara to Telijjawila, and was surprised at the number of vegetables grown and the care taken in planting out the gardens. The results should be seen at the Weligam Korale Show on the 15th and 16th. Allowance must be made for the severe drought now prevailing in this district.

There are large experimental gardens at Sultanagoda and Telijjawila.

Considerable progress has been made with castration.

The Kandaboda Pattu Branch has experimented with ground nuts and transplantation of paddy. The members present decided to offer prizes, and after considerable discussion, in which a number of members took part, the following prizes were agreed upon as likely to assist the agricultural development of the district:—

(1.) Ten-rupee prize for the best results from transplantation in a field of not less than one bushel sowing extent.

(2.) Ten-rupee prize for the best vegetable garden in the pattu.

(3.) Ten-rupee prize for the best results of any product grown in a paddy field at a time when paddy could not be cultivated.

(4.) Ten-rupee prize for the best exhibit of any curry stuff grown on high or low ground.

(5.) Ten-rupee prize for the best lot of sugarcane grown on an acre, or of betel grown on half an acre.

(6.) Ten-rupee prize for the best lot of ginger or onions grown in any garden in the district.

(7.) Five-rupee prize for the best school garden at any school other than a Government school.

(8.) Five-rupee prize for the best laid out and planted garden.

The choice of prizes was made entirely by the donors, and the discussion showed an interest in the improvement of the agriculture of the district which should have good results.

At the meeting of the *Kandy Branch* it was decided to start experimental gardens worked by Branch Societies, to extend the castration demonstrations, and to apply for the services of the tobacco expert.

A paper entitled "Notes on Live Stock" was read before the *Badulla Branch* by Mr. P. C. J. Fernando, Stock Inspector.

At a meeting of the *Nuwara Eliya Branch* on the 19th February, Mr. H. D. Martin promised to give a demonstration on grafting of plants at the meeting, and Mr. J. K. Nock offered to read a paper.

Agricultural Shows.—The Show fixed for 14th and 15th May at Kurunegala has been postponed, on account of the severe drought, to 23rd to 25th August. The Society will offer prizes of Rs. 50 (or gold medals) at Weligam Korale Show for the best exhibit of vegetables grown in a villager's garden, at the Gampola Show for the best native bull in the Show.

The two portable iron sheds will be used for the first time at the Weligam Korale Show. Arrangements are being made for special exhibits from Peradeniya and the Government Stock Garden at Agricultural Shows in charge of a member of the staff.

Experimental Gardens.—Two gardens have been opened, one at Angammana, the other at Gampolawela by the Gampola Branch. At the Weragoda Experimental Garden started by the Wellaboda Pattu (Galle) Branch there has been a sale of vegetables held twice a week since the middle of September; six acres of the ten acres obtained for the garden have been cleared; fifty-four different varieties of vegetables have been planted. Mr. Drieberg reports "What struck (him) in the vegetable garden was that the work was being done very systematically and thoroughly. The beds were well prepared, and the soil was in good mechanica condition as the result of soil mulching, which was just what was needed during the prevailing dry weather."

Paddy.—The consignment of 50 bushels of Knishu paddy ordered from Japan has been received, and applicants have been requested to communicate with me at once. Leaflets have been issued in English and the vernacular giving particulars with regard to the paddy.

Copy of Proceedings of the Board of Revenue, Madras, have been received stating that steps will be taken to send to Ceylon 227 bushels of five-month paddy seed in July, 137 bushels of six-month paddy seed in May, and 60 bushels muttu-samba before the 25th June.

These varieties of seed paddy have been ordered for the Kurunegala Branch.

Cotton.—The patent hand-power MacCarthy cotton gin and the hand-saw gin sent to the Society by the British Cotton-growing Association are available. Applications should be made to me.

Manures.—Applications are being received for the fertilizers for cocoñuts, tobacco, cotton, &c., offered by Messrs. Freudenberg for experiment. Applicants should state the extent of land on which the experiment will bemade, the age of the cultivation, and the yield of the last crop taken from the land. Only a very limited number of applications can be entertained, and they must be supported by the recommendation of the applicant's Local Branch.

Sericulture.—Mr. A. Perera, Assistant Inspector of School Gardens, purchased 88 lb. of cocoons in his circuit in the Central Province, and there are signs of a considerable supply being now forthcoming.

The Sericulture Committee are being consulted as to whether further advances should be made by the Society for the purchase of cocoons.

Castration.—Demonstrations have been held at Teldeniya in the Central Province, at ten centres in the North-Central Province where 161 animals were castrated, at Delft, and at four centres in the Mannar District, at Veyangoda (arranged by Mr. D. J. Arsecularatne) and Panadura in the Western Province. Further demonstrations are being arranged for in the Southern, Western, and Central Provinces, and at Ruanwella in the Province of Sabaragamuwa, where no demonstrations have hitherto taken place.

The Government Veterinary Surgeon reports that there are "two very fine imported buffalo cows for sale at the Government Dairy. In full milk each gave over fifteen bottles. Price Rs. 125 each.

Publications.—The leaflets on "Shade Trees" and on "Agricultural Shows: Instructions on forwarding Exhibits" are now being issued.

The Government Veterinary Surgeon's report on castration work done last year is sent to each member of the Society. A leaflet on "Salt as Manure" by Mr. Kelway Bamber, Government Analyst and Chemist, is with the printer.

The *Dinakaraprakasa* has kindly furnished one hundred copies of two editions of the paper containing the Proceedings of the last Board Meeting in Sinhalese. These copies have been circulated to the Branch Societies.

E. B. DENHAM,
Secretary, Agricultural Society.

March 5, 1906.