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Reviews.

AGRICULTURE IN THE TROPICS.

An Elementary Treatise by J. C. Willis, M.A., SC.D., Director of the Royal Botanic Gardens, Ceylon; Organising Vice-President, Ceylon Agricultural Society; Editor of the *Tropical Agriculturist.*

Dr. Willis' long-looked for work on Tropical Agriculture has lately reached us, and will be eagerly read by all whose duties bring them into contact with the theoretical side of agriculture and the problems of its improvement.

The book is not a technical treatise on methods of cultivation. The author's object, as stated in the Preface, is:—"To place before the public, as clearly as may be, something of the underlying 'political' and theoretical side of the subject, setting forth what such agriculture really is, the conditions under which it is carried on, its successes and disasters and their causes, the great revolution which is being effected by western influences, and other general principles underlying the whole subject, in whatever country it may be carried on." With this object in view the book is primarily addressed to "the student, the administrator and the traveller" by an author who, in addition to being himself a traveller and a student, will soon be left without a rival to dispute his position as the leading authority on agricultural administration in the Eastern Tropics, owing to the approaching retirement of Dr. Melchior Treub, the famous Director of Agriculture of Java.

The book is divided into four parts with the following titles:—Part I. The Preliminaries to Agriculture. Part II. The Principal Cultivations of the Tropics. Part III. Agriculture in the Tropics (general). And Part. IV. Agricultural Organisation and Policy.

In the first part Dr. Willis deals with such matters as soil and climate, labour and capital, irrigation and cultivation and similar fundamental factors of agricultural progress, from a general standpoint, whilst Part II. contains a series of separate sketches dealing with the main products of tropical agriculture in turn. In this part, in accordance with the general plan of the book already referred to, all practical details of cultivation are omitted, but the student will find here, nevertheless, a well-balanced general account of the principal agricultural resources of the tropics.

It is to Parts III. and IV., however, that experts and those specially interested in the progress of agriculture will turn with special attention, for here they will find discussed those questions of organisation and policy which have been made the subject of special study by the author ever since his first arrival in Ceylon.

As regards the policy to be adopted with reference to native agriculture, the author's position is decidedly a progressive one. He is all for improvement and development; and it would scarcely be becoming for the temporary editor of a journal devoted to this very object to differ from his chief in this respect. The ideal to be aimed at, according to Dr. Willis, is the creation of a class of native capitalist planters who shall grow produce for export just as the European planters now do.

But, however much we may be inspired by the passion for progress, we must not try to move too quickly. The innertia, the innate conservatism of the Eastern mind is enormous, and in face of such an attitude, which is by no means necessarily a defective one, false steps are particularly dangerous. The agricultural expert ought to be particularly sure of his ground before he indulges in any assertions as to the superiority of new methods over old ones, and every new importation of machinery or seed ought to be made the subject of careful and exhaustive tests under the new conditions before it is adopted as suitable for introduction amongst the native cultivators.

With regard to the importation of new machinery another point has to be remembered. The most modern implements were not invented suddenly. They arrived at their present stage of comparative perfection by a gradual process of evolution which went on side by side with a similar evolution in the minds of the men who had to use them. If the native with his stereotyped ideas of agriculture looks askance at what is to him a totally new invention, we have only ourselves to blame for adopting an unnatural method of amelioration. The proper plan is to start with familiar implements and methods, and to introduce gradual modifications in the right direction.

For the small cultivators co-operation is the watchword. By this means alone can the small holder of land expect to continue to exist in a country of capitalists. Co-operation, says Dr. Willis, is excellent in agriculture, and the reason that the continental agriculturists of Europe are probably more prosperous than their British colleagues is mainly that they have gone in largely for co-operation. Co-operative credit, co-operative seed supply, co-operative distirbution of produce must all be undertaken if the small proprietor is to retain his position and avoid the necessity for earning the wages of capitalists. Not that capitalist agriculture is to be deprecated in the tropics. It is chiefly by the example of his more progressive and wealthy neighbour that the tropical native may hope to advance his own methods of cultivation. All progress requires capital.

And this policy of progress has been tacitly adopted by all those tropical governments which have embarked upon a career of road making and railway construction, since railways at least are meaningless except in relation to an export trade.

Throughout the book the example of Ceylon is continually upheld and made a basis for comparison, but this will not be regarded as a defect by readers of the *Tropical Agirclutui ist.* Ceylon, we are told, has generally led the way in the various European planting enterprises, first with coffee, then with cinchona, cacao, tea, cardamoms and rubber; although the cultivation of sugar—probably the oldest of all such enterprises—has never been made a success here. Certainly few tropical countries can compete with Ceylon in the variety and interest of its agricultural productions.

A number of valuable suggestions are also given as regards the policy to be adopted in opening up a comparatively new country for agricultural purposes. Many of these are drawn from the comprehensive report written in 1904 by Dr. Willis for the Government of the Federated Malay States. Thus the question of road reservations is fully discussed. In a swampy country a similar system of drainage reservations will also be required. In opening out such a country the author recommends the development of native and estate agriculture side by side. The large agriculturist serves as an example to the small one, and in his turn can draw upon the villages for additional labour at times when that commodity is scarce.

The book is published by the Cambridge University Press, and nothing more need be said with regard to its appearance and general production.

R. H. L.

REVIEW.

"Economic Loss to the People of the United States through Insects that carry Disease." By L. O. Howard, Ph. D., Chief of the Bureau of Entomology, U.S.A.

Under the above title, Dr. Howard has published a most important circular (of 38 pages), in which he brings forward overwhelming evidence of the maleficent agency of certain insects in the dissemination of disease.

In his introduction, he instances the now generally accepted (and—in many cases—fully demonstrated) connection between

(1) The Anopheles mosquito and Malarial Fevers;

(2) The Mosquito *Stegomyia fasciata* and 'Yellow Fever';

(3) Certain species of *Culex* and Filariasis (including Elephantiasis);

(4) The House Fly and Typhoid Fever, Asiatic Cholera, Dysentery, Purulent Ophthalmia and Tuberculosis;

(5) The Rat-Flea and Bubonic Plague;

(6) The 'Tsetse Fly' and 'Sleeping ickness':

to say nothing of the conveyance of numerous dangerous diseases of domestic animals by ticks and other insects.

Dr. Howard draws attention to the fact that Mosquitoes are responsible for considerable monetary loss in other ways than as carriers of disease. "Possibly the greatest of these losses is in the reduced value of real estate in mosquito-infested regions, since these insects render absolutely uninhabitable large areas of land available for suburban homes, for summer resorts, for manufacturing purposes, and for agricultural pursuits." "All over the United States, for these insects, and for the house fly as well, it has become necessary at great expense to screen habitations."

MALARIA.

After describing the ravages of malaria in different parts of the world, and pointing out that, besides actual loss of life, it is the cause of enormous loss of efficiency to labour in malarious localities, the author goes on to emphasize the fact that "malaria is a preventable disease. It is possible for the human species to live and to thrive and to produce in malarious regions, but at a very considerable inconvenience and expense. The Italian investigators, and especially Celli and his staff, have shown that by screening the huts of the peasants on the Roman Campagna and by furnishing field labourers with veils and gloves when exposed to the night air, it is possible even in that famous hotbed of malaria to conduct farming operations with a minimum of trouble from the disease. Moreover, Koch and his assistants in German East Africa have shown that it is possible, by stamping out the disease amongst human beings by the free use of medecine, that a point can be gained where there is small opportunity for the malarial mosquitoes to become infected. Moreover, the work of the parties sent out by the Liverpool School of Tropical Medicine and other English organizations to the west coast of Africa has shown that by the treatment of malarial-mosquito breeding pools the pernicious coast fever may be greatly reduced. Again, the work of Englishmen in the Federated Malay States has shown that large areas may be practically freed from malaria. The most thorough and satisfactory of all measures consists in abolishing the breeding places of the malarial mosquitoes. With a general popular appreciation of the industrial losses caused primarily by the malarial mosquito, and secondarily by the forms which do not carry malaria, as indicated in the opening paragraphs, it is inconceivable that the comparatively inexpensive measures necessary should not be undertaken by the General Government, by the State Governments, and by the boards of health of communities just as it is inconceivable that the individual should suffer from malaria and from the attacks of other mosquitoes when he has individual preventives and remedies at hand."

A few excellent examples of anti-malarial work may be instanced.

"The latest reports on the measures taken to abolish malaria from Klang and Port Swettenham in Selangor, Federated Malay States, indicate the most admirable results. These measures were undertaken first in 1901 and 1902, and have been reported upon from time to time in the Journal of Tropical Medicine. The expenditure undertaken by the Government with a view to improving the health of the inhabitants of these towns has been fully justified by the results, which promise to be of permanent value. The careful tabulation of cases of deaths and of the results of the examination of blood of children in especially drained areas indicates the following conclusions: (1) Measures taken systematically to destroy breeding places of mosquitoes in these towns, the inhabitants of which suffered terribly from malaria, were followed almost immediately by a general improvement in health and decrease in death rate.

(2) That this was due directly to the work carried out and not to a general dying out of malaria in the district is clearly shown by figures pointing out that while malaria has practically ceased to exist in the areas treated, it has actually increased to a considerable extent in other parts of the district where anti-malarial measures have not been undertaken."

"Another striking example of excellent work is found in the recently published report on the suppression of malaria in Ismailia, issued under the auspices of the Compagnia Universelle du Canal Maritime de Suez. Ismailia is now a town of 8,000 inhabitants. It was founded by De Lesseps in April, 1862, on the borders of Lake Timsah, which the Suez Canal crosses at mid-distance between the Red Sea and the Mediterranean. Malarial Fever made its appearance in very severe form in September, 1877, although the city had up to that time been very healthy, and increased, so that since 1886 almost all of the inhabitants have suffered from the fever. In 1901 an attempt to control the disease was made on the mosquito basis, and this attempt rapidly and completely succeeded, and after two years of work all traces of malaria disappeared from the city. The work was directed not only against Anopheles mosquitoes, but against other Culicids, and comprised the drainage of a large swamp and the other usual measures. The initial expense amounted to 50,000 francs, and the annual expenses since have amounted to about 18,300 francs."

"The results may be summarized about as follows:—Since the beginning of 1903 the ordinary mosquiotes have disappeared from Ismailia. Since the autumn of 1903 not a single larva of Anopheles has been found in the protected zone, which extends to the west for a distance of 1,000 meters from the first houses in the Arabian quarter and to the east for a distance of 1,800 meters from the first houses in the European quarter. After 1902 malarial fever obviously began to decrease, and since 1903 not a single new case of malaria has been found in Ismailia."

"A very efficient piece of anti-malarial work was accomplished in Havana during the American occupation of 1901 to 1902, incidental in a way to the work against yellow fever. An Anopheles brigade of workmen was organized under the sanitary officer, Doctor Gorgas, for work along the small streams, irrigated gardens, and similar places in the suburbs, and numbered from 50 to 300 men. No extensive drainage, such as would require engineering skill, was attempted, and the natural streams and gutters were simply cleared of obstructions and grass, while superficial ditches were made through the irrigated meadows. Among the suburban truck gardens Anopheles bred everywhere, in the little puddles of water, cow tracks, horse tracks, and similar depressions in grassy ground. Little or no oil was used by the Anopheles brigade, since it was found in practice a simple matter to drain these places. At the end of the year it was very difficult to find water containing mosquito larvæ anywhere in the suburbs, and the effect upon malarial statistics was striking. In 1900, the year before the beginning of the mosquito work, there were 325 deaths from malaria; in 1901, the first year of the mosquito work, 171 deaths; in 1902, the second year of mosquito work, 77 deaths. Since 1902 there has been a gradual though slower decrease, as follows: 1903, 51; 1904, 44; 1905, 32; 1906, 26; 1907, 23.

YELLOW FEVER.

The theory that Yellow Fever was conveyed by the mosquito Stegomyia fasciata, was first proposed by Finlay, of Havana, in 1881. But it was not until ten years later that the truth of this theory was finally demonstrated.

"The importance of the discovery cannot be over-estimated, and its first demonstration was followed by anti-mosquito measures in the city of Havana, undertaken under the direction of Gorgas, with startling results."

"Yellow fever had been endemic in Havana for more than one hundred and fifty years, and Havana was the principal source of infection for the rest of Cuba. Other towns in Cuba could have rid themselves of the disease if they had not been constantly reinfected from Havana. By ordinary sanitary measures of cleanliness, improved drainage, and similar means the death rate of the city was reduced, from 1898 to 1900, from 100 per thousand to 22 per thousand; but these measures had no effect upon yellow fever, this disease increasing as the non-immune population following the Spanish war increased, and in 1900 there was a severe epidemic."

Stegomyia calopus (= *fasciatus*) was established as the carrier of the fever early in 1901, and then anti-mosquito measures were immediately begun. Against adult mosquitoes no general measures were attempted, although screening and fumigation were carried out in quarters occcupied by yellow fever patients or that had been occupied by yellow fever patients. It was found that the Stegomyia bred principally in the rain-water collections in the city itself. The city was divided into about thirty districts, and to each district an inspector and two labourers were assigned, each district containing about a thousand houses. An order was issued by the mayor of Havana requiring all collections of water to be so covered that mosquitoes could not have access, a fine being imposed in cases where the order was not obeyed. The health department covered the rain-water barrels of poor families at public expense. All cesspools were treated with petroleum. All receptacles containing fresh water which did not comply with the law were empied and on the second offence destroyed. The result of this work thoroughly done was to wipe out yellow-fever in Havana, and there has not been a certain endemic case since that time."

In 1904, similar work was commenced along the route of the Panama Canal, with the most complete success.

"The remarkable character of these results can only be judged accurately by comparative methods. It is well known that during the French occupation there was an enormous mortality among the European employés, and this was a vital factor in the failure of the work. Exact losses cannot be estimated, since the work was done under seventeen different contractors. These contractors were charged $1 a day for every sick man to be taken care of in the hospital of the company. Therefore it often happened that when a man became sick his employer discharged him, so that he would not have to bear the expense of hospital charges. There was no police patrol of the territory, and many of these men died along the line. Colonel Gorgas has stated that the English Consul, who was at the Isthmus during the period of the French occupation, is inclined to think that more deaths of employés occurred out of the hospital than in it. A great many were found to have died along the roadside while endeavouring to find their way to the city of Panama. The old superintendent of the French hospital states that one day three of the medical staff died from yellow-fever, and in the same month nine of the medical staff. Thirty-six Roman Catholic sisters were brought over as nurses, and twenty-four died of yellow-fever. On one vessel eighteen young French engineers came over, and in a month after their arrival all but one died."

THE TYPHOID FLY.

But the part of Dr. Howard's paper that is of more particular interest to us at the present moment is that which relates to what he calls the "Typhoid Fly." This is our domestic pest—the House-fly. He says:—"The name "typhoid fly" is here proposed as a substitute for the name 'house fly,' now in general use. People have altogether too long considered the house fly as a harmless creature, or, at the most, simply a nuisance. While scientific researches have shown that it is a most dangerous creature from the standpoint of disease, and while popular opinion is rapidly being educated to the same point, the retention of the name house fly is considered inadvisable, as perpetuating in some degree the old ideas. Strictly speaking, the term "typhoid fly" is open to some objection, as conveying the erroneous idea that this fly is solely responsible for the spread of typhoid, but considering that the creature is dangerous from every point of view, and that it is an important element in the spread of typhoid, it seems advisable to give it a name which is almost wholly justified, and which conveys in itself the idea of serious disease."

"The true connection of the so-called house fly with typhoid fever and the true scientific evidence regarding its role as a carrier of that disease have only recently been worked out. Celli in 1888 fed flies with pure cultures of the typhoid bacillus, and examined their contents and dejections microscopically and culturally. Inoculatons of animals were also made, proving that the bacilli which passed through flies were virulent. Dr. George M. Kober, familiar with Celli's researches, in his report on the prevalence of typhoid fever in the District of Columbia, published in 1895, called special attention to the danger of contamination of food supplies by flies coming from the excreta of typhoid patients."

Though a very unsavoury subject, its importance—in connection with the prevalence of typohid fever in Colombo—makes no excuse necessary for entering fully into these unpleasant details and for quoting largely from Dr. Howard's paper. It should be mentioned that—some ten years ago—He made a rather thorough investigation of the insect fauna of human excrement, and made a further investigation of the species of insects that are attracted to food supplies in houses. In a paper entitled 'A Contribution to the Study of the Insect Fauna of Human Excrement (with special reference to the spread of typhoid fever by flies'), he showed that 98·8 per cent. of the whole number of insects captured in houses throughout the whole country under conditions indicated above were *Musca domestica*, the typhoid or house fly. He further showed that this fly, while breeding most numerously in horse stables, is also attracted to human excrement and will breed in this substance. It was shown that in towns where the box privy was still in existence the house fly is attracted to the excrement, and, further, that it is so attracted in the filthy regions of a city where sanitary supervision is lax, and where in low alleys and corners and in vacant lots excrement is deposited by dirty people. He stated that he had seen excrement which had been deposited overnight in an alleyway in South Washington swarming with flies under the bright sunlight of a June morning (temperature 92 F.), and that within 30 feet of these deposits were the open windows and doors of the kitchens of two houses kept by poor people, these two houses being only two elements in a long row.

The following paragraph is quoted from the paper just cited:—"Now, when we consider the prevalence of typhoid fever, and that virulent typoid bacilli may occur in the excrement of an individual for some time before the disease is recognized in him, and that the same virulent germs may be found in the excrement for a long time after the apparent recovery of a patient, the wonder is not that typhoid is so prevalent, but that it does not prevail to a much greater extent. Box privies should be abolished in every community. The depositing of excrement in the open within town or city limits should be considered a punishable misdemeanour in communities which have not already such regulations, and it should be enforced more rigorously in towns in which it is already a rule. Such offences are generally committed after dark, and it is often difficult or even impossible to trace the offender; therefore, the regulation should be carried even further, and require the first responsible person who notices the deposit to immediately inform the police, so that it may be removed or covered up. Dead animals are so reported; but human excrement is much more dangerous. Boards of Health in all communities should look after the proper treatment or disposal of horse manure, primarily in order to reduce the number of house flies to a minimum, and all regulations regarding the disposal of garbage and foul matter should be made more stringent and should be more stringently enforced.

"It is not alone as a carrier of typhoid that this fly is to be feared. In the same way it may carry nearly all the intestinal diseases. It is a prime agent in the spreading of summer dysentery, and in this way is unquestionably responsible for the death of many children in summer. One of the earliest accurate scientific studies of the agency of insects in the transfer of human disease was in regard to flies as spreaders of cholera. The belief in this agency long preceded its actual proof. Dr. G. E. Nicholas, in the London *Lancet*, Volume 11, 1873, page 724, is quoted by Nuttall as writing as follows regarding the cholera prevailing at Malta in 1849:—'My first impression of the possibility of the transfer of the disease by flies was derived from the observation of the manner in which these voracious creatures, present in great numbers, and having equal access to the dejections and food of patients, gorged themselves indiscriminately, and then disgorged themselves on the food and drinking utensils. In 1850 the *Superb*, in common with the rest of the Mediterranean squadron, was at sea for nearly six months; during the greater part of the time she had cholera on board. On putting to sea, the flies were in great force; but after a time the flies gradually disappeared, and the epidemic slowly subsided. On going into Malta Harbour, but without communicating with the shore, the flies returned in greater force, and the cholera also with increased violence, After more cruising at sea, the flies disappeared gradually with the subsidence of the disease.'"

"With tropical dysentery and other enteric diseases practically the same conditions exist."

"The typhoid fly also possesses importance as a disseminator of the bacilli of tuberculosis." This was shown to occur in the following manner:—

"1. Flies may ingest tubercular sputum and excrete tubercle bacilli, the virulence of which may last for at least fifteen days."

"2. The danger of human infection from tubercular flyspecks is by the ingestion of the specks on food,"

Some interesting experiments upon the number of bacteria carried by flies are recorded. From these it appears that—"The numbers of bacteria on a single fly may range all the way from 550 to 6,600,000. Early in the fly season the numbers of bacteria on flies are comparatively small, while later the numbers are comparatively very large. The place where flies live also determines largely the numbers that they carry. The average for the 414 flies (employed in the experiment) was about one and one-fourth million bacteria on each. It hardly seems possible for so small a bit of life to carry so large a number of organisms. The method of the experiment was to catch the flies from the several sources by means of a sterile fly net, introduce them into a sterile bottle, and pour into the bottle a known quantity of sterilized water, then shake the bottle to wash the bacteria from their bodies, to simulate the number of organisms that would come from a fly in falling into a lot of milk." By counting the number of bacteria in a definite small quantity of this water, it was possible to estimate the total number that were present in the infected liquid.

Dr. Howard then considers the practical means for mitigating the serious danger to humanity. He says :—"Even if the typhoid or house fly were a creature difficult to destroy, the general failure on the part of communities to make any efforts whatever to reduce its numbers could properly be termed criminal neglect; but since, as will be shown, it is comparatively an easy matter to do away with the plague of flies, this neglect becomes an evidence of ignorance or of a carelessness in regard to disease-producing filth which to the informed mind constitutes a serious blot on civilized methods of life."

"Strange as it may seem, an exhaustive study of the conditions which produce house flies in numbers has never been made. The life history of the insect in general was, down to 1873, mentioned in only three European works and few exact facts were given. In 1873, Dr. A. S. Packard studied the transformations of the insect and gave descriptions of all stages, showing that the growth of a generation from the egg state to the adult occupies from 10 to 14 days."

"In 1895 the writer traced the life history in question, indicating that 120 eggs are laid by a single female, and that in Washington, in midsummer, a generation is produced every ten days. Although numerous substances were experimented with, he was able to breed the fly only in horse manure. Later investigations indicated that the fly will breed in human excrement and in other fermenting vegetable and animal material, but that the vast majority of the flies that infest dwelling houses, both in cities and on farms, come from horse manure."

"In 1907 careful investigations carried on in the city of Liverpool by Robert Newstead, indicated that the chief breeding places of the house fly in that city should be classified under the following heads :—

(1) Middensteads (places where dung is stored) containing horse manure only.

(2) Middensteads containing spent hops.

(3) Ashpits containing fermenting materials.

"He found that the dung heaps of stables containing horse manure only were the chief breeding places. Where horse and cow manures were mixed the flies bred less numerously, and in barnyards where fowls were kept and allowed freedom relatively few of the houseflies were found. Only one midden containing warm spent hops was inspected, and this was found to be as badly infested as any of the stable middens. A great deal of time was given to the inspection of ash pits, and it was fonnd that wherever fermentation had taken place and artificial heat had been produced, such places were infested with house fly larvæ and pupæ, often to the same alarming extent as in stable manure. Such ash pits as these almost invariably contained large quantities of old bedding or straw or paper, paper mixed with human excreta, or old rags, manure from rabbit hutches, etc., or a mixture of all these. About 25 per cent. of the ash pits examined were thus infested, and house flies were found breeding in smaller numbers in ash pits in which no heat had been engendered by fermentation. The house fly was also found breeding by Mr. Newstead in certain temporary breeding places, such as collections of fermenting vegetable refuse, accumulations of manure at the wharves, and in bedding in poultry pens."

"Still more recent investigations were carried on during 1908 by Professor S. A. Forbes who has reared it in large numbers from the contents of paunches of slaughtered cattle, from refuse hog hairs, from tallow vats, from carcasses of various animals, miscellaneous garbage, and so on."

"All this means that if we allow the accumulation of filth we will have house flies, and if we do not allow it to accumulate we will have no house flies. With the careful collection of garbage in cans and the removal of the contents at more frequent intervals than ten days, and with the proper regulation of abattoirs, and more particularly with the proper regulation of stables in which horses are kept, the typhoid fly will become a rare species. It will not be necessary to treat horse manure with chloride of lime or with kerosene or with a solution of Paris green or arsenate of lead, if stable men are required to place the manure daily in a properly covered receptacle, and if it is carried away once a week."

"The orders of the health department of the district of Columbia, published May 3, 1906, if carried out will be very effective. These orders may be briefly condensed as follows:"—

"All stalls in which animals are kept shall have the surface of the ground covered with a water-tight floor. Every person occupying a building where domestic animals are kept shall maintain, in connection therewith, a bin or pit for the reception of manure, and pending the removal from the premises of the manure from the animal or animals shall place such manure in said bin or pit. This bin shall be so constructed as to exclude rain water, and shall in other respects be water-tight, except as it may be connected with the public sewer. It shall be provided with a suitable cover and constructed so as to prevent the ingress and egress of flies. No person owning a stable shall keep any manure or permit any manure to be kept in or upon any portion of the premises other than the bin or pit described, nor shall he allow any such bin or pit to be overfilled or needlessly uncovered. Horse manure may be kept tightly rammed into well-covered barrels for the purpose of removal in such barrels. Every person keeping manure in any of the more densely populated parts of the district shall cause all such manure to be removed from the premises at least twice every week between June 1 and October 31, and at least once every week between November 1 and May 31 of the following year. No person shall remove or transport any manure over any public highway in any of the more densely populated parts of the district except in a tight vehicle, which, if not enclosed, must be effectually covered with canvas, so as to prevent the manure from being dropped. No person shall deposit manure removed from the bins or pits within any of the more densely populated parts of the district without a permit from the health officer."

A significant pragraph in Mr. Newstead's Liverpool report, referred to above, contains the following words:—"The most strennous efforts should be made to prevent children defecating in the courts and passages; or that the parents should be compelled to remove such matter immediatedly; and that defecation in stable middens should be strictly forbidden. The danger lies in the overwhelming attraction which such fecal matter has for house flies, which later may come into direct contact with man or his food stuffs."

"We have thus shown that the typhoid or house fly is a general and common carrier of pathogenic bacteria. It may carry typhoid fever, Asiatic cholera, dysentery, cholera morbus, and other intestinal diseases; it may carry the bacilli of tuberculosis and certain eye diseases; it is everywhere present, and it is disposed of with comparative ease. It is the duty of every individual to guard so far as possible against the occurrence of flies upon his premises. It is the duty of every community, through its board of health, to spend money in the warfare against this enemy of mankind. This duty is as pronounced as though the community were attacked by bands of ravenous wolves."

This illuminating paper concludes with a short account of "Endemic Disease as Affecting the Progrees of Nations.'

After reading the crushing indictment set forth so ably in Dr. Howard's paper, one is constrained to ask—What are we doing in Ceylon towards the scientific prevention or mitigation of our insect-borne diseases?

E. ERNEST GREEN.

Government Entomologist.

GUMS, RESINS, SAPS AND EXUDATIONS.

ACCOUNT OF MANURIAL TRIAL ON YOUNG RUBBER TREES.

By E. MATHIEW.

Situation of Estate.—Singapore, Holland Road.

Owner.—F. M. Elliot, Esq.

Age of Trees.—The trees are from seed sown in February, 1907.

Nature of Soil.—Light-grey sandy on yellow clay sub-soil.—Poor in humus and other plant food, but mechanically in very good condition, *i.e.*, loose and friable.

A field was selected 150 feet by 156, containing 160 trees planted in quincunx 15 × 13 feet, and occupying the lower part of a gentle slope,

Before the application of the manures, the trees were well weeded for 3 feet all round the foot of the trees, and each was given a light hoeing. All the trees received exactly the same treatment with regard to cultivation.

The field of 160 trees was divided in 4 plots of equal size, each plot containing 4 rows of 10 trees=40 trees per plot.

Plot O, of 40 trees remained unmanured.

Plot NPK, (Nitrogen-Phosphoric acid and Potash, received 80 lb.

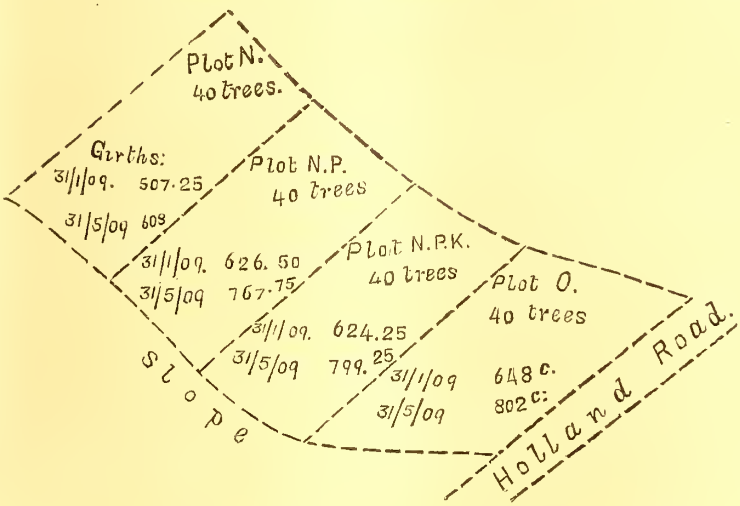
of a mixture containing	Ammonia superphosphate	55 ,,
	Muriate of Potash and Bonemeal	25 ,,

Each tree received 2 lbs. of this complete manure.

Plot NP, received the Ammonia Superphosphate and Bonemeal 55 lb. but no potash, each tree getting 22 oz.

Plot N, received the Ammonia alone 20 lb. Each tree getting 8 oz.

The field had somewhat the following contour:—



The manures in each case were sprinkled in a shallow trench, 3 inches deep, dug all round the trees 2 feet from the stem, the dug earth being put back to cover up the manures. The plot O, although unmanured, was also trenched in order to insure complete similarity of treatment.

On 31st January, 1909, the girth measurements of the 160 trees were taken, 3 feet from the ground, and the figures were those recorded on sheet A enclosed.

At that date, the 40 trees (each 2 years old exactly, from seed) of each plot measured respectively:—

Total measurement 40 trees. Plot O.=648 centim, =per tree $6\frac{5}{8}$"=yearly incremen of girth 3 3/16"

Total measurement 40 trees. Plot NPK.= 624·25" =per tree $6\frac{1}{4}$" =yearly increment of girth $3\frac{1}{4}$"

Total measurement 40 trees. Plot NP. = 626·50' =per tree 6 3/16"=yearly increment of girth 3 3/32"

Total measurement 40 trees. Plot N. = 507·20" =per tree 5" yearly increment of girth $2\frac{1}{2}$"

It will be seen that plot O, the unmanured plot, showed much better growth than the other plots, by reason of its position at the foot of the slope. We shall have to take this into account in the summing up of the experiment.

On 31st of May last, exactly four months after the application of the manures (too short a period for the manures to have given their full effect) the trees were again measured, the figures being those recorded on sheet B. The trees were measured in the same order as on sheet A.

Summing up the experiment, we get:—

Measurement of 40 trees. Plot. O. 648 on 31-1-09, 802 on 31-5-09, Gain=154 centim.

Measurement of 40 trees. Plot NPK. 642·25 on 31-1-09, 799·25 on 31-5-09, Gain=175 centim.

Measurement of 40 trees. Plot NP. 626·50 on 31-1-09, 767·75 on 31-5-09, Gain=141·25 centim.

Measurement of 40 trees. Plot N. 507·25 on 31-1-09, 608 on 31-5-09, Gain=100·75 centim.

The fact that the unmanured plot O shows a larger increase than either NP. or N. plots, would be disconcerting were it not that, as already pointed out, the anomaly is explained by the favoured position of the plot at the foot of the slope below the other plots. At the start of the experiment, *i.e.*, on 31st January, it showed far better growth than the other plots, its yearly increase of girth, as shown above, being at the rate of $3\frac{3}{16}$ of an inch as compared with the next plot, N, which gave $3\frac{3}{32}$ inch.

This shows that the trees of plot O were of more vigorous growth owing to the washings received from the upper plots.

This fact, although it vitiates the trial to a great extent, gives it added interest if we compare with O, the results obtained from plot NPK, for whilst O has more than kept pace with NP and N, it has not done so with NPK, 40 trees of NPK gaining 175 centimetres in the four months, while the 40 trees of O only gained 154·25.

How is that O, which gained by the wash at the expense of NP and N, failed to gain at the expense of NPK?

To my mind, the ressult shows plainly that the failure of plot O to gain on NPK is solely due to the presence of potash in NPK, for whilst both nitrates and phosphoric acid are subject to be carried away in solution in the wash, this is not the case, at least to the same extent, with potash which is energetically retained by clay, and thus it only benefits the trees to which it is applied.

If, now, we compare the plots NPK and NP, we find that these two plots started almost exactly at the same stage of growth—the plot NP had, in fact, a slight advantage of 2 centimetres ·25 at the start, NPK measuring 624C·25. to NP 626C·50.

We may say, therefore, that the two plots started on January 31 with absolutely even chances. Yet, four months after we find that NPK has gained 175 centimetres on 40 trees, while NP has gained 141·25 centimetres on 40 trees.

In 4 months each tree of

N	has gained	3·53 =	per year	10·59 or $4\frac{1}{8}$ in.
NPK	,,	4·37 =	,,	13·11 or $5\frac{1}{8}$,,

which means to say that, assuming the manures to continue acting at the same rate till the end of the year, the complete manure (nitrogen—phosphoric acid and potash) will bring to each tree one inch more of girth than the nitro-phosphatic manure without the potash.

The improvement in growth brought about by the application of nitrogen only to plot N has been only slight, *i.e.*, 100·75 centimetres in the four months on the 40 trees. This shows a yearly increase (over and above the normal increase of girth before manuring) of half an inch, which is not wholly negligable, but considering the cost of nitrogenous manures, it is doubtful whether a purely nitrogenous application is profitable, apart from the fact that such a one-sided application exhausts the reserves of other constituents in the soil, thus tending to retard growth later on.

As I have already stated, the plot O started with too great an advantage to make the comparison with NPK quite fair. Yet we find that at the end of the four months Plot O grew from 648 to 802C·25 gaining 154C·25. Plot NPK grew from 624·25 to 799·25 gaining 175C, a gain of 20C·75 which will be found to work out at 9/16 of an inch yearly.

But we can get at a truer estimate of the effect of the full manure by comparing the rate of growth of the trees of the same plot NPK before and after manuring.

The 2-year old 40 trees of NPK grew from 624C·25 which shows a yearly growth of $3\frac{1}{16}$ inch to 799·25 which shows a yearly growth of $5\frac{1}{8}$ inch. Each tree, at this rate, would therefore gain, by manuring with a complete manure, $2\frac{1}{16}$ of an inch in one year, over and above the normal rate of increase of the trees without manure.

To put it otherwise, if we assume the tappable stage of a tree to be reached when a tree has attained a girth of 20 inches, a tree manured with a complete manure would be tappable at the age of 4 years, while the same tree, unmanured, would only be tappable after its 6th year.

These conclusions apply of course to the present case, and they are liable to vary with variation of soils and other factors.

The one fact which it is important to show is that a complete manure increases girth, and, therefore, quickens the growth of wood and bark, and the inference to be drawn from this is, since the elaboration of the latex depends on the formation of new ducts in the renewed bark tissue (already tapped)—that the production of latex itself must be quickneed. This, however, is too big a question to be settled by inferences, and I hope to be able later on to give a more tangible demonstration of the fact.

Sheet A.

MR. F. M. ELLIOT'S RUBBER PLANTATION, HOLLAND ROAD, SINGAPORE.

Girths of 160 trees.

2 years old on 31st January, 1909.

Plot. O. 40 Trees.	Plot. N.P.K. 40 Trees.	Plot. N. P. 40 Trees.	Plot. N 40 Trees.
21·	18·	17·	12·50
20·50	18·	17·50	12·50
23·	19·50	16·50	16·25
16·50	20·	16·25	11·25
19·	18·50	17·25	12·
14·50	15·	17·	14·50
10·	9·	9·50	15·
9·50	9·50	18·	10·50
13·75	15·	14·	15·
14·50	10·50	13·	24·

Plot. O. 40 Trees.	Plot. N.P.K. 40 Trees.	Plot. N.P. 40 Trees.	Plot. N. 40 Trees
13·50	20·	18·50	14·
11·50	16·	20·25	17·
14·50	16·50	17·75	13·25
10·25	17·	16·	14·
11·	17·50	16·	15·
13·25	18·	13·50	15·
9·	17·75	14·	12·50
13·	9·	15·25	9·50
9·	8·50	16·50	10·
14·	10·	12·50	22·50
13·	20·	20·	13·50
12·50	21·	18·	12·50
14·	17·	17·	15·50
19·50	15.	14·50	8·
20·50	17·	14·	11·50
22·25	19·	17·	12·25
24·	16·25	13·50	11·75
21·75	8·75	13·	10·50
20·50	10·	15·50	11·
22·	10·50	12·	9·75
20·35	22·	19·50	12·25
21.	20·50	16·50	15·50
15·50	17·25	20·	16·50
15·50	14·50	12·35	15·
18·	16·25	15·	11·
18·	17·	13·	7·50
20·	10·50	16·	10·
12·50	12·	14·	7·
19·	18·50 (double	15·	10··75
17·	8· stems)	14·50	9
748	624·25	626·50	507·20

Average 16 cent. 20 = 6⅜ inches. — Average 15 cent. 60 = 6⅛ inches. — Average 15 cent. 66 = 6 3/16 inches. — Average 12 cent. 68 = 5 inches.

Sheet B.

Girth of 160 Trees on 31st May, 1909.

O.	NPK.	NP.	N.
26·	24·	20·50	15·50
24·50	23·	22·50	16·
27·50	24·50	21·	22·
22·50	25·	19·	14·
23·	24·	19·75	15·25
20·25	19·	20·50	18·50
14·25	13·75	11·75	21·50
12·25	13·25	23·75	12·75
17·	20·25	18·50	18·25 } doubl stem
16·50	15·	18·50	16·25 }
19·25	24·	24·50	15·25 }
16·	20·25	22·75	16·75
17·50	22·	22·	19·50
13·	22·75	20·	14·50
14·75	22·	19·	16·25
15·50	22·25	18·	16·
9·50	24·25	16·75	19·
16·25	13·	19·50	13·25
11·	12·25	20·25	10·75
17·25	12·50	15·25	10·25
17·	27·50	24·25	15·50
15·50	26·25	20·	16·
18·	22·50	20·50	13·
123·25	17·50	17·	19·
27·	20.25	15·25	10·
28·50	24·	21·	13·50
28·50	21·25	15·	14·25

Average 20C·50 = 7 15/16 inch. — Average 20C· = 7¾ inch. — Average 19C·19 = 7 9/16 inch. — Average 15·20 = 6¼ inch.

O.	NPK.	NP.	N.
26·50	10·50	17·	14·50
24·25	13·50	17·25	12·50
27·	13·50	15·50	14·
23·50	27·50	25·50	11·
24·	26·50	21·75	15·
19·	21·	25·50	18·
18·	16·	13·25	19·
22·75	19.50	18·	18·25
21·	21·	17·	13·50
24·50	23·75	18·25	7·
16·	16·25 double stem	15·75	12 25
23·	11·	18·75	6·
21·25	12·50	19·50	13·50
	10·50		10·75
802·25	799·25	767·75	608·

SOME NOTES ON CEARA PLANTATIONS.

By GEOFFRY WILLIAMS.

(From the *Agricultural Journal of British East Africa*, Vol. I., Part IV., January, 1909.)

Of all the open districts of East Africa perhaps the least known is the forest belt between Makindu and Voi. The few of us who live there dwell in a solitude that is but seldom broken. The trains pass by in the night, and when the hungry passenger reaches Kiu or Samburu he quite fails to realise that he has covered 150 miles of country during the hours of darkness. To this day I am asked in Nairobi if Kibwezi is not the next station to Voi, or if I do not find it trying to live in the middle of the Taru Desert. But for all that the day may come when this little known area is one of the most important in the country, and we even live in hopes of the time when we may hope to board a train at a more christian hour than two in the morning.

In spite of its bad reputation for fever, our part of the country is favoured in many ways and offers good opportunities to the planter. Everyone of course knows of the big Sansevierea Fibre Concession at Vci and elsewhere, and I will not refer to them here further than to say that in spite of the dangers of fluctuation in price to which fibre is subject and other difficulties, they should become, with the aid of large plantations of sisal, one of the most important industries of the Protectorate.

This article is, however, more particularly concerned with "Ceara Rubber," the prospects of which are undoubtedly promising. The soil and climate appear to suit the tree admirably, and the somewhat variable rains to which we are subject in this part of the Protectorate do not seriously affect it. As is of course well known, ceara is a very tricky species of rubber, and though it will grow almost anywhere, it gives an unsatisfactory yield unless the conditions are exactly right. Too much rain is as bad or worse than too little, and many a tree that appears all that it should be, proves a sad disappointment when tapped. But judging from small first samples taken home last summer, and valued at least equal to the best Para, it seems that the tree is at home in this district, and that it should not now be long before the venture emerges from the experimental stage and begin to yield a satisfactory profit.

The Kibwezi Plantations have certainly not been granted the best of good fortune on starting. The rains of 1908 were lamentably small and development was seriously hampered. Many thousands of trees died in the long drought owing to their not getting the start one had every reason to expect in March and April, and those that survived were greatly weakened and took some time to recover even with the good rains that have fallen since October last; but on the other hand, the trees which were over six feet high before the failure of the rains suffered little if at all, and we have the satisfaction of knowing that once a Plantation is established we need not unduly fear a drought. At the worst the trees will cease to increase in girth and possibly give a small yield for the time, and that is one anxiety off the planter's mind. Since November this establishment has planted out some 80,000 young trees, the majority of which have taken hold satisfactorily, and this year the plantations may fairly hope to recover from the drought and disappointment of 1908. Fortunately sufficient trees were planted before the failure of the rains to enable a certain amount of tapping to be carrried out this year, and by July or August some return of a practical kind ought to be forthcoming.

One does not care to make too many roseate prophecies, but the planters here can at least say that, after some experience they still believe, and with more solid grounds of faith than before, in the excellent prospects of their venture,

To turn from generalities to detail, I will give a few particulars of the management of our own estate. The first thing that any intending planter, at any rate in this district, should bear in mind is that a Rubber Estate absorbs labour as a sponge water. It is easy to draw up tables, more or less accurate, giving the cost of planting a given number of acres, but the expense does not stop there, and I am a firm believer in the absolute necessity of capital for the proper development of an enterprise of this kind. At certain times of the year labour is required in quantity, and as these dates cannot be accurately foreseen since they depend on the fall of the rains, it is essential to keep a good head of labour in readiness. Boys cannot be obtained here at a moment's notice, and the end of August is none too soon to begin gathering numbers for work during the rains in October and November. Our labour is drawn from so many services that it is almost impossible to make out a fixed scale of pay. All tribes drift up and down the line from Wanyanwezi and Swahili to Wakikuyu and Kitui-Wakamba, and conditions are quite different to those obtaining in the Highlands. Roughly speaking however, the scale is as follows:—

Wanyanwezi are taken on at Rs. 8 and no posho.
Wachaga ,, ,, , ,, 6 or Rs. 7 ,,
Wakikuya and Wakamba at Rs 3 or 4 and posho or at Rs. 5 or 6 and no posho.

The rates are of course sometimes raised after a few months. Broadly speaking, we find that taking trouble to understand the various types and make them contended has its effect in keeping down the scale of wages since, here at any rate, a native does not readily want to work, and if he is not satisfied high wages will not keep him. But enough—this article is not intended to be a dissertation on the much prayed labour question.

From the plantation point of view, our year begins at the end of the long rains in May. It is then that the boundaries of new shambas are marked off and the limits of new plantations fixed. Most of the available force of labour is armed with the inimitable panga, and clearing is the order of the day. Week after week and month after month one spends one's time perambulating in the sun under a green cotton umbrella (at least I personally insist on the umbrella) superintending the destruction of the bush. At first sight it would seem as if superintendence was hardly required for such work, but it is annoying how little commonsense is shown by the average boy. A tall tree, for example, is a useful wind break, but that tree if cut down takes four boys a week to get rid of it, yet none but one's best boys can discriminate between such a tree and a rambling bush ten feet high.

Then all this cleared stuff must be piled into vast bonfires and burnt, a proceeding which when a belt of thorn is being negotiated is most trying to the temper and calls for an immense expenditure of matches. Of course, if one could wait till September to burn the refuse, it would then all go in grass fires, but alas! this course is impossible, and our grass being of the most stubborn type utterly declines to burn early in the season. Behind the cleaners the ground must be got ready for the "marker out" at this time, quite the most important person on the estate, and in one case a Manyerna from Tanganyika way with that possession most rare in the native—a straight eye—attended by three satellites one at each end of a wire fifty yards long, and one acting as feeder with an armful of pegs, he meanders about checking angles and squaring corners, and behind him stretches an ever-increasing vista of neat rows 12 feet by 6 feet to mark the ultimate resting places of the rubber trees, some of which will be "permanent" plantation at 12 feet and the rest tapped to death in two years or so.

Attached to the "marker out" is a small force of five or six boys who sit in a shady bit of forest near at hand everlastingly cutting and sharpening pegs. The way is prepared for him behind the cleaners by a gang with jembies who cut through the grass roots and skin the land; this, by the way, being one of the most tiresome and slow of all the steps in the making of a shumba. While all this is going on, there are the seed beds to be looked to, and they are quite as important as anything else. Seeds do not germinate nor young trees grow as well as one could wish in the cold season, and yet from 50,000 to 100,000 seedlings must be got ready against the rains. For all one can do the loss is heavy owing to sun, rats and other causes, and not every seed that germinates sees the shamba; but with fair luck October is reached with a good shamba ready and plenty of young trees waiting to be planted, and then comes a pause in the general activity while every one waits in ill-concealed anxiety for the rain. Will it come up to time (October 30th is the day with us) or not; so much hangs on that, a week more or less in the length of the rains makes such a difference. This year happily it did come on the fateful 30th, next morning there is a rush to the raingauge. An inch or over is enough to risk planting out. If the inch is passed one's energy is portentous; before breakfast the seed beds must be visited and seedlings got up by the thousand. Every available boy plants furiously till dark, while a stream of porters passes to and fro from the river to the shamba (now over a mile and a half) with bundle after bundle of trees. Our aim is to get in 10,000 trees in one day, and once we achieved it, the luckless partner whose fate it is to count the plants gets a backache that lasts a week. After this another lull and more waiting for rain, and so onwards till the rains are over any time between the middle of December and the middle of January. Then comes the cleaning of the shambas. Everything becomes engulfed in a sea of grass, creeper and bitter apple, and the young trees are simply swamped. Cleaning some 250 acres I may point out is not done in a day, and until March it is a race to get it finished. Only the grass up the lines of trees is cleared, but that alone is more than enough. In March come rains again, and all the misses in the shambas are planted up and every effort made to keep down the grass, and before there is time to think of it, it is May once more. Take it all round a fairly strenuous year.

Just a word on the enemies one has to fight as I have done. Happily they are not many, but what they are are serious. First, is the grass. The more you remove it, the more it seems to grow, and if the trees are not kept free they do not take long to make their dissatisfaction evident. Second, come the rats in the seed beds. They have a particular liking for a freshly burst seed and take such heavy toll that it is necessary to plant vastly more than you need to plant out. Third, are the small buck who nip off the tips of the young trees soon after they have sprouted after being cut back on planting out. They do not destroy the tree, but they delay the growth just at a time when every moment is of value and are a great and most exasperating nuisance. Fourth, last and worst are the porcupines. There is nothing a porcupine likes so much as the bulbous root of a young tree, and when we first started planting, we were horrified to find our trees destroyed by hundreds every night. The porcupine digs them up, one by one in the rows and eats the roots leaving the rest to wither. But luckily a low, wide meshed wire fence is a sufficient bar to his depredations, and we now enclose each new shamba before a tree is planted therein. On the whole I think we have reason to be thankful that our enemies are not worse.

I have not mentioned wild pigs, as though I believe they are troublesome at the coast, they have not as yet touched any trees up here.

DEVELOPMENT OF THE AMAZON.

(From the *India Rubber World,* Vol. XXXIX., No. 4, January, 1909.)

The company referred to on another page as having been formed to execute greatly needed improvement works at the port of Para, through which the great supply of Amazon rubber passes, and at which arrives the miscellaneous assortment of the world's products which pay for this rubber, is composed of men of responsibility and distinction in the development of enterprises in new countries which the Amazon region distinctly is. The merit of their proposition is evident by the sale of their bonds in the leading *bourses* of the world, though this may count less with some people than the success of the members of the directory in such enterprises as the Canadian Pacific Railway, the United Fruit Co., and certain important undertakings in South America.

It is impossible that the southern half of this hemisphere should always remain undeveloped. It happens that the development of the Amazon States naturally proceeds along the lines of least resistance by handling its most valuable natural product—rubber. In order to handle rubber economically and to get into the rubber interior the manufactures of North America and Europe, it is necessary to make it possible for ships to approach nearer to the city of Para. What is proposed to be done there has been done on an immense scale at Liverpool and in New York, and why not at Para? The work is lower at Para because of a smaller volume of traffic up to date, and the fact that the owners of capital are not generally informed as to the possibilities of commercial development there. It is not a chimerical proposition at all. It is to the interest of every user of a rubber tyre, to every railroad company, to every consumer of rubber in any form—that the cost of rubber be minimized, and one important item involves the expense of handling freight at the mouth of the Amazon.

Considered alone, the improvement of the port of Para does not measure with the great engineering works of the world, yet it is of distinct importance and interest to the rubber trade on account of the fact that more than half the crude rubber entering into consumption of the world is to-day "lightered" from the Para *trapicthes* into steamers for New York and Europe. There is, beyond this, however, the possibility that allied capitalistic interests may go much further and combine with this assured improvement at Para other large works of utility that likewise have a bearing upon commerce in rubber. Prior to the beginning of the Para enterprise something had been done at Mananos to facilitate the shipment of rubber, and last of all is the projected Madeira-Mamore railway, which now appears to be a certainty. With the Para and Manaos harbour improvements facilitating ocean shipments, and the circumventing of the falls of the Madeira accomplished, and all working in concert—through an understanding between the investor—isn't it possible that the handling of rubber between forest and factory may be materially cheapened.

The dream has been indulged in many times that by "bottling up the Amazon" the Para rubber supply could be so monopolized as to enable a few men to put their own price upon the raw material. But this would be against public policy, and could not long prevail. However, the mere suggestion of the matter has done more than any other one thing to stimulate the planting of rubber in Asia. The intelligent investment of capital does not depend for success upon monopoly, but upon promoting permanently the general good, and this seems to afford a sound basis for the grouping of such interests as have been mentioned here in connection with the rubber region. We do not know that this suggestion has been put into words before, and it may be long before the idea here outlined is realized, but its realization would seem as natural as has been the development of the systems whereby wheat from the Western United States is so cheaply placed in the hands of consumers beyond the Atlantic. The prospect may not be pleasing to the rubber planting interests, but the latter will have ample time in which to strengthen their position before the possibilities of the Amazon have been taken advantage of.

CASTILLOA ELASTICA.

(From the *India Rubber Journal,* Vol. XXXVII., No. 4, February, 1909.)

The pits dug for the unwary Planter who opens out land in *Hevea brasiliensis* without obtaining a preliminary grounding in Plantation lore are shallow compared with those that threaten, or have threatened in the past, the similarly careless Castilloa Planter. In the first place there are at least three species of Castilloa which are catalogued as rubber yielding. The first, most important, and the best yielding variety, is *Castilloa elastica,* Cervs, The two other varieties, *Castilloa Tunu*, Hemsl., and *Castilloa australis*, Hemsl., are not so well known. The former is distributed through the forests of British Honduras, Nicaragua, and Costa Rica, but the gum yielded by it does not compare favourably with that of *C. elastica*, Cervs., though it has uses of its own. *C. australis* is not widely distributed and has no high character as a rubber producer.

It may be judged how unpleasant the consequences might be if the wrong tree was planted, as we believe has occurred more than once. When Kew nods, as it once did, confusing *Castilloa elastica*, Cervs., and *Castilloa Tunu*, Hemsl., the individual planter must work warily.

Castilloa elastica, Cervs., occurs in Mexico, San Salvador, Nicaragua, Costa Rica, Colombia, Ecuador, Guatemala and Honduras through an enormous range in latitude. It probably contributes the greater bulk of the Caucho rubber which comes upon the market.

The exports of rubber (mainly *Castilloa*) from the following countries is thus stated: Costa Rica 132,337 lb. (1906), Honduras 68,000 lb. (1905), Panama 238,760 lb. (1907).

CASTILLOA AND CULTIVATION.

We received a letter from a correspondent by the last mail, in which the effect of wind on Hevea was described, and a remark made to the effect that the wind-blown plants of Hevea were subsequently attacked by pests. To our surprise we learned that the Castilloa trees on the same estates stood the wind better and were free from pests. In the West Indies, where Castilloa is used largely as a shade for rubber trees, the leaves and stems are subject to the attacks of various fungi and insects. Generally speaking, as a separate product or as one for shading minor crops, it is not regarded favourably in the East. In Mexico, however, matters are somewhat different, and a hopeful view is taken of this species.

In its natural state it grows best at a low elevation; above 2,000 to 2,500 feet it grows slowly. The native method of tapping is to inflict a wound by means of a long machette, and to insert a leaf at the base of the gash. These incisions are made around the tree at a distance of 2 to 2½ feet above each other. Throughout the coagulating and drying processes, the natives do not appear to protect the rubber from exposure to light. Very often the latex is spread out on long leaves and exposed to the sun to dry, the result being that a large proportion becomes sticky.

The bark of *Castilloa elastica* is thicker and rougher than that of Hevea, and differs in different parts of the tree. The laticiferous system is also unlike that of Hevea.

ACREAGE UNDER CASTILLOA.

The Republic of Mexico can probably claim a larger acreage than any other part of the world under Castilloa, it being estimated by one authority that something like 110,000 acres have been planted since 1872. We are informed that there are over a dozen plantations, each a few thousand acres in extent, planted with this species.

OILS.

SOY BEANS, OIL AND CAKE.

OPENING FOR INDIAN TRADE.

(From the *Indian Trade Journal*, Vol. XIV., No. 170, July 1, 1909.)

Rapid development has recently taken place in the trade in soy beans in the United Kingdom and other Western markets. These beans, which are the seeds of *Glycine soja*, are grown on a very extensive scale in China and Japan, where they are used as food and also as a source of oil and bean cake. The soy bean oil has proved suitable for many manufacturing purposes, and hence the demand for it has rapidly increased; its price in London is about £21 15*s*. per ton against £21 10*s*. for linseed oil and £22 17*s*. 6*d*. for cotton seed oil. The beans when crushed give about 10 to 16 per cent. of oil, and the cake, as we shall show presently, is used for feeding purposes like linseed cake; while, as a manure, it is said to be particularly useful. Although a comparatively new article of import in England, it is stated that as much as 350,000 tons were imported into the United Kingdom this season, and it threatens to interfere somewhat seriously with the Indian trade in linseed and cotton seed. The value of the beans landed in London is about £6 15*s*. a ton, whereas cake sells at about £6 5*s*. The oil, it is said, has not been found serviceable for the making of paint, linoleum or varnish as it dries very slowly; but it is being used for soap, for lubricating and also for human food.

The soy bean is essentially an Asiatic product and comes mainly from Manchuria. There is reason to believe that it has been tried in various parts of the world, but has not proved a success, requiring a tropical climate. It is cultivated on a considerable scale in India already, but mostly only for local use as a food-stuff or as green manure, and there appears to be no large supply available for export at the present time. In view, however, of the very large demand to which we have referred, it seems to be worth while to determine whether it would not be profitable to undertake the cultivation of soy beans in India as a regular crop for export. The bean will grow fairly well whereever maize can be grown; and, like many other leguminous plants, it has the property of enriching in nitrogen the soil in which it is grown, so that it is particularly suitable for cultivation in rotation with maize and similar crops. This last consideration will probably weigh with the Indian agriculturist, who is not always in a position to purchase manures to improve the output of his fields; while Indian exports of this product would enjoy an advantage over those from Manchuria in the matter of ocean freight.

In *Farmers, Bulletin* No. 58, published by the United States Department of Agriculture, the soy bean is dealt with exhaustively from every point of view. It is there stated that the bean thrives best in soils of medium texture, well supplied with lime, potash, and phosphoric acid. It endures drought well, and is not easily injured by excess of moisture. The early varieties are best for seed crops, and the medium or late varieties for hay, forage, and silage. Seeds may be planted at any time during the spring and early summer, but preferably as soon as the ground becomes well warmed up. If sown broadcast, about three-quarters of a bushel of seed to the acre are required, but only half a bushel if drilled. Little cultivation is needed when growing for forage; when for seed, weeds must be kept down until the plants shade the soil. The soy bean may be used for soiling, pasturage, hay, and ensilage, or the beans may be harvested and fed as grain. The forage is very rich in fat and muscle-making materials, and should be fed with fodder corn, sorghum, or some other feeding stuff rich in fat-forming nutrients. The seed can be fed to the best advantage when ground into meal, and is almost without equal as a concentrated food. It is cut for hay when the plants are in late bloom or early fruit; for ensilage the crop can be cut later, but it is better to cut before the pods begin to ripen; for green forage, cutting may begin earlier and continue rather later than for either hay or ensilage; the crop may be cut for seed after the pods become about half ripe. The soy bean is also excellent for green manuring.

There is reason to believe that the soy bean cake is making headway in England not only on account of its cheapness, but also owing to its superiority over its rivals. For instance, we see it stated in a London newspaper that Professor Douglas A. Gilchrist recently carried out certain trials to test the comparative feeding values of soy and decorticated cotton cake. These trials were carried out at Newton Rigg, the Cumberland and Westmorland Farm School, under the supervision of the manager, Mr. W. T. Lawrence. Three cows and three heifers, after their first calf, were set apart on February 6th, 1909, for these experiments, which continued for twelve weeks. They were all at an early stage of their lactation period at the commencement; and, since the milk naturally declined in quantity as the trials progressed, it was decided to feed soy cake during the first and last three weeks, and decorticated cotton cake during the middle six weeks. The total milk yield of six weeks (throughout the first and last three weeks), when they were receiving soy cake, was 5,576 lbs. or an average of $22\frac{1}{8}$th lbs. (equal to 2 1/7th gallons) per cow daily; while the total milk yield of the same cows during the middle six weeks, when they were receiving decorticated cotton cake, was 5,438 lbs. or an average of $21\frac{3}{5}$th lbs, (equal to 2/11th gallons) per cow daily. So far as milk production, therefore, is concerned there was a slight advantage in favour of soy cake. The milk of the cows that received soy cake contained 3·7 per cent. fat in the first three weeks and 4·1 per cent. fat in the last three weeks. This is equal to an average of 3·9 per cent. fat. The milk of the cows that received decorticated cotton cake in the middle six weeks contained on the average 3·9 per cent. fat. Both foods, therefore, gave the same results as far as the fat content of the milk is concerned. Each cow gained $10\frac{3}{5}$th lbs. in live weight during the six weeks they were receiving soy cake, and 6th lbs. during the six weeks they were receiving decorticated cotton cake. The advantage in this respect is, therefore, again in favour of the soy cake.

There seems to be no reason to doubt that the trade in soy beans, in the United Kingdom at least, will rapidly expand, and it rests with the merchants in India to decide whether they are to have a share in it. This is the more necessary should the product continue to cut into the linseed and cotton seed trades, as recent market reports state that it is doing. Should it permanently affect the demand for Indian cotton seed, the resultant drop in the internal price will afford compensation in that it will improve the projects of those companies that engage in the manufacture of cotton seed oil and ghi substitutes.

FIBRES.

DISINFECTION OF COTTON SEED.

From the *Agricultural News*, Vol. VIII., No. 187, June 26, 1909.)

Now that the time is at hand for planting cotton for the coming crop, it might be well to consider again the advantages to be derived from the disinfection of cotton seed, and the methods to be employed.

Corrosive sublimate is a poisonous substance and a germicide. If eaten by insects, animals or persons, it is a poison in the ordinary sense, and a very powerful poison at that. As a germicide it kills bacteria, fungus spores, and similar organisms by coming in contact with them. It is used in a water solution, at a strength of 1 part of corrosive sublimate to 1,000 parts of water. To make this strength, use 1 oz. of corrosive sublimate and 7 gallons of water or 1 lb. to 100 gallons. The poison may be dissolved in a small amount of hot water, and then poured slowly into the full amount of water. It is essential that the poison should be thoroughly dissolved in water before the solution is used.

There are two points that must be borne in mind—one is, that the wooden tub or cask in which the cotton seed is usually soaked will probably absorb a certain amount of the corrosive sublimate, thus weakening the solution; and the other is that the seed must be thoroughly wetted, but must not stay in the solution too long. In dealing with the first of these points, the tub or cask may be prepared some time before it is proposed to disinfect the seed. After it has been thoroughly washed, the tub should be filled with a solution of corrosive sublimate, 1-1,000, and left to stand a few hours. By this time the reaction between the wood and the solution will have been completed. The solution may then be thrown away, and the tub is ready for use in disinfecting cotton seed.

In order that the seed may be thoroughly wetted it is only necessary to stir it in the solution for a few minutes, when it is first put in, so that the solution may come in contact with all parts of the surface. Ten to twenty minutes should be quite long enough for thorough disinfection.

It is estimated that the cost of disinfection amounts to about one cent for 12 lb. of seed, 1 gallon of the solution being sufficient satisfactorily to disinfect 12 lb., and the planter should always bear this in mind. This solution is weakened by the loss of corrosive sublimate, which is absorbed by the testa or hard outer covering of the seed.

When the seed has become thoroughly wetted it should be taken out and, if it is desired, may be planted at once, without drying; but if it is not to be planted at once it should be thoroughly dried before being put in bags for storing.

There are no disadvantages to the disinfection of seed except the cost and the labour required, each of which is only a small item. The advantages to be expected are several. Seed often germinates better as a result of disinfection; it is reported that fields of cotton planted with disinfected seed suffered less from leaf-blister mite than the adjoining fields, the seed for which was not disinfected; the spores of fungus diseases are often transported with the cotton seed, and disinfection is the best means known of killing such spores and thus warding off subsequent attacks.

One of the most troublesome of the fungus diseases liable to be transported with the seed is anthracnose. This fungus causes the damping off which often kills the young cotton seedlings when only a few days above ground.

When this attack is serious, a large proportion of the seedlings may be killed. Later in the life of the cotton this fungus causes the well-known anthracnose of the boll. If the process of disinfection is carefully carried out, and the directions given herewith are observed, there ought to be no ill-effects from it, but rather well marked benefits ought to be realised.

THE INTRODUCTION OF DRILL-SOWING AND INTER-CULTIVATION:

ON TO THE BLACK COTTON SOILS OF TINNEVELLY, MADRAS PRESIDENCY.

BY H. C. SAMPSON, B.A.

(From the *Agricultural Journal of India*, Vol. IV., Part II., April, 1909.)

In 1907-8, the Government of Madras gave an allotment of Rs. 5,000 for the improvement of cotton cultivation, and it was decided that a part of this sum should be utilised in introducing the practice of drill cultivation for cotton into the Tinnevelly District.

To some extent, the way had been prepared. This method of cultivation had been introduced on to the Koilpatty Agricultural Station, and in the 1906-7 season, after this station had been enlarged, there were 51·35 acres of cotton, all sown with the drill. The crops which were much superior to those outside the farm began to attract attention in the neighbourhood. In March, 1907, when the cotton-picking was at its height, Mr. Couchman, Director of Agriculture, and Mr. Wood, Deputy Director of Agriculture, who then had charge of this division, when inspecting this station, assembled the neighbouring *ryots*. The methods of cultivation were explained to them, the farm crops were compared with those outside, and the implements were shown at work and even handled by the *ryots*. Several of them there and then promised to try this method of cultivation if assistance were given them. The very roughness in the workmanship of the implements pleased them, as such work could easily be turned out by their own carpenters and blacksmiths. But a promise given when a crop is ripe for picking is a very different thing to its fulfilment at the next sowing time, and there were many obstacles to be overcome before such a revolutionary change in the methods of cultivation could be brought about. A brief description, therefore, of the people and the local conditions, and the method of cultivation which it was wished to introduce, seems necessary. The black cotton soil cultivators of this district are both delugus, who, it is said, came south Nuring the time of the Vizianagar and Taick dynasties and settled in the district, and Tamils. The Telugu is noted throughout the Presidency for his love of the black cotton soil, and throughout the whole of the Tamil country Telugu villages are to be found wherever there is any extent of black cotton soil.

In two of the three Taluks which adjoin the Koilpatty Agricultural Station, viz., Ottapidarum and Satur, the vernacular of one-fifth and one-third, respectively, of the total inhabitants is Telugu, and when one bears in mind that this race is almost entirely confined to the black soil areas, the proportion who cultivate cotton must be much greater. The chief Tamil castes are the Vellalas, Pallars, Maravars and Shanars. The first two are both good cultivating castes. The Maravars also cultivate, but depend also on dacoity and cattle-lifting, and are, therefore, not so thrifty. The Shanars are the toddy-drawing caste and are excellent petty-cultivators, growing irrigated garden and cereal crops under wells. Thus, the introduction of any improvement has to be repeated in almost every village, for it by no means follows that if one village adopts an improvement, the next village, if of a different caste, will follow its example. And besides the natural conservatism of the *ryot*, superstition and fear of offending the deities have also to be overcome. As an example of this: in November, 1907, a very heavy rain of more than 7 inches fell on one day and breached several tanks, besides doing considerable damage to the standing crops on the black soil. As a result, some *ryots* refused to work the bullock-hoes in their drill-sown crops, as they said that this rain was a signal of divine wrath. One man actually ploughed up his crop.

The present agricultural practice on the black soil was dealt with in detail in the Scientific Report of the Koilpatty Agricultural Station, 1907-8. From this it will be seen that the Tinnevelly black soil *ryot* is an excellent cultivator. Suffice it to say here that instead of sowing cotton broad-cast, covering with the plough and doing the after-cultivation with hand-hoes, we wished to introduce the practice of sowing in rows with the bamboo seed-drill, covering the seed with the blade cultivator and doing the after-cultivation with the small blade bullock-hoes. All these implements, though common in the Northern Districts and in other parts of India, are unknown in the South of Madras.

When it was decided to take steps to introduce this system of cultivation, there were only two coolies in the district who knew how to work these implements, and these were only local men who had been trained on the Koilpatty Agricultural Station, and who only knew that particular class of soil. Therefore, it was decided to bring down men who had been used, all their lives, to these implements from the Bellary District. Accordingly, some twenty-six sets of implements were made during the hot weather months, ready to be lent out to *ryots*, and six Bellary men were sent down at the beginning of September (six weeks before the sowing season). Five of these only reached their destination; one being afraid to go so far from his native country, left the train at the next station after its departure and went back home. These men were purposely brought down early in the season, so that they could become accustomed to the South Country bullocks and could train the other coolies employed in the Agricultural Station. It proved afterward that it was well that this precaution had been taken, for these men were, with one exception, only of use in training the local farm coolies under the supervision of the farm staff. They proved to be just as conservative, in their own way, as the *ryots*, whom they had been intended to teach. They were unable to handle or drive the bullocks which were unused to the noises made by them when driving. In fact, several *ryots* refused to let these men continue working, as they could not drive a straight furrow and preferred the newly-trained local coolie who was used to their local cattle. This was not the only objection to these Bellary men. They knew no Tamil, and their language was a mixture of Telugu and Canarese, so that they could only make themselves understood in the Telugu villages. Also their different customs and unthrifty habits at once prejudiced the Tinnevelly *ryots* against them.

During the first year of the introduction of these implements, the Manager of the Agricultural Station selected the adjoining Telugu village in which to concentrate his efforts. The selection was a good one. The Telugu, who is comparatively a recent arrival in the district, is not so bound down to custom as the aboriginal Tamil, and it is easier to get him to try improved methods. The village mainly depends on its black soil which was, on the whole, excellently farmed land. Some sixty acres were sown with the drill last season and some excellent crops obtained. In one or two other neighbouring Tamil villages, small areas of 4 or 5 acres were sown. In one case, the owner of the land quarrelled with the whole of the rest of the village for introducing something new, but they were appeased when they saw his crop, and this season in the same village more than seventy acres have been sown with the drill. In the first year about 200 acres were sown on *ryots*' fields with the drill.

In the year 1908-9, a similar allotment was made for cotton improvement, and it was decided to continue this work as well as to introduce seed-farms for growing pure Karangani cotton of the strain selected on the Koilpatty Agricultural Station. This gave an opportunity of spreading this system of cultition further afield than Koilpatty, but was a much more difficult matter to arrange, as in many parts of the district the Department was unknown, and the Agricultural Station at Koilpatty had not been heard of.

In order to cope with this work as well as the extension, probably on the success of the previous year's operations, several new hands had to be trained. This meant a very careful selection on the part of the Manager at Koilpatty, and many of the would-be sowing experts had to be got rid of after a trial. Besides this, the Manager had to bear in mind the villages in which the extension would probably take place, and to train either a man of that village or a man of similar caste. The best men it was found were petty *ryots* who owned land in the village where they were to work. They, as a matter of course, looked after their own interest and sowed their own lands first. This new introduction naturally attracted much attention in the village and gave others confidence in the practice. When the sowing season commenced, there were some twenty-two trained coolies available. Their training was by no means complete, as they had only been taught to sow in dry land, at first with coarse sand, and afterwards with boiled cotton seed. Thus, they had never seen any crops which had come up with their sowing and had never sown in a moist seed-bed. It was necessary, therefore, for one of the staff to be present at the commencement to see that the work was started properly.

The seed-farms were, however, the main outside centres of the introduction of this improvement. Five centres had been selected in different parts of the district, and to each of these trained coolies were sent with a set of implements. My assistant, M. R. Ry. J. Chelvaranga Raju, had charge of this work and made the necessary arrangements with the owners of the land. The terms on which this was obtained were as follows:—The land selected should not have grown cotton the previous season and would be required for one season only. The Government should pay the assessment, provide the seed, sow it with the drill and do the subsequent bullock-hoeing when necessary. The *ryot* was to do the primary cultivation, was to pen the land with sheep, and was to do any hand-weeding, was to thinly crop as directed, and was to sell to the Department the main season *Kappas*, well-dried, at Rs. 4 per candy of 500 lbs. above the market price. It was interesting to follow each of these seed farms, as each was worked under different conditions. The most satisfactory was at Pallikkottia, a Vellala village, where 30 acres of cotton were grown for us. The land belonged to several owners in the village, each contributing three or four acres. No man in the village owned or rather farmed more than 15 acres, and most of them had to depend on this for a living. Thus, we had excellently farmed land to deal with. At first the *ryot* thought that he was risking a great deal, having never seen anything but his own cultivation before, but afterwards, when he saw the germination and subsequent growth, he looked after his share of the cultivation to the best of his ability. We were ingeniously told when inspecting this area that next year we could have our pick of the best lands in the village if we wished to grow cotton again, implying that this year they had given us anything but their best land. This village had already ordered two shares of implements to be made for them in Tinnevelly. The trained coolie who looked to the sowing of the seed-farm had also to sow land, for people wished to try drill cultivation on their own account, but this was confined to another village some ten miles away, as the people of Pallikkottai thought at the sowing time that they were already risking enough in growing seed for us. Though 30 acres of seed farm are allowed for each trained coolie to manage, if we had not been particular about getting the seed sown in good time, he could have sown a larger area. Therefore, this demonstration work was also added, as it was thought that a man of this class would be spoilt if he were allowed to idle his time. In the village where the demonstration blocks were, some inducement was necessary to get people to try this. My assistant offered to sow an area of three acres of land with two pairs of bullocks at the same time that one of the *ryots* who had just commenced sowing broadcast in the next field of similar area would with seven pairs. This offer decided the owner, and the work was completed in both fields at the same time. I saw the crops on inspection two months after sowing. No rain had fallen since sowing till a few days before. In the broadcasted field there were a few stray plants, and the other seeds were just germinating. In the drill-sown field there was an excellent stand.

In the next seed-farm at Maniyachi, it was only with the Tahsildar's influence that people unwillingly consented to grow seed for us; 20 acres belonging to three owners were sown, and naturally they gave their worst fields for the purpose. Cattle could only be hired to work the implements through the influence of the village headman. Sowing was, however, completed on November 11th, having been delayed by previous incessant rain, and no more rain fell till the end of January. The third seed-farm at Mullakulam belongs to a retired Government official, who, until now, has leased out the land on a yearly lease. The land here is poor and very shallow, and, as a result of the system of lease, very foul with weeds, but this year we had to be content with what land we could get. Here one of the objections to locally trained coolies was met with. The man had been used to sowing on the fairly deep soil of Koilpatty, and coming here he sowed at the same depth. Heavy rain soon waterlogged this shallow soil, and germination was spoilt. One of the owner's own servants, an excellent Telugu cultivator, was trained locally to assist this coolie sent from Koilpatty, and he, knowing the land evidently, sowed accordingly, as his sowings gave an excellent stand. The owner has done everything to assist with his share of the work and has now got the land fairly clean, so that the next year his labour will not be lost. Demonstration plots in the neighbouring village of Telugu cultivators have given excellent crops, one of the best that I saw in the course of my last inspection.

The fourth seed-farm of 30 acres is at Nainapuram. Here the owner is a rich man, and with the help of his son and an agent attends to the cultivation himself. This has not been inspected by me as yet, but evidently the crop has proved satisfactory, as the owner has already ordered a set of implements to be made for him for next season. The fifth seed-farm is at Ettayapuram on one of the zamindar's Home-Farm lands. This is 100 acres and the largest of all, but here work is not so easy as it is when the land belongs to smaller *ryots*. The land is not so well cared for, and all the work has to be done through the managers of the several Home Farm lands, while the Home Farm coolie establishments naturally follow the lead of their master. This much depends on whether the manager happens to favour the work. This seed-farm is doing well, and the *ryots* of the village say that this land has never borne such a good crop, but, at the same time, it shows a striking difference to a 20 acres block which the zamindar's uncle has grown for seed for us. The owner attends to all the details of his cultivation himself, and has sown our seed with the drill, but though quite willing to grow seed for the Department, does not care to accept even the assessment. This gentleman frequently visits the Koilpatty Agricultural Station and takes a keen practical interest in what he sees there. He has also had a set of implements made locally for his own future use. His crop was the best I have seen this year.

As these seed-farms were in a way the forerunners of the extension of drill cultivation, the very best of the trained coolies were sent to these. A mistake, however, was made in one or two cases in not making proper arrangements for the welfare of these men. All of them were Pariahs or low caste men, and consequently in some cases they had rather a rough time of it. The sowing season is the commencement of the rains, and there is a great fall in the night temperature after rain. In consequence, several of the coolies fell sick with fever and had to be replaced by inferior men, and even these could ill be spared. In future, arrangements will have to be made in the village to house these men properly and to arrange for their food being prepared at a fixed rate.

Apart from these seed-farms and the demonstration plots in their neighbourhood, there has been a rapid extension of drill sowing in the villages around Koilpatty, where some 500 acres have been sown. One village alone accounted for more than 230 acres, while two more each had over 70 acres. In a few cases, outlying *ryots* have also sown, having either seen the farm crops last year or the crops of *ryots* who had sown with the drill the previous season. Including the seed-farms, there is an area of about 1,000 acres this year sown with the drill.

The mere fact of sowing is, however, by no means everything. Each *ryot* who has sown has to be seen constantly. He has to be induced to thin, and shown when and how, to use the bullock-hoe. As the thinning and, very often, the hoeing clash with other farm work, the *royts* are often unwilling at the time to do so. They may make promises, but they do not always fulfil them. This means considerable patience and tact in dealing with them, Thinning especially goes against the grain, for the *ryot* says, "It is like taking the life of my children to pull these plants which have grown," but still this must be done if this system of cultivation is not to degenerate into that of the Bellary District where the seed-rate is more than double that used in Tinnevelly and no thinning is done. Many of the wives and children of the Koilpatty coolie staff who are employed for casual labour on the Agricultural Station, have had to be pressed into service and sent out with one of the Assistant Managers to show *royts* how to thin their crops. Small boys are probably the best, as their youth favours them in their training, and they can do the work with that unconscious confidence which always appeals to a *ryot*. With all the success already obtained in this introduction, it is by no means certain yet whether this method of cultivation, if now left to itself, would last. The questions which next present themselves are (1) when should the Department withdraw its help, and (2) how to leave the work on a substantial basis. This is, of course, looking into the future, but it seems necessary that the Department should give some concession, but only if the *ryot* will do the same. The proposal next season is that the Department should lend one set of implements to the village for every one that the village is prepared to make, provided that 60 acres are sown with the two sets, and if the villagers among themselves guarantee to sow 200 acres with the drill, the services of the trained coolie will be lent to them for the season. To a very great extent, the success so far attained has depended on the Manager and the Assistant Managers of the Koilpatty Agricultural Station. The Manager, M. R. Ry. A. V, Tirumurunganatham Pillai, has only been at this station for 3¼ years, joining as an Assistant Manager. On 14th December, 1906, he was put in charge of the station, and it says much for him that he, not being a native of this district, should, in that time, gain the confidence of the neighbouring *ryots* as well as the loyal support of his Assistant Managers, and that he can entrust his own coolies, most of whom are Pariahs, to carry out his instructions when sent out into the district. The success of the seed-farms from the very first has largely depended on the untiring efforts of my assistant M. R. Ry. Chelvaranga Raju. It is no easy matter to supervise work in five separate centres scattered over four Taluks, especially when one has to travel through black cotton soil country in the monsoon season.

FIBRES FROM FIJI.

(From the *Bulletin of the Imperial Institute*, Vol. VI., No. 4, 1908.)

The fibres described in the following report were forwarded from Suva, Fiji, in December, 1907, for examination and valuation. They consisted of very carefully prepared specimens of Sisal, Mauritius and bowstring hemps, and of ramie ribbons and filasse.

SISAL HEMP.

It was stated that this sample had been grown in the Government House grounds, and prepared by a Death and Ellwood fibre machine. It consisted of perfectly cleaned and nearly white fibre, of very good lustre and even diameter. The product was from 4 to 5 feet long, and of very good strength.

On chemical examination it yielded the following results :—

	Present sample from Fiji. Per cent.	Sisal hemp from Brit. E. Africa for comparison. Per cent.
Moisture ...	8·7	11·1
Ash ...	0·5	1·0
a-Hydrolysis (loss) ...	8·5	11·2
b-Hydrolysis (loss) ...	10·7	14·1
Acid purification (loss)	0·9	2·3
Cellulose ...	79·0	78·2

This fibre was of excellent quality, superior in composition to many samples of Sisal hemp previously examined at the Imperial Institute, and would be valuable for rope-making. The commercial experts to whom the fibre was submitted considered that it was worth £34 to £35 per ton (with Mexican Sisal at £25 to £27 per ton), and that it would be a strong competitor of the Sisal hemp now produced in German East Africa.

MAURITIUS HEMP.

This fibre was stated to have been prepared at the Government Experimental Factory, Fiji, from leaves grown at Koronibello, Bua, Vanua Levu.

It was soft, well prepared, of good colour, lustre, and strength, and from 4 to 6 feet long.

The results of its chemical examination are given in the following table, to which, for convenience of comparison, are added the results yielded by a sample of the fibre from Mauritius.

	Present sample from Fiji. Per cent.	Sample from Mauritius. Per cent.
Moisture ...	9·5	13·0
Ash ...	1·0	2·5
a-Hydrolysis (loss) ...	14 0	7·5
b-Hydrolysis (loss) ...	16·5	18·3
Acid purification (loss)...	5·1	2·0
Cellulose ...	78·0	76·4

The results of the chemical examination show this fibre to be superior to the sample from Mauritius which was examined at the Imperial Institute. It was of good length and strength, and would make excellent ropes. The fibre was valued by commercial experts at about £31 per ton (with "good average" Mauritius hemp at £22 10s. per ton).

BOWSTRING HEMP.

This fibre, derived from *Sanseveira guineensis*, was prepared at the Government Experimental Factory from leaves grown in the Government House grounds.

It was an excellent specimen, nearly white, of good lustre, fairly even diameter and good strength, and $2\frac{1}{2}$ feet long.

On chemical examination it gave the results which are tabulated and compared below with those furnished by a sample from Sierra Leone.

	Present sample from Fiji. Per cent.	*Sanseveira guineenis* from Sierra Leone. Per cent.
Moisture ...	8·6	10·6
Ash	0·5	0·4
a-Hydrolysis (loss)	9·1	8·9
b-Hydrolysis (loss)	12·1	13·9
Acid purification (loss)	1·3	1·8
Cellulose ...	75·0	78·0

This fibre compared very favourably with previous samples examined at the Imperial Institute, but was rather short for rope-making. It was regarded by commercial experts as worth about £27 per ton.

CONCLUSIONS.

These three fibres were of superfine quality, and would be readily saleable in large quantities. The bowstring hemp was, however, rather short, and it was recommended that efforts should be made to obtain a fibre of longer staple, since the shortness detracts considerably from its value.

The commercial experts, to whom the fibres were submitted, stated that they would be interested to learn whether commercial supplies are likely to be available in the near future.

RAMIE.

Two samples of ramie were received, one consisting of ribbons and the other of filasse.

The ribbons, said to have been obtained by passing the stems through a Death and Ellwood fibre machine, were clean, well-prepared, of pale-greyish straw clour and much stiffer than a standard sample of hand-scraped China grass. The strength was normal and the length of staple 24 to 36 inches; for comparison it may be stated that a standard sample of China grass had a maximum length of 42 inches. A somewhat prolonged treatment of the ribbons with dilute alkali resulted in the production of a clean lustrous fibre.

The commercial value of ramie ribbons of the quality of this sample would probably be about £25 per ton in London, with hand-scraped China grass at from £25 to £30 per ton. It was pointed out, however, that the demand for ramie is somewhat limited, and that it would therefore appear advisable to proceed very cautiously with the development of the industry.

The sample of "filasse" consisted of very lustrous fibre, which was of even pale cream colour. When tested for strength and elongation in comparison with standard samples, it was found to be somewhat inferior, as is shown by the following table:—

	Strength. Grams.	Elongation. Per cent
Standard sample (*a*) ...	36·10	2·80
" " (*b*) ...	42·70	3·00
Ramie from Fiji ...	29·67	2·34

The ultimate fibre had a maximum length of 10 inches and a diameter of 0·0010 to 0·0025 inch, with an average of 0·00162 inch. Microscopical examination showed that the material had the characteristic structure of ramie.

The sample was not in a state suitable for the market, as manufacturers usually prefer to buy the scraped ribbons and to "degum" the material and prepare the filasse themselves.

AMERICAN COTTON TRADE.

COST OF PRODUCING COTTON.

(From the *Indian Trade Journal*, Vol. XIII., No. 165, May, 27, 1909.)

The *Farm and Ranch*, a paper published at Dallas, Texas, has been printing a voluminous correspondence on "What it costs to produce cotton," contributed by farmers, who have given actual figures or estimates based on their own experience. Such estimates are, of course, likely to err, if at all, on the high side, and indeed some of the figures given have been so obviously exaggerated as to draw protests from other farmers. The whole correspondence in nine issues of the paper has been carefully analysed by Messrs. A. Norden & Co. of New York, and excluding only a few letters which contained insufficient details, they have tabulated and averaged the figures contained in the remaining 45 letters, written by 37 farmers in Texas, four in Arkansas, three in Oklahoma, and one in Louisiana. The size of the plantations dealt with ranged from 1 to 100 acres, and the aggregate area was 1,153 acres. The results of this analysis are so interesting that no apology need be made for reproducing them in detail. Messrs. Norden say:—

We have taken everything exactly as given, correcting only some obvious errors, and wherever some one detail was missing we have made full allowance, giving the producer the benefit of the doubt. To take up the items in detail,—preparation of the soil, planting and seed, and cultivation, are exactly as given, the only feature to be noted in these items is the fact that in most of the examples practically none of this expense is really an actual cash outlay, but only an allowance of suppositions wages that the farmer makes to himself for the work done by himself at rates varying from $1 to $3 per day, and averaging about $1·75 per day. "Rent' in most cases is figured at $4 per acre, some paying only $3, while others rent on shares of the produce, in which case it is considerably higher, contingent on the outturn of the crop. Where rent is not mentioned, the farmer owning his own land, we have charged it at $4 per acre. "Wear and tear" on stock and implements is only included by a few, but from those few we gather that 75c. per acre would be a full allowance. To be sure, one man includes a three hundred dollar pair of mules and several hundred dollars worth of implements in his estimate of the cost of one crop of 50 acres, but such figuring is manifestly absurd, as the outfit would serve for at least five crops, possibly ten. We have figured on only five years' life on such property or 20 per cent. annual deterioration. Many have omitted to account for the seed, or have given the seed to the ginner to pay for ginning. In these cases we have figured the seed at only $11 per ton, charging in the ginning column and crediting in the seed column. To arrive at the item "yield of lint cotton per acre," whenever exact figures have not been given, or where the result has been stated only in bales or in seed cotton, we have taken a most unfavourable basis, *viz.*, one bale to three acres, which is rather less than the average, 500 lb. per bale, though Texas cotton averages considerably higher, and the seed cotton to third itself (1,500 lb. seed cotton equals 1,000 lb. seed and 500 lb. lint), though it will probably run 37 to 38 per cent. lint. The estimated net cost of production of one pound of lint in these examples ranges from 1·4c. per lb. to 22·8c. per lb., but neither of these extreme results should be taken as a basis. The former was the result of an exceptional yield—658 lb. of lint cotton per acre, and accounting for the seed at 50c. a bushel, while the latter was the result of a crop failure, 65 lb, of lint cotton per acre. In the following table we have separated the reports as follows:—

	Net cost of production.
General average of 45 reports ...	7.73*c.* per lb.
Average of seven exceptionally favourable reports figuring below 5*c.* per lb.	4·25*c.* ,, ,,
Average of 32 reports figuring between 5*c.*, and 3*c.*	6·82*c.* ,, ,,
Average of six exceptionally unfavourable reports figuring over 9*c.* per lb.	16 04*c.* ,, ,,

——	General average of 45 estimates.	Average of 7 estimates reporting cost below 5 cents.	Average of 32 estimates reporting cost between 5 and 9 cents.	Average of 6 estimates reporting cost over 9 cents.
Acres reported on ...	1,153	31½	880½	241
Preparation of soil (dollars per acre)	1·62	1·34	1·59	1·78
Planting and seed (dollars per acre) ...	·65	·62	·67	·62
Cultivation to maturity (dollars per acre) ...	3·43	4·09	2·78	5·70
Rent (dollars per acre)	4·13	3·46	4·18	4·01
Wear and tear (dollars per acre) ...	·75	·75	·75	·75
Total cost to bring one acre to maturity ..	10·58	10·26	9·97	12·86
Yield of lint cotton per acre (lb.) ...	189	290	209	100
Cost of lint cotton in field (cents per lb.) ..	5·60	3·54	4·77	12·86
Picking (cents per lb.)	2·21	1·69	2·4	2·87
Ginning and hauling (cents per lb.) ..	1·10	·84	1·07	1·44
Gross cost of lint cotton (cents per lb.) ...	8·91	6·07	7·98	17·17
Less value of seed per lb. of lint ...	1·18	1·82	1·16	1·13
Net cost of lint cotton per lb. ...	7·73	4·25	6·82	16·04

It is believed that with this elimination of the extreme figures on both sides, leaving the average of the 32 replies showing cost of production 6-82 cents per lb., the result is a very fair representation based on the producers' own figures of the average cost of producing cotton in Texas; though, as will be seen by the table, this cost depends principally on the yield per acre. No one can figure on the cost of a crop failure, and nothing is allowed for personal expenses of the producer and his family. Obviously the man who raises a few bales of cotton only and nothing else will have a hard time getting along, no matter how high cotton may sell, while the man who raises his own supplies will make money, no matter how low cotton may sell. It is, of course, understood that nothing is included in these figures for "fertilizers." In the Eastern belt this is a serious addition to the cost, though it is probably compensated for to some extent by increased yield per acre.

Messrs. Norden also call attention to the publication in the *Cotton Trade Journal* (Savannah) for April of a statement of cost of production said to be made up from figures given by Mr. J. M. Barwick, one of the leading farmers of Clarendon County, South Carolina. Adding rent and wear and tear to conform with Messrs. Norden's Texas calculations, Mr. Barwick's crop figures come out as follows:—

	$
Ploughing, putting in fetilizers, etc., 20 acres at $8	160·00
Fertilizers, 20 acres at $25 ..	500·00
Hoeing	30·00
Rent	80 00
Wear and tear	15·00
Picking 35 bales at $7·50	262·50
Hauling, ginning, etc., 35 bales at $2 ..	70·00
Gross cost of production ..	1,117·50
Less seed ...	262·50
Net cost of production 35 bales, 17,500 lb. cost of 1 lb, 4·89*c* ...	855·0

In the light of these figures it is difficult to accept the Southern assurances that the farmers "will go to the poorhouse on 8*c.* cotton" and that they "must have 10*c.* to live above want"—unless indeed we interpret "want" in the liberal sense of the economists.

DRUGS.

THE CAMPHOR INDUSTRY.

(From the *Indian Trade Journal*, Vol. XIII., No. 169, June, 24, 1909.)

At a meeting of the Congress of Applied Chemistry in London on May 31st, Professor Haller delivered an address on the Chemistry of Camphor. In the course of his remarks he said that it was about 1905 that the first attempts to supplement the supply by artificial camphor came into view. All the processes of manufacture started with pinene, a carbon compound found in the essential oil of turpentine. The latter was obtained by steam distillation from the resin yielded by various conifers growing in the forests of the temperate zone. The principal countries of origin were, in order of importance, the United States, France, Russia, the Central European States, Germany, and Austria. In recent years Spain had also contributed to the world's markets. The French essence produced from the sea pine was considered to hold the first place in respect of quality; that of the United States, from pitch pine, was less valued; and those of Russia and Germany, obtained chiefly from the *Pinus silvestris*, were of inferior quality. The question of Industrial camphor depended as much on the price of a good essence as on the methods employed. The efforts expended on the problem had resulted in no new fact or original discovery. The numerous methods employed were only improvements or variants of reactions previously known. They might be divided into two large groups according to whether the essence was first converted into hydro-chlorate of pinene, or was submitted direct to the action of organic acids. The high prices of camphor, to which they owed the evolution of the new industry, had only been temporary for reasons which it was extremely difficult to discover. Only those establishments, which in the fortunate period of high prices found themselves in possession of an economical and thoroughly efficient process and were in a position to organize a prompt supply in response to the demand of the moment, had been able to take advantage of the remunerative prices and recover the cost of installation. He should add that the camphor which they produced, apart from its optical inactivity, possessed in all respects the same properties as natural camphor when it was sufficiently refined. Comparisons had been made between the camphor industry and the alizarine and indigotine industries, and some enthusiastic spirits had not been afraid to celebrate this new triumph of industrial science. With regard to the two substances mentioned, science and industry had incontestably got the better of nature. The cultivation of madder had completely disappeared from the departments of the Midi in France, and artificial indigo was on the way to ruin the immense and numerous plantations of India, Java, and Guatemala. Would the same thing happen with camphor? It would be rash to say so, for various reasons which he enumerated. The conditions were very different both with regard to the supply of the natural product, the cultivation of which had been freshly stimulated, and with regard to the fundamental substance used in producing artificial camphor—namely, the essence of turpentine, the supply of which was limited and the price fluctuating. For these and other reasons the future of the camphor industry was uncertain.

PAPAYA JUICE.*

(From the *Philippine Agricultural Review*, Vol. II., No 3, April, 1909.)

Papaya juice is extracted from the fruit of the papaya tree, which grows rapidly, attaining its full bearing capacity in a year. It produces from 40 to 50 papaws of a dark green colour, ripening to a deep yellow, in shape resembling a squash. A very light superficial incision is made in the fruit, and a clear water-like juice exudes therefrom, which becomes opaque on exposure to the air. As it drips from the fruit it is received in a porcelain-lined receptacle. As it is very corrosive, metal receptacles would injure its appearance and qualities. It possesses great digestive virtues, and the refined article is considered superior to all animal pepsins.

After the desired quantity has been collected, the juice is placed in shallow porcelain or glass-lined pans and allowed to evaporate. While this is not a very delicate or difficult operation, it requires considerable attention, so that the juice will dry uniformly and the product be white and well granulated. In its granulated state it is shipped to the United States where it undergoes a refining process, and is sold as the papaw of commerce for medicinal purposes.

* Extract from Annual Report of United States Consul, A. J. Lespinasse, Tuxpam, Mexico.

The ripe papaw is palatable and is an excellent aid to digestion. Meat wrapped in papaw leaves for a short time becomes quite tender without any impairment in appearance or taste.

In extracting the juice the hands should be protected by rubber gloves, as in its crude state it attacks the tissues. An average tree will produce about one-fourth of a pound of the granulated juice. It sells in the United States for from $4 to $6 per pound in the crude state.

"[Papaya, *Carica papaya*, £. (*Passifloraceæ*).—A tree commonly cultivated for its edible fruits, introduced from America."

"The Papaw. Merrill."—A great many types of this tree grow in these islands. It is subject to great variations in growth, gives a heavy yield per acre, and makes good hog feed. When set out 10 by 10 feet apart and cultivated it improves greatly in quality and quantity of yield.—EDITOR.]

EDIBLE PRODUCTS.

THE BRAZIL NUT.

BY H. F. MACMILLAN.

Bertholetia excelsa (N. O. Myrtaceæ.)—"Brazil-nut," or "Para-nut."—A tall handsome tree, with oblong wavy leaves which are 14 to 16 inches long and about 3 in. broad, native of Guiana, Venezuela and Brazil. In its native home, especially on the banks of the Amazon and Orinica, the tree attains a height of over 100 feet. I have no record of its success as yet in the Eastern tropics, except at Peradeniya, where, but for the indifferent ground chosen for it when first planted out thirty years ago (1880), it would seem to find a congenial home. The tree referred to is now about 40 to 50 feet high, produces at the top every year, in the dry season, large erect racemes of white flowers followed several months later by a few fruits, which hang on the tree for many months after ripening. The large round fruit is from 4 to 6 inches in diameter, with a brown and hard woody shell, which has to be sawn, or broken with an axe, in order to get at the contents. In the interior are arranged from ten to twelve large angular seeds with a hard woody testa; these are the Brazil-nuts of commerce, which form an important article of export from their native country, being largely used for dessert in Europe, America, &c. The tree may be propagated by seed or gootee (layering), and thrives best on a rich alluvial soil, in a hot and moist climate.

THE TRANSPLANTING OF RICE.

(From the *Agricultural Journal of India*, Vol. III., Pt. IV., October, 1908.)

(*Continued from p. 124.*)

The water supply on the Raipur station has so far been very inadequate, and for that reason late-ripening paddy has not yet been tried in these series. With a late heavy-yielding paddy and an adequate water supply, the results would have been still more favourable. This is at least indicated by the outturns obtained on the demonstration farms last year, where *Gurmatia*, a late paddy grown in this division, was sown.

The results were as shown below:—

OUTTURN OF PADDY IN LBS. PER ACRE.

	Transplanted by the Department.	Biasi by Cultivators.	Increase due to transplanting.	Value of increases due to Transplanting. In year of normal rainfall.		1908.	
				Rs	A.	Rs.	A.
Jageshwar Farm ..	3,940	2,450	1,490	35	7	49	11
Jawarbhandha Farm ...	1,690	600	1,090	25	15	36	5
Kolar Farm ..	2,880	1,272	1,608	38	5	53	9

The transplanted plots of the department and the *biasi* plots of the cultivators were manured alike and irrigated alike, so that the difference in the outturns is due to the superiority of this new method of sowing introduced. The result appeared all the more striking to the village cultivators, because the department only took over these demonstration plots about a fortnight before the rains, and no manure was applied save that which had been added by the ryot himself. He followed the example set to him by the demonstration farms and irrigated his rice this year for the first time. Even the primitive mind of the chamar could not fail to see that under these circumstances the increase in the outturn must have been due to the one varying factor, *viz.*, the method of sowing. As a cultivator, he could not help seeing that on the demonstration plot the *Sircar* (Government) produced a better crop than his own by means that were at his disposal.

See p. 218. Photo by H. F. Macmillan.

THE BRAZIL NUT (*Bertholletia excelsa*).

In his inspection note on these farms Mr. F. G. Sly, I. C. S., Director of Agriculture, writes:—"It has been fairly demonstrated that the outturn of rice can be very largely increased, indeed almost doubled, by adpoting transplanting instead of *biasi*. All the villagers frankly agreed to this conclusion, and have been evidently much impressed with this demonstration. In discussing the matter with them, I found that most had decided to transplant some of their land next year. Two objections were put forward to a large extension of the practice. The first is that transplanting is more insistent in its demand for water at a particular time; but they agreed that this is no difficulty under good irrigation tanks. The second is that it demands a large supply of labour at the particular time of transplanting, although the total expense is smaller owing to saving of seed and to the avoidance of all weeding after transplanting. This objection has some force, but it is hardly likely to stand in the way of the adoption of such a profitable practice. A third objection is that the system is difficult in parts where the holdings are very much scattered (the survival of the *lakhabhata* system); but this should not militate much against a large increase in the transplanted area. So far as our experience goes both on the Government farm and on the demonstration plots, I cannot point to any strong reason why transplanting should not succeed and extend in Chhattisgarh; although if this is the case, it is extraordinary why it should not have been introduced earlier, seeing that it is practised in the neighbouring districts of Balaghat and Bhandara, and to a very limited extent in Chhattisgarh itself." The introduction of transplanting in a paddy tract is an enormous boon in the increase in outturn due to this method of sowing. It is a means, too, of inducing the cultivator to irrigate his crop, as the department recommends that for the present transplanting should be restricted to irrigated areas where late paddies can be grown. The importance of irrigation alone to this tract can scarcely be estimated, for the Chhattisgarh cultivator is more dependent on water than any other in these Provinces. In a year like that just past, irrigation for him meant a bumper crop, while the want of it meant a very poor yield, much suffering and the necessity of Government relief to tide him over a year of indigence. Despite these facts, the Irrigation Department has experienced very great difficulty in inducing the cultivators of this division to utilize the water of Government tanks, for that the Chattisgarh does not yet fully appreciate the value of water as a factor in increasing the yield of his crops, is evident from the fact that of 2,830,074 acres of rice in this division only 23,528 acres were irrigated during 1907-08. It was clearly the duty of the Agricultural Department to take up this line of work in earnest, and these demonstration farms were, therefore, started *last year* (1907), mainly with the view of getting this backward class of cultivators to inco-operate into the general farm practice of their villages, the results of the work done at the Raipur station, by transplanting and irrigating their staple crop.

Demonstration work has so far been beset with many difficulties, and has in the past been the least successful of all the lines of work undertaken by the Agricultural Department. The success of the work last year was due to the following reasons:—(1) that it was undertaken and carried through with a definite aim; (2) that the department only attempted to demonstrate methods which had been clearly proved by experiment at the Raipur Experimental Station to be practicable and profitable; (3) that the work was carefully supervised; and (4) that the cultivators were made to feel that the work was done solely in their interests.

Other steps taken to popularise this method may be described. Cultivators are encouraged t inspect the Raipur Experimental Farm and see for themselves the results obtained from transplanting there; this farm was visited last year by 4,203 visitors. All the meetings of the Raipur District Agricultural Association are held on the farm, and the members are shown plots of transplanted and *biasi* rice growing side by side, which is an object lesson that appeals to all. A statement of the results obtained from transplanted and *biasi* plots, respectively on the experimental and demonstration farms, is prepared in the vernacular on large cardboard sheets, and the results explained at meetings of the Agricultural Association and at Fairs. Short articles on the same have appeared in the vernacular editions of the *Agricultural Gazette* published by this department; and finally, transplanting was demonstrated last year on the demonstration farms.

As a result of these methods of bringing the advantages of transplanting to the notice of cultivators, it was felt this year that the time had come to induce cultivators to attempt this important improvement on a large scale in their villages.

Last year the object aimed at was to make the demonstration farms a thorough success and to gain the good-will and confidence of the villagers. With this end in view the department supplied both bullocks and seed, and care was taken to see that the agricultural assistant did not worry the visitors by requests for supplies.

It was found necessary, however, to promise the cultivators concerned that, if the crop of the demonstration farms proved a bumper one, they would get all the produce, while if it was only a medium crop, the department would recoup itself by demanding one-half of the same. This condition proved most effective in preventing the owners of the crop from allowing their cattle to graze at night in the rice fields, which is a common practice in Chhattisgarh, and which threatened at first to interfere very seriously with our work owing to the injury done to the nursery beds.

The agricultural assistant in charge allowed such cultivators as expressed their willingness to transplant small areas to take spare seedlings from the nursery plots of the demonstration farms. Cultivators from the neighbouring villages were encouraged to come and inspect the plots transplanted by the Department, and the names of those who promised to transplant this year, and the area to be transplanted by each were recorded. Before last year's crop was harvested, a rough estimate had been formed of the area to be transplanted this year, and nursery beds for the same were prepared during the dry weather. The villages were grouped into what we call demonstration centres, there being four or five villages in each. Each centre was under the charge of an agricultural assistant, and a ploughman experienced in transplanting was placed under his orders in each village. In villages where the malguzar complained of shortage of working cattle, a pair of buffaloes was also sent to him. It was decided to supply the seed free of cost wherever necessary, for two reasons :—(1) because where the cultivators have not been accustomed to irrigate their rice, they grow early or medium varieties, which do not yield so well as the late variety, namely, Gurmatia, which is largely grown on the Raipur farm, and which is recognized as the best heavy-yielding paddy in Chhattisgarh; and (2) free seed was to many an inducement to transplant, more especially to those who had fared badly owing to last year's scarcity. The villagers as a whole share equally in the work of ploughing and sowing the nursery plots, and each transplants his own fields with the seedlings taken from the nursery plots. The nursery plots are thus common property. This co-operation is carried still further when the seedlings are ready for transplanting, and it is no uncommon sight to see almost all the village ploughs at work in one field. In the case of the work being unnecssarily delayed, the malguzar is always appealed to by the agricultural assistants in charge. In villages where the malguzar and tenants were well-to-do, they supplied their own seed. Of the area to be transplanted, the department has supplied seed for 550 acres; while the cultivators are using their own seed for nearly 1,000 acres.

The one great difficulty experienced in carrying through this rather ambitious scheme of work has been that of supplying competent agricultural assistants to put in charge. Owing to the paucity of assistants, it was found impossible to comply this year with all the demands made for assistance in introducing this new method. In the absence of trained men, the department has adopted a plan which promises to be successful in practice. Ploughmen experienced in transplanting have been obtained from districts that are more advanced in rice cultivation. These have been sent out together with a few Chamar ploughmen from the Raipur Farm, some being attached to demonstration centres where they work under the agricultural assistant in charge, while others are employed in villages where they work under the direction of the malguzar, or other respectable cultivator at whose request they have been sent. With the assistance of such men the malguzars of certain villages are transplanting from 20 to 40 acres this year, and some of them are retaining the services of the ploughmen at their own cost. With very few exceptions these malguzars are members of the District Agricultural Associations. In many cases these ploughmen have proved more reliable than some of the agricultural assistants who have been put in charge of this work. They are at least practical agriculturists and belong to the best farming centres, which is not true of many of our assistants. As ploughmen they have been accustomed to hard work under the rather uncongenial conditions which characterise village life in a paddy tract, and readily adapt themselves to similar conditions when transferred to another district. Not so the Brahmin who, accustomed to the comforts of town life and the society of his own caste-fellows, finds life in a humble Chamar village almost unbearable, and leaves his work to look after itself on the pretext of illness.

As ploughmen for this kind of work are not available in Chhattisgarh itself, arrangements have been made to train boys in transplanting on the Raipur Farm. Twelve orphan boys varying in age from 13 to 19 have already completed their training there this year, and will be employed in future, either by the Missions to which they belong, or by the Department of Agriculture, in introducing this method among cultivators. Next year a new batch will be trained, and members of the Agricultural Associations and others interested in the work will also be asked to send men to undergo this training.

That this piece of demonstration work has produced results beyond all expectation, that a great amount of work has been accomplished this year with a very small trained staff, and that even the Chamar cultivators have learnt a most useful lesson from it, is amply proved by the fact that this year with five assistants and twenty-four ploughmen experienced in transplanting, the Department is transplanting about 1,300 acres scattered over thirty-nine villages. In addition to this, the members of the Agricultural Associations, to whom assistance could not be given this year, have agreed to transplant in all about 250 acres.

The success of this piece of work is due in no small measure to the very effective supervision exercised over it by the Superintendent of the Raipur farm; for in these Provinces the policy of the Agricultural Department is to put the Superintendent of the experimental station of each division in charge of the demonstration work of the same. This answers admirably where the Superintendent is a sound practical man. The experimental work and demonstration work form parts of one great scheme; the one is incomplete without the other.

If separate assistants were made responsible for the different parts of that scheme, there would be less efficiency and much less work done per man. With one Superintendent for both, cultivators are made to feel that the demonstration farms are but off-shoots of the experimental farm, the one difference being that the former demonstrates only, while the latter experiments and demonstrates. The Superintendent inspects each centre once a month. The assistants in charge of the different centres forward weekly diaries to the Deputy Director through the Superintendent. The Deputy Director inspects the different centres as often as possible.

This year's results show that the opinion held by many to the effect that the Chhatisgarhi is too lazy and unenterprising to adopt transplantation, that his bullocks are too weak for it and his soils unsuitable, is at least open to doubt. Our experience of the Chamar ploughmen at the Raipur Farm is that they are very good workers when properly directed, though lacking in initiative. Judging from the large number of Chamar cultivators who have this year come from neighbouring villages for seedlings, which they have uprooted for themselves and carried away in head loads for four or five miles, I am convinced that the term "lazy" is not applicable to them all. In any case it is the duty of the Agricultural Department not only to demonstrate improvements, but also to encourage, direct and otherwise assist the less enterprising cultivators to adopt them. That his soil is suitable for transplanting there is no shadow of doubt.

That the weakness of the small Chhattisgarhi bullock will stand in the way of extensive cultivation of any kind is evident; still there are already in every village a few fairly good buffaloes and bullocks of sufficient strength to do all the extra work required for transplanting on a moderate scale even under existing conditions. Next year the Department intends to make the conditions still more favourable for transplanting by encouraging the cultivators to make a lighter *datari* specially for this work, and by letting out buffaloes on hire to cultivators at the rate of one pair for each area of 50 acres to be transplanted.

In his inspection note on the work which is being carried out this year, Mr. B. P. Standen, I.C.S., C.I.E., Director of Agriculture, writes as follows:—

"There can be no doubt that transplantation has come to stay in Chhattisgarh. Nearly the whole of the 38,000 acres now transplanted in this division lies in the zamindaris situated in the hills and jungles to the south, east and west. I am told that a great deal of this so-called transplantation consists rather of thinning by hand than of transplantation proper. All cultivators who have witnessed the demonstrations have been deeply impressed by the great saving of seed and the large increase in the outturn. The difficulties to be overcome before the area transplanted will expand largely, are those mentioned in Mr. Sly's inspection note, together with the scarcity of strong plough cattle and a rumour started by ill-disposed persons, that all transplanted land will be assessed to rent and revenue at a specially high rate. The Settlement Commissioner has promised to take steps to contradict this rumour, and, as the revenue of the greater part of Chhattisgarh is about to be fixed for twenty years, it is not likely to affect transplantation after the current year.

At present the demonstration plots are confined to irrigable land, and it is desirable not to urge transplantion at present on unirrigable land, although it is safely practised on large areas in the Wainganga valley, where the rainfall is somewhat higher (*vide* Mr. Cloustons' para 1). "In that part of the country the rice bunds are generally higher and the fields hold more water than in Chhattisgarh, so that risk of damage by drought is less. When once well established in the irrigable lands of Chhattisgarh, the practice will be readily extended to dry areas. There is no reason to suppose that the labour difficulty offers any serious obstacle. Labour is more plentiful than in the Wainganga valley, but the transplanters naturally work very slowly; with practice they will complete their tasks in one-third or one-quarter of the time, and cultivators will find that they have ample leisure for weeding the *biasi* crop after transplantation is completed. In connection with this part of the subject, it may be mentioned that although the cost of weeding a *biasi* crop properly is not less than that of transplanting rice on a smaller area, the Chhattisgarh very often weeds his crop very perfunctorily, securing no doubt a much smaller crop, but at the same time avoiding expenditure which he perhaps cannot afford without burrowing at a high rate of interest. To such a man the unavoidable expenditure on labour in transplanting is a serious consideration.

"The want of a sufficient number of strong cattle seems to be the most important obstacle at present. The Chhattisgarh bullock is the smallest and weakest in the Provinces, rarely more than 36″ high behind the hump and always in very bad condition in July, when the heavy work of transplantation has to be got through. Buffaloes are used for all heavy work, and with the *datari* used now, are indispensable to prepare the fields for transplantation. It may be possible for the little bullocks to pull the small *dataris* which will be tried next year; but for really thorough cultivation, I think, buffaloes will be required. There is now one pair of buffaloes for every 28 acres of rice land in Raipur District including the zamindaris; but the proportion of buffaloes to rice is much smaller than this in the open parts of the Khalsa. It is found impossible to breed useful buffaloes in the open country, owing to the absence of good grazing areas and the great heat of the shadeless plains; consequently all the buffaloes in the open country are imported. By far the greater number come from Rewah and Saugor, and are bought at from Rs. 60 to Rs. 80 a pair. A few are brought from the zamindaris of Kauria and Bindra Nawagarh. In these remote places there is little demand for *ghi*, and the calves get most of the milk, so that they are fine strong animals and sell for double the price fetched by those from the north. They are consequently less used. Transplantation, while increasing the demand for buffaloes, will provide the cultivator with the means of purchasing them, and we may hope that in a short time the effective demand may so far increase as to make it worth the while of the inhabitants of the northern Feudatories to follow the example of their neighbours in Rewah, and send cattle to the 'Khaloti.' Meantime, we must do what we can by hiring out buffaloes to needy cultivators, as suggested by the Deputy Director of Agriculture, by taccavi loans and possibly by co-operative credit to make smooth the rough path of progress under the feet of the conservative Chhattisgarh till he begins to cry 'Excelsior' without prompting."

This note may fittingly end with the statement that if a normal crop is reaped this year, the additional profits put into the pockets of cultivators by the labours of Mr. Clouston, Mr. Tundilall Powar and their assistants will considerably exceed the whole of the annual expenditure on their salaries and the cost of the experimental farm at Labandih.

Transplanting should in future extend very rapidly in Chhattisgarh if the Agricultural Department continues to work on the present lines. Of the enormous gains which its introduction will mean to the farming community of this division, it is impossible to form anything like an adequate estimate. It should be possible within the next twenty years to raise the standard of cultivation to that already attained in Balaghat. For Chhattisgarh that would mean 1,926,450 acres of transplanted rice or an increase of 1,897,892 acres, which would increase the profits of the farming community of this division by nearly four crores of rupees annually.

THE SPICES OF THE TROPICS.

Their Distribution, Cultivation and Uses.

By H. F. Macmillan.

(*Paper read before the Board of Agriculture, 2nd August, 1909.*)

From remote ages the Spices of the tropics have attracted traders from distant lands, and formed a lure for adventurous explorers. More especially can this be said of the spices of Southern Asia, as the cinnamon of Ceylon, nutmegs and cloves of the Moluccas, cardamoms, ginger, and pepper of Southern India. Some of the ancient cities of Europe are said to have been indebted for a large share of their wealth to the trade in tropical spices during the time of the Romans. Cinnamon, which has long made the name of Ceylon famous, was from the earliest times perhaps the most coveted of all spices. It is mentioned in the Songs of Solomon and in the Book of Proverbs; the Arabians supplied it to the Greeks and Romans, but jealously shrouded in mystery the sources of its origin and the manner of obtaining it. It is supposed that the spice, being first brought from Ceylon to the western coast of India, was carried to Arabia and Egypt by African and Arabian traders, finally reaching Europe after a journey of very many months. Cinnamon was for a long period a State monopoly in Ceylon, and its cultivation was not declared free until 1833. At one time, it is said, cinnamon was sold for £8 per lb., pepper at 10*s*. a lb., while other spices commanded similar fabulous prices. As recently as 1880 cardamoms were sold for over 9*s*. a lb. In 1826 the English import duty alone on pepper was 2*s*. 6*d*. a pound, on nutmegs and mace 3*s*. 6*d*. a pound each, on cloves 5*s*. 7½*d*., while vanilla was taxed to the extent of nearly 17*s*. per lb.

Distribution of Spices.

For a long period the uncultivated or wild trees of the forests furnished the world's supply of spices, which were consequently confined to the natural habitat of the plants. Subsequently the spread and cultivation of spice-producing plants was for a long time retarded by the system of State monopoly established by the Dutch in the principal spice-producing countries. So severe, for instance, was the Dutch consorship in regard to Cinnamon in Ceylon that an infringement was, it is said, punishable even by death. The history of Cloves, Nutmegs and Pepper at the hands of the Dutch in the Malay Archipelago might be told in similar language, the plants being either deliberately destroyed, or their cultivation enforced to suit the circumstances. An amusing story told in this connection is that the Home Dutch Government once despatched orders to their Colonial Governor requesting him to reduce the number of Nutmeg trees, but to increase the cultivation of Mace trees, being of course ignorant of the fact that both spices were produced by the same tree. But this is an error which is not uncommon even nowadays. Sir Hugh Clifford informs us how the clove tree became extinct in the islands of Tidor and Ternate by being deliberately destroyed by the Dutch, in their endeavour to secure their monopoly of the spice by confining the tree to Amboyna. Notwithstanding the severe restrictions of the Dutch, however, the escape of the precious spice plants to other countries gradually took place, both by smuggling and by the agency of migrating birds. Of the latter the principal culprit was a kind of pigeon, which extracted the nutmeg from its pulpy covering, digested the mace, and voided the seed uninjured. The French succeeded in 1770 in introducing the Clove tree into Mauritius and Reunion, from whence it soon reached Zanzibar, &c. A striking result of this is that the world's greatest supply of cloves now comes from these Islands, and not from the native home of the tree, the Moluccas. Similarly Jamaica obtained Ginger from India, and has long practically commanded the supply of that product; and the same may be said of Reunion and Seychelles in regard to the production of Vanilla, whose native home is South America. Now with the free interchange of plants from one country to another, followed by systematic methods of cultivation, the supply of spices has increased manyfold, prices have been reduced so as to bring the articles within the reach of all communities, while the consumption and demand have enhanced in proportion.

The Importance of Spices.

Spices form one of the most important classes of vegatable products. Not only do they contain valuable medicinal properties, but their presence renders agreeable articles of food which are otherwise unpalatable. When used judiciously in cooking they aid the digestion by their effect in increasing the secretion of the gastric fluids; to the confectioner they are particularly essential, and are largely used for his purpose, more especially on the Continent of Europe; while in the preparation of superior beverages they are also important. In medicine certain spices, especially ginger, cardamoms, and cloves hold a very important place, and doctors also find them indispensable in disguising nauseous decoctions. The antiseptic properties of spices, especially cloves, due to their volatile oils, is well known, and for preservative purposes both in domestic and scientific uses, they are often unsurpassed. The appropriateness of spices to sacred uses has long been recognised, being always a favourite ingredient for burning in incense, while in certain social customs of oriental countries spices are to this day used as an emblem of happiness. It is recorded, I believe, that spices were used in the funeral piles of the Egyptian Kings, and that the extravagant Nero burnt at the obsequies of his wife "a quantity of cinnamon and cassia exceeding in amount the whole importation into Rome for one year." Finally, not the least virtue of certain spices is their effect in sweetening the breath of persons who are addicted to masticating habits, popularly known locally as betel-chewing. For this purpose cardamoms especially are esteemed in India and Ceylon, star-anise in China, while the disguising effect of cloves is well-known to genteel topers of other climes. Certain authorities consider that the presence of spices has a beneficial effect on climate, their volatile oils acting as a preventive against mosquitoes and other germ-carrying insects.

The following are the principal spices of the tropics in alphabetical order. These do not include the spices of temperate or warm-temperate countries, such as carraway, cumin, &c.

DESCRIPTION, CULTIVATION AND USES OF SPICES.

S. = Sinhalese. T. = Tamil. N. O. = Natural Order.

Allspice; Pimento: "Jamaica Pepper" (*Pimento officinalis*, N. O. Myrtaceæ).– A small, smooth and white-barked tree, 25 or 30 feet high, native of the West Indies and Central America. The dried unripe berries, which are of the size of small peas, are the Allspice or Pimento of commerce. The name "allspice" is due to a supposed resemblance of the spice to a combination of the odour and flavour of cinnamon, nutmegs and cloves. The tree has been introduced into Ceylon over a century ago and establihsed at Peradeniya, where it flowers in the dry weather, and occasionally sets a few fruits, but outside the Botanic Gardens it is rarely met with in this country. It is considered to yield best in a hot and rather dry climate, and prefers a loose loamy or alluvial, well-drained soil. In Jamaica the berries are picked by hand while green, but just ripe, and then dried in the sun, the latter process taking 6 to 10 days. The fruits are known to be sufficiently dry when the seeds rattle on shaking, and are of a dark colour. A crop cannot be expected within six or seven years, and when in full bearing a tree will yield a hundredweight of the dried spice. Jamaica is the only country that exports this spice. Allspice is sold at present in England at about 2*d*. to 3*d*. per lb.

Pimento oil, which is obtained by distillation from Allspice leaves, is imported into London and sold for 2*s*. 9*d*. to 3*s*. 6*d*. per lb.

Allspice, lemon-scented (*Pimenta citrifolia*, N. O. Myrtaceæ.)—This distinct spice-tree was introduced from Dominica to Peradeniya in 1888, and has become perfectly established here, being now about 30 feet high, of an erect slender habit; but it has not yet fruited. The leaves upon being bruised have a delightful lemon-scented odour.

Allspice, Carolina (*Calycanthus floridus*, N. O. Calycanthaceæ).—A hardy shrub of North America, the wood and roots of which are of a spicy nature, and smell strongly of camphor.

Allspice, Japan (*Chimonanthus fragrans*, N. O. Calycanthaceæ).– A shrub with small pale yellow flowers. Suited for high elevations only.

Bay-rum Tree, or "Wild Cloves" (*Pimenta acris*, N. O. Myrtaceæ).—A small West Indian tree, the aromatic leaves of which yield by distillation an oil which is used in the preparation of Bay-rum. The tree has been established at Peradeniya, and may be seen in the spice collection there. The dried leaves are exported from Dominica and other West Indian Islands to America, &c.

Cardamoms; "Enasal," S. (*Elettaria Cardamomum*, N. O. Scitamineæ).—A perennial with large leafy shoots, 8 to 15 feet long, and strong creeping root-stock (rhizome), native of the moist forests of Ceylon and Southern India, up to 3,000 feet. In cultivation it thrives best at 2,500 to 3,500 feet, provided sufficient forest trees are left to afford protection from strong wind and sun. The spice consists of the fruit, or rather the numerous small seeds enclosed by the green ovoid capsule. The fruits are gathered before they are fully ripe, washed free from sand, &c., and then subjected to sulphur fumes, after which they are bleached in the sun; when dried and ready for export they are of a pale straw colour. As they vary in size and shape, from $\frac{1}{4}$ to $\frac{3}{4}$ inch long, and from oblong to oval or almost round, they are graded for export. Cardamoms are a powerful aromatic and are used chiefly in confectionery, as an ingredient in curry powder, and also in medicine. The seeds are much esteemed by the natives for use with masticatories, or for sweetening the breath. The plants are increased by division of the "bulbs" (rhizomes), or by sowing seed in well-prepared nursery beds. In planting out, 2 to 4 "bulbs" or plants are placed in each hole or clump, these being 7 or 8 feet apart each way, or about 850 to the acre. A small crop may be expected in three years from the time of planting, and from the 6th year a return of 250 lb. to 500 lb. per acre may be obtained according to cultivation, nature of the soil, &c. The plants are in bearing all the year round, the crop being gathered once every fortnight or three weeks; the fruits must be cut by scissors, not pulled by hand. Cardamoms now fetch from 1*s*. 5*d*. to 3*s*. per lb. in London. Twenty years ago they were sold for as high as 9*s*. a pound.

The total export from Ceylon for 1908 was 715,418 lbs., and the highest price realised was about 2*s.* 7*d.* per lb.

Varieties.—"Malabar Cardamom" is distinguished by the leaves being softly pubescent on the under side, and the flower-racemes having a tendency to trail near the ground. "Mysore Cardamom" has the leaves glabrous on both sides, and the flower-racemes are of a more erect habit. The latter variety is therefore preferred for cultivation, as the fruits, being further from the ground, are not so liable to get damaged as those of the trailing racemes.

Cassia Bark; Cassia Lignea, or Chinese Cassia (*Cinnamomum Cassia*, N. O. Lauraceæ).—A small tree, 20 to 30 feet high, with long lanceolate brittle leaves, allied to the Cinnamon. The tree is a native of Southern China, and has been introduced in 1882 to Peradeniya, where it is now well established, bearing seed each year in July and August. The whole tree is pleasantly aromatic. In its native country it is cultivated for its fruit "buds" or for the bark, the latter being peeled off much in the same way as cinnamon, and made up in bundles for export. The first crop of bark is said to be obtained when the trees are about six years old, the yield per acre being "about 11 piculs (1 picul = $133\frac{1}{3}$ lb.), which is sold by the producers for about \$1·50 per picul, *i.e.*, \$18·50 per acre." In addition to this, however, a yearly income is made from the sale of leaves and the dried unripe fruits, the latter being exported as "Cassia Buds," which are esteemed as a spice, especially for confectionery. The tree is propagated from seed, and requires similar conditions of soil and climate as Cinnamon.

Chillies, or Capsicums; "Miris" or "Gasmiris," S.; "Cochika," T. (*Capsicum spp.*, N. O. Solanaceæ).—Small annual or biennial herbaceous, shrubby plants, cultivated throughout the tropics for the sake of their pungent fruits, which are usually an indispensable spice in the food of people in tropical countries, more especially that of the natives. The fruits are also used in pickles and sauces, in the manufacture of "Cayenne pepper," and in medicine. Though all are generally known as "chillies" or "capsicums," there are many species or varieties, such as *Capsicum annuum* (Red-pepper), *C. baccatum* and *C. minimum* (Bird-pepper or Guinea-pepper), *C. frutescens* Goat or Spur-pepper), *C. tetragonum* (Bonnet-pepper), *C. fastigiatum* (from Japan), &c. Some forms of chillies known as "Bell Capsicums," are entirely free from the acrid and burning pungency so characteristic of these fruits, and may be eaten cooked as a vegetable or in salads. Chillies thrive best in loose humous soil, which must be well-tilled, and will grow up to 3,000 feet or more above sea-level. Seeds may be sown in beds or boxes, the seedlings being planted out in well prepared ground when 3 to 4 inches high, at distances of about 2 feet apart, or at the rate of 10,800 plants to the acre. A crop is obtained in about 8 months, and the yield may be from 1,000 lbs. to 1,400 lbs. dried chillies per acre. Chillies sell in London at 30*s.* to 45*s.* per cwt., the "Nepaul chillies usually fetching the highest price, these being sometimes sold in London for £4 per cwt. Chillies are largely exported from Zanzibar, India, Natal, West Indies, &c.

Cinnamon; "Kurundu," S. (*Cinnamomum zeylanicum*, N. O. Lauraceæ).—A moderate or large-sized tree, 40 to 60 feet high, native of Ceylon and South India. In cultivation it is coppiced low, so as to induce the growth of long straight clean shoots, which are cut periodically, close to the ground, for the bark. The young clean bark is slit longitudinally and removed by the "peelers"; it is then piled into heaps to undergo a slight fermentation, a process which facilitates the next operation of removing the cuticle or epidermis, which is done by scraping with a curved knife. The bark then dries and contracts into quills, the smaller of which are placed inside the larger, forming smooth canes about 3 feet long and, when dry, of a light yellowish brown colour. These are made into bales of about 100lbs. for export. Two cuttings a year are obtained, commencing with the rainy seasons, in May and October; the shoots cut are mostly of 2 years' growth. A return of a bale of 100 lbs. per acre may be expected from the first crop, in the 4th or 5th year from time of planting, the yield increasing each year until the 8th or 10th year, when as much as three bales per acre may be obtained. The present price of cinnamon in London is about 7*d.* to 10*d.* per lb. The tree is propagated by cuttings, layers, transplanted stumps, or by seed; seedling plants from nurseries, though usually taking longer to yield a return, are often preferred. The plants are put out in the field at a distance of about 10 feet apart, or approximately 435 to the acre. A light sandy porous soil produces the best cinnamon; the tree thrives up to about 2,000 ft. in the moist zone. "Cinnamon Chips" are the small waste pieces resulting from the cutting and peeling operations, and are exported chiefly for the distillation of "Cinnamon oil." The latter is also manufactured locally to some extent and exported. There are several varieties of Cinnamon, the principal being "Penni" or "Rasa-kurundu," Tittha-kurundu," and "Kahata-kurundu," all Sinhalese names. Cinnamon was the first article of importance exported from Ceylon, and at one time was sold in Europe for fabulous prices.

Clove; "Karâbu," S. (*Eugenia caryophyllala*, N. O. Myrtaceæ).—A small conical tree, 30 to 40 feet high, native of the Moluccas, introduced and established in Ceylon before the arrival of the British. The cloves are the dried unexpanded flower buds. These are picked green, usually during January and February in Ceylon, and being spread in the sun for a few days to dry they become brown. The tree likes a rich sandy soil on sloping land, and thrives up to 1,500 feet. It is propagated by seed, which takes 5 or 6 weeks to germinate. The seedlings, which are of very slow growth, may be planted out when 12 or 15 inches high, at distances of 25 ft. apart. The first crop may be obtained when the trees are 7 to 8 years old, the yield increasing until they are about 15 or 20 years old, when 8 lbs. to 10 lbs. of dried cloves per tree may be obtained. Zanzibar and Pemba furnish by far the greater part of the world's supply of cloves, Penang and Amboyna coming next in importance as sources of supply. The present price of cloves in London varies from 8*d.* to 1*s.* 2*d.* per lb.

Madagascar Clove, or Clove-nutmeg (*Ravensara aromatica*, N. O. Lauraceæ).—A medium-sized tree, 30 to 40 feet high, with small leathery leaves, native of Madagascar, introduced at Peradeniya in 1847. The whole tree is strongly aromatic. The round fruits, of the size of marbles, have a large hard kernel which seems to combine the odour of nutmeg and clove, and is said to be used and esteemed as a spice in its native country, being also exported in small quantities to Europe. The tree is propagated by seed, and is suited to the moist low-country under 1,500 ft. altitude.

Brazil Clove (*Dicypellium caryophyllatum*, N. O. Lauraceæ).—A tree of Brazil, the "cloves" of which are said to be remarkable for their fine aroma, being largely employed in their native country for flavouring as well as for medicinal purposes. The bark furnishes "Clove Cassia."

Ginger; "Inguru," S., "Inji," T. (*Zingiber officinale*, N. O. Scitamineæ).—A herbaceous perennial, with leafy shoots which grow to a height of about 18 inches, native of tropical Asia, but introduced and cultivated in all tropical countries. The underground tuberous stems (rhizomes), resembling thickened roots, are the ginger of commerce. These are called "hands" or "races," from their palmate shape, and are exported in two forms, "peeled," and "unpeeled" (or coated and uncoated) ginger. The former is prepared by scalding the tubers in boiling water, the epidermis being then removed by a narrow bladed knife. Unpeeled or coated ginger (*i.e.*, not deprived of the epidermis) is merely washed, and then dried in the sun. The rhizomes are exported in bags or barrels, and are sold in London at from 40*s.* to 60*s.* or more per cwt. according to quality. Jamaica ginger invariably commands the highest price, Calicut or Cochin ginger usually coming second. The plant requires an equable hot and moist climate, a shaded situation, a rich well-tilled, humous or loamy soil, and thrives up to 3,500 ft. in Ceylon. It is propagated by division of the tubers or rhizomes, which are planted in rows 2 ft. apart, with 16 inches between the plants in the rows. A harvest is yielded about 10 months from the time of planting, when the leaves begin to wither. Under favourable circumstances an acre will yield from 2,000 to 3,000 lbs. or more dried ginger. Ginger has long been highly valued for medicinal purposes, especially in England; it is also esteemed in preserves and confectionery. Preserved ginger is prepared chiefly in China, where the plant is largely grown.

Grains of Paradise, Guinea Grains, or Melegueta Pepper (*Amomum Melegueta*, N. O. Scitamineæ).—A herbaceous perennial, allied to the Ginger and Cardamom plants, native of West Tropical Africa. The small dark aromatic seeds are imported from the Gold Coast into Europe, where they are used chiefly in cattle medicine, for flavouring cordials, and for imparting an artificial strength to spirits, wine and beer. In Africa they are largely used by the natives to season food, and are considered very wholesome. It is said that about 1,000 cwt. of this spice is imported annually into England, and sold for 80*s.* to 90*s.* per cwt.

Mace; "Wasâ-vâsi," S., "Poolie," T.—This consists of the net-like wrapper (*aril*) surrounding the nutmeg, inside the husk (see Nutmeg). At first scarlet, it becomes yellowish brown with drying and exposure. Mace is a much esteemed spice in Europe and America, being used in confectionery and for culinary purposes. In yield the proportion of mace should be about one-fifth in weight of that of the nutmegs, and 100 of the latter will produce about 3½ oz. dried mace. Good pale to fine red mace fetches from 1*s.* 4*d.* to 2*s.* 3*d.* per lb. in London.

Nutmeg; "Sâdikka" S. (*Myristica fragrans*, N. O. Myrtaceæ).—A medium-sized tree, 30 to 50 ft. high, native of the Moluccas, introduced into Ceylon about 1804, now often met with cultivated in the low-country. The "nutmeg" of shops is the hard brown oval kernel of the fruit. Immediately surrounding it is the scarlet aril or *mace* in the form of a net, next to which is the thick fleshy juicy husk. The pale amber fruit much resembles a peach or an apricot in form and appearance. When ripe the husk splits and discloses the nut covered with the mace. The nuts drop to the ground, when they are collected and separated from the mace; both are then dried separately in the sun or in heated sheds. When exported the nuts are graded; 70 to 120 or more go to a pound, these fetching at present in London about 8*d.* to 1*s.* 4*d.* and 4½*d.* to 10½*d.* per lb. respectively, the largest size commanding the highest price. The tree thrives best in deep loamy and well-drained soil, in a hot and moist climate, and up to 1,500 ft. elevation. Being diœcious—that is, the male and female flowers are borne on separate trees—it is impossible to tell to which sex a tree belongs until it flowers. The proportion of one male to 10 or 12 female trees (or 10 males to an acre) should be enough for ensuring fertilization of the flowers of the latter. The trees become productive at the age of 7 to 8 years of age, and increase in yield till they reach about 30 years, when the crop may be 3,000 to 5,000 or more nuts per tree; they produce two crops a year, and continue to be productive for very many years. Trees about 70 years old in Peradeniya Gardens bear heavy crops annually. Propagation is usually by seed, which take about three months to germinate. Sow in pots or boxes under cover or in a well-prepared bed in a shady corner, cover with an inch of fine soil, and water daily in dry weather; artificial shade is beneficial until the seeds are germinated. When the seedlings are old enough to handle, transfer them to baskets or bamboo pots, and plant out in permanent places when 8 or 10 inches high, at distances of about 30 ft. apart. Owing to the uncertainty of the proportion of male and female plants when raised from seed, propagation by budding or grafting should as far as possible be resorted to.

Calabash Nutmeg, also called "Jamaica Nutmeg" *(Monodora Myristica*, N. O. Anonaceæ).—A small tree of Western Tropical Africa, with large leaves and sweet-scented flowers, introduced to Peradeniya in 1897. The large globular fruits contain a number of aromatic seeds whose odour and flavour are considered to resemble those of the nutmeg proper. The tree is suited to the moist low-country, and thrives in moderately good soil. It has not as yet flowered or fruited at Peradeniya.

There are other so-called nutmegs, which are of little or no importance as a spice, such as the "Brazil Nutmeg" (*Cryptocarya moschata*, N. O. Lauraceæ); "Clove Nutmeg" (See "Madagascar Clove"), the Papua Nutmeg (*Myristica argentea*), and the "Wild Nutmeg" of India and Ceylon (*Myristica laurifolia*).

Pepper, "Black" or "White,"; "Gammiris," S.; "Molavu," T. *(Piper nigrum.* N. O. Piperaceæ).—A creeping vine indigenous to the moist low-country forests of Ceylon and South India. Both "black" and "white" peppers are obtained from the same plant. The berries (pepper-corns) when of a reddish colour are picked and spread in the sun, when they become black and shrivelled. This when ground with the outer covering left on, forms 'Black-pepper." By depriving the fruits or "corns" of the black covering by maceration in water, "white-pepper" is obtained. The pepper vine requires a moist heat with shade, and thrives up to 1,500 feet above sea-level. Artificial or natural supports, in the form of posts or trees, are necessary, the latter being preferable and more durable. Erythrina, Mango, Jak and other quick-growing trees answer well the purpose of supports, while they also provide a light shade, which is beneficial. In Sumatra and Malaya posts of some hard and durable wood are generally used for supports. Propagation is best by cuttings, which should be selected from the ends of the best bearing vines, and may either be started in a nursery bed, or put out *in situ* where they are to remain. A crop may be expected in the third year from planting, but the vines will not be in full bearing till the sixth or seventh year. The pepper vine yields two crops a year, and with good cultivation a return of 2,000 to 3,000 lbs. per acre should be obtained, allowing for the plants to be planted 7 feet by 7 feet, or 880 to the acre. The most economical method of Pepper cultivation is to grow the vines on trees which are used for shades for other crops, as "Dadaps" in Tea or Cocoa. Pepper plants will continue to yield good crops for 25 to 30 years. The present market price of pepper in London is from 3½*d.* to 4*d.* per lb., and the chief sources of supply are Penang, Sumatra, and Malabar.

Pepper, Cayenne.—This is made by drying and grinding the smaller and most pungent kinds of chillies, as the fruits of *Capsicum annuum* and *C. frutescens.* The Cayenne-pepper of shops is usually adulterated with flour or other powders.

Pepper, Long—consists of the unripe fruiting spike of *Piper longum* dried in the sun. The plant is a native of India and Ceylon, and is cultivated in parts of India. "Long pepper" is used chiefly in medicine, being less pungent than "black" or "white" pepper.

Pepper, Japan *(Xanthoxylon piperitum.* N. O. Xanthoxylaceæ).—A deciduous tree of Japan, the black aromatic pungent fruits of which resemble pepper-corns, and are used as a spice in Japan.

Pepper, Negro; Ethiopian, or West African pepper (*Xylopia aromatica*, N. O. Anonaceæ).—A tall shurb, native of Western Africa, producing clusters of pod-like fruits which are about 2 inches long. These have aromatic and pungent properties, and when dried are used in West Tropical Africa instead of pepper.

Star Anise (*Illicium verum*, N. O. Magnoliaceæ).—A shrub or small tree, native of Southern China, where it is cultivated for the sake of the fruits, which when ripe burst open and spread out in the form of a star, The whole fruit is agreeably fragrant and aromatic, and in China and Japan is much used as a condiment in cookery, also for chewing after meals to sweeten the breath and as a digestive. It forms an important article of commerce in the Far East, and is imported into Europe and America to some extent for flavouring liqueurs and spirits, being the chief flavouring ingredient in the French "Anissette de Bordeaux." An aromatic oil is obtained from the fruit by distillation resembling Oil-of-anise. Seeds have been obtained on different occasions and sown at Peradeniya, but never germinated. It is said that the Chinese always take good care to boil the seed before it leaves the country, so as to maintain the monopoly of the spice. The Japanese Star Anise is the fruit of *Illicium anisatum*, which has somewhat the odour of Bay leaves.

Turmeric, "Kaha," S. (*Curcuma longa*, N. O. Scitamineæ).—A perennial herb, about 2 feet high, cultivated throughout tropical Asia. The rhizome or tuberous roots, which are of a yellow colour and a waxy resinous consistency, are ground into a fine orange-yellow powder, which has an aromatic taste somewhat resembling ginger. It is commonly used as a condiment in Native cookery, and is a prominent constituent of curry powder ; it is also employed in India for dyeing wool and silk. Turmeric is cultivated in India, whence it is chiefly exported to Europe, &c. The annual yield is from 12,000 to 16,000 lbs. per acre. Turmeric fetches at present in London 5*d.* to 7*d.* per lb. The plant is propagated by the rhizomes, or division of the crown, and is suited to loose rich soil under partial shade, in a hot and moist climate up to 2,000 feet. Cultivation same as for Ginger.

Vanilla (*Vanilla planifolia.* N. O. Orchideæ).—A creeping vine with long fleshy leaves, native of Mexico, and introduced into Ceylon in 1847. "Vanilla Beans" are the dried and cured pod-like fruits, so much esteemed from early times for flavouring purposes. Vanillin, the flavouring substance of Vanilla, has of late been produced artificially, and this together with over-production of the natural article has resulted in making the latter a less profitable cultivation. The vine thrives best in a hot and fairly humid climate, from sea-level to about 1,500 feet; it requires support in the form of light-foliaged trees, or trellises of bamboo, &c., and a mound of humous soil or leaf-mould should be placed round its roots at the base. Among the best live supports for Vanilla are Physic-nut (*Jatropha Curcas*), Calabash (*Crescentia Cujete*), Erythrinas, and the Temple Tree (*Plumiera alba*). Cuttings of the vine from three to six feet long should be planted against the trees or other supports, and tied up to these until established. At the end of 18 months the plants should be pruned back to induce accessible branches. A crop may be expected in three years from the time of planting. The principal flowering season of the vine in Ceylon is April to May. Owing to the construction of the flowers it is necessary to pollinate or "marry" them by hand, as otherwise no fruits will set. The marrying process must be done in the morning or forenoon ; the operation consists of lifting the adhesive pollen masses on a pencil and bringing these in contact with the viscid stigmatic surface. An expert can pollinate from 600 to 700 flowers in half a day. Not more than six flowers in a cluster should be fertilised, and a vine should not be made to bear more than 25 to 30 pods, half that number being sufficient for a weak plant. The fruits are ready for gathering in six to nine months after fertilisation of the flowers, the proper state for harvesting being indicated by a slight yellowing at the end of pods. The latter when collected are dipped into almost boiling water, then placed in the sun to dry, after which they are "sweated,"—that is, rolled up in blankets every evening and placed in a closed box to ferment, being spread in the sun during each day. This process is continued for 8 or 10 days, when the pods will have become brown and pliable. When cured, vanillin accumulates as crystals on the pods. Pods which are inclined to split should be tied up at the end with a piece of thread. If for export, it is necessary to further dry and occasionally turn the pods under cover for five or six weeks, when they may be graded, made up in pound-packets and packed in soldered tins. On an average 125 cured pods will weigh a pound. They are usually exported in boxes of 12 lbs. An acre of good Vanilla with about 680 plants is considered to give a return of about 200 lbs. of cured pods. The price of vanilla fluctuates from about 8*s.* to 18*s.* per lb.

Vanillon or Vanillos (*Vanilla pompona*). —A native also of Mexico, yielding an inferior quality of vanilla known by the names of "Vanillon" or "Vanillos." It is claimed, however, to have advantages over the Vanilla, its pods not having a tendency to split, as well as being easily cured, whilst the vines are said to flower three or four times during the year.

THE QUALITY OF TEA.

(From the *Chemist and Drugist*, Vol. LXXIV., No. 1534, June 1909.)

The subject of what factors determine the quality of tea, and of the best methods of improving the quality of certain grades, has long occupied the attention of tea-growers, and has recently been most exhaustively studied by Dr. Harold H. Mann, Scientific Officer to the Indian Tea Association, who has embodied the results of his observations and experiments in pamphlet form. Hitherto no satisfactory explanation of the variation in the qualities of different teas has been forthcoming, and a complete answer cannot, in Dr. Mann's opinion, be given. Tea owes its value principally to three constituents: (1) Essential oil, producing the flavour; (2) caffeine or theine, producing the stimulating action; and (3) tannin, giving the astringency and, when fermented, the colour to the liquor. The essential oil, though often spoken of, is in reality a material of which extremely little is known. It can only be said that it is an oily body which can be driven off from the tea at a high temperature, especially along with the steam when the leaf is wet. On exposure to the atmosphere the oil quickly changes into a resin with a very marked tea-like smell. It is evidently one of the chief factors in determining flavour in tea. It is equally certain that caffeine is the principal stimulating material in tea, and for long its quantity was supposed to bear, therefore, a close relationship to the market value. This supposition is now proved to be quite unfounded, and though the medicinal value of tea may vary with the quantity of caffeine, the market value certainly does not. It is, however, present in quantities which may vary from 3 to 5 per cent. in good teas, and in the lowest grades it may go down to 2 or 3 per cent. The third constituent of tea of primary importance is tannin. This has generally, if not always, been considered by the medical profession as the objectionable part of tea; but the value of tea in the market, on the other hand, seems to be closely connected with the quantity of tannin easily extracted from the tea by boiling water. The tea, in fact, containing the most tannin, usually have the greater value unless possessed of less flavour—a fact which was proved by Dr. B.H. Paul some years ago. If teas possessing marked flavour be eliminated and the total soluble matter and tannin be determined and considered together, it is possible to form a fair idea of the market value of a tea so far as it depends on the liquor given on infusion. The tannin is, as a matter of fact, the chief, if not the only, source of pungency in teas, particularly when in an unfermented condition, and when changed by fermetation it is the principal factor determining the colour of the liquor. Thus the market points which have value in a tea-liquor may be said to be chiefly caused as follows:—

(*a*) FLAVOUR.—Caused principally by the essential oil.

(*b*) PUNGENCY.—Caused in great measure by the unfermented tannin.

(*c*) COLOUR OF LIQUOR.—Caused chiefly by the fermented tannin.

d) BODY OF LIQUOR.—Measured principally by the total soluble matter, of which a large part is tannin, fermented and unfermented.

Apart from flavour, it is evident that the constituents which it is important to investigate from a commercial point of view are (1) the sum total of substances capable of being dissolved under tea-drinking conditions, and (2) the tannin in all its various forms.

The principal factors leading to the production of quality are stated by Dr. Mann to be:

1. Elevation and in a measure latitude.
2. Regularity and sufficiency of rainfall.
3. Variety of plant.
4. Special character of soil and manuring.
5. Kind of pruning.
6. Method of plucking.
7. System of manufacture.

Each of these factors has its influence, and these are exhaustively considered by Dr. Mann, who says it has too often been the first maxim learnt by a young planter that "good tea is made in the garden and not in the factory," consequently comparative neglect of improvement and of close supervision and care in the factory has been the result. Now it is being more and more recognised that while good tea can be made by no known process from inferior leaf, in a vast number of cases the tea actually produced is inferior to what could, by closer supervision and better-regulated manufacture, be made from the same leaf. It is established, therefore, that while no one factor has been found paramount, there is ample reason to believe that good tea is the result of an enormous number of detailed causes, some under the control of a planter, some beyond his power, and some beyond his knowledge. But once this is realised, and it is becoming increasingly realised in the Indian tea districts, it will become obvious that tea-planting merits more detailed study than has been given to it in the past.

"The Lancet," in an annotation on tea, some time since said that the controversy has long been settled in the minds of scientific men, but has been revived by trade partisans also the argument in favour of China tea on the ground that it is far less astringent than is Indian tea rests on a scientific basis, and that they are content to leave the controversy there. Again, it says, if a dyspeptic is permitted to take tea at all it should be China tea, since analysis has shown again and again it is less likely to derange a delicate digestive system. The adding of milk to tea is considered in the circumstances a perfectly physiological, if not æsthetic, proceeding, as the infusion of a powerful Indian tea would produce infinitely more harm than it does.

THE CULTIVATION OF SWEET POTATOES.

(From the *Queensland Agricultural Journal*, Vol. XXIII., Part 1, July, 1909.)

The sweet potato, so-called, is botanically not related to the English potato, but to the Convolvulaceæ, and is scientifically known as *Convolvulus batata or Batata edulis*; also, rarely as *Ipomea batata*. The convolvulus-like flowers frequently produced by the plant often produce seed from which new varieties have been raised. The plant is cultivated in the first instance for the sake of its roots, which often grow to a very large size; and, secondly, for its spreading vines, which, under certain conditions, afford food for stock, although they should be sparingly used for this purpose, since, like sorghum, they contain a certain amount of a poisonous element. The leaves when cooked make a good vegetable, resembling spinach in flavour and appearance. The sweet potato thrives well in all parts of the sea-board of Queensland, and in inland districts where there is suitable soil and a fair rainfall. Extremely moist climates are not favourable to its cultivation, owing to continuous wet weather producing fungoid disease in the roots. Hence, the most suitable districts for the plant are rather the semi-tropical than the tropical. A good rainfall followed by two or three months of dry heat extending with slight rain at long intervals up to the harvest time are the climatic conditions which are most favourable to the sweet potato.

CHOICE OF SOIL.

The choice of soil is a matter of great importance. Stiff, wet soils are more injurious to the sweet potato than to the English potato. Clay soils and very rich alluvial soils are also objectionable. On the latter, there will be produced an immense quantity of vines, but very few good tubers, the roots all running out long and thin in all directions. The very best soil is a light sandy loam, not necessarily deep, but loose and dry. Even on pure sand good results have been obtained by the judicious use of manure. A well-cultivated sandy, loamy forest soil is preferable to rich black volcanic, or rich alluvial scrub soils.

The soil chosen, then, should be free, dry, and safe from inundation in time of flood.

PREPARATION OF THE LAND.

The land should be ploughed fairly deeply; and, if the soil be very poor, manure of some kind must be used—a potash and phosphoric acid manure at the rate of 550 lb. per acre. Stable manure, if available, may be used, but it should be supplemented with kainit or, if procurable, wood ashes.

PLANTING.

The rows of furrows should be opened up at a distance of from 3 ft. apart, and well loosened and widened. The manure is then applied, the furrows covered with the plough, and flatly ridged up to a height of 6 or 8 in. The young vine cuttings are then planted on top of the ridges about 18 to 20 in. apart. The cuttings should be from 8 to 12 in. long, and the soil should be well firmed round them. Should the weather be very dry at planting time, it will be found advantageous to dip the cuttings in a thick paste of cowdung and loam.

When vines are unattainable, as sometimes happens when planting in August is intended, small tubers should be procured and planted in a well-prepared bed in May. They will throw up an abundant supply of shoots, which must be covered with grass or litter during the winter months, as the sweet potato vine is very susceptile to frost.

AFTER CULTIVATION.

The next business is to keep down the growth of weeds, which will be very much in evidence in the spring, and these are more deleterious to the sweet potato than to many other crops. As a rule, the weeding should begin when the young plants begin to throw out runners. For this purpose a small harrow or cultivator may be run along the rows, and the weeds on the ridges destroyed with a hoe. At the next cleaning, more hand labour is needed, as the vines will be running vigorously. After this, it is well to draw loose soil round the plants, but without burying any of the vines.

Care must be taken, when using a cultivator, not to disturb the hills or ridges. Many growers run the plough between the rows for a third time, first turning over the vines on to their respective ridges. The half of the soil between the ridges is then turned on to the right-hand ridge and the other half upon the left hand. The vines are then brought to their natural position, and the crop henceforth needs no more attention.

HARVESTING.

When the roots are ready for harvesting, which should be before the first frosts set in, the digging should only be done during dry weather. The first thing to do is cut away the vines with a sickle or scythe, when the roots may be lifted either with a digging fork or with a specially adapted plough, which is so constructed as to prevent the roots falling back into the furrows. The roots, which are usually free from adhering soil, are then gathered up and carted to the barn.

KEEPING.

If it is intended to keep them for any length of time to await a favourable market or for winter use, they should be pitted with sand. Put down a thick layer of sand either in the barn or in a well-drained spot outside. On this place a layer of tubers, then run in sand until all the crevices are filled up, and the layer is covered. Now lay down another layer of tubers, run in more sand, and repeat the process until as many as may be required are pitted. Then cover with straw or bush hay.

TO ASCERTAIN THE RIPENESS.

When the sweet potato is ripe, the sap has reached what may, with some propriety, be termed the crystalisable stage, *i.e.*, when the root is cut or broken and exposed to the air, a white crust or artificial skin is formed over the cut part, and protects it from the air and from the agencies of decay. If it is not ripe, the cut part turns black, and no such artificial skin is formed. If, therefore, proper judgment is exercised as to the time and manner of digging, handling, and storing, there is little danger of loss.

CHANGE OF PLANTS.

Owing to the constant planting of cuttings from the same stock, sweet potato tubers will deteriorate and become diseased. The grower will, therefore, do well to obtain cuttings or young tubers from another district. Another certain plan of obtaining a clean crop, free from disease, is to grow the plants from seed as has sometimes been done at the Penal Establishment at St. Helena. When the tubers are about to form, a good plan is to twist the vines up in a heap on top of the main stems. It will then be found that the potatoes will at once begin to increase in number and size. One grower says that it does not matter how rich the soil is, providing the tops are twisted.

NON-SETTIFG OF TUBERS.

It not unfrequently occurs that no tubers, or at any rate only a few, will form. This non-setting may be brought about through various influences; but the most common one is the want of care in selecting cuttings from the most fruitful vines. It is a well-known fact that a cutting will, in almost any case, reproduce the peculiarities of the parent plant; therefore, a crop of tubers cannot be expected from vines taken from an unfruitful parent.

The class of soil has also much to do with the non-tubering trouble. Many soils will produce a good crop of sweet potatoes when newly broken-up, and in a loose, friable condition; but having been under crop for a few years, and becoming, consequently, closer in texture, the results obtained will usually be—plenty of vines and strings, but no tubers.

The best remedy is to obtain some good tubers from a reliable source, preferably from another district. By planting these in a hot-bed, and giving a plentiful supply of water, a number of cuttings would be obtained from the same eye in a very short space of time.

LIABILITY TO DISEASE—THE WEEVIL.

Like most plants the sweet potato is liable to disease and the attacks of insect pests, which affect both vines and tubers.

Of insect pests the worst in Queensland is the sweet potato weevil, which was first noted in Australia in 1886, but whence it arrived here is not known. It was discovered in that year on Mr. A. Miles' farm at Hemmant, near Brisbane. The only remedies which could be suggested by the Government Entomologist were destruction of all affected tubers and a change of crop; but these extreme measures were not adopted. Accordingly, the weevil within the next two years made its way to Woolloongabba, a part of Brisbane itself, and shortly afterwards spread to all the farming districts in the South-eastern part of the State, eventually reaching Bundaberg, Mackay, and all the other Northern sugar-growing districts, utterly destroying the crops.

The damage is noticeable in vines and tubers. The former possess much less foliage than they otherwise should; they are thicker, shorter, and more irregular in growth than in a healthy plant. These thickened stems are found to be hollow and rotten. No tubers are enabled to attain their full development, and they are seen to be pierced with holes, traversed through and through with brown tunnellings, and more or less completely destroyed. The only certain remedy is that already given, viz., complete destruction of the whole crop, and other crops planted instead.

Mr. S. C. Voller, however, says that he found sulphur to be a perfect remedy. He dusted dry sulphur into the crowns or butts of the plants when they began to run, by which means he completely defeated the weevil. A second application might be necessary later on in the season.

POISONOUS PROPERTY OF THE VINES.

Recurring again to the already mentioned poisonous properties of the sweet potato vine, in 1905 several farmers reported serious losses amongst their pigs. In all the cases, the animals had been given sweet potato vines as a portion of their rations. The matter was referred to the Government Analyst, who suggested the possibility of a poisonous glucoside in the vines being the cause of the mortality.

The importance of a closer examination becoming apparent, samples of three different varieties of the sweet potato vine were obtained from the farm of the Agricultural College at Gatton. The analyses of these samples, carried out at the laboratory of the Agricultural Department, proved conclusively the presence of a glucoside, which, on standing for a short time, yields hydrocyanic acid (prussic acid). similar to the poisonous principle found in cassava roots and in the stalks of immature green sorghum.

The following is the result of the analyses:—

	Hydrocyanic Acid. Percentage of Green Manure.
I. *White Maltese*—	
Moisture, 87·4 per cent.; or ·973 grains per lb. of green substance	·0139
II. *Rosella*—	
Moisture, 86·9 per cent.; or 1·113 grains per lb. of green substance	·0159
III. *Spanish Giant*—	
Moisture, 87·0 per cent.; or 1·323 grains per lb. of green substance	·0187

These analyses show that the vines yield as much as 1 gr. of prussic acid per lb. of the green feed, which quantity accounts easily for the sudden death of animals feeding on larger quantities of such food. Boiling the vines, and taking care to pour off the first water in which they were boiled, would considerably lessen the danger.

FOOD VALUE OF SWEET POTATOES.

The food value of the sweet potato will be seen from the following comparative analysis:—

100 lb. of sweet potatoes contain—

	Per cent.
Water	69·32 to 73·11
Ash	1·09 ,, 1.29
Protein (*i.e*, flesh-forming) material... ...	1·38 ,, 2·47
Fibre	0·86 ,, 1·23
Nitrogen free extract (starch, sugar, gum, &c.)...	29·73 ,, 28·46
Fat	0·43 ,, 0·85

a total of 27·46 to 32·49 of dry matter.

As a comparison, it may be said that 100 lb. maize contain 89·1 dry matter, 10·5 of protein, and 75 lb. nitrogen free extract; while 300 lb. sweet potatoes contain 86·7 lb. dry matter, 4·5 lb. protein, and 75·3 lb. nitrogen extract.

MANURE FOR SWEET POTATOES.

Where the soil on which sweet potatoes are to be grown requires manure, the following mixture will be found to be very effcacious after applying stable manure or ploughing under a green crop:—

90 lb. sulphate of potash
90 ,, high-grade superphosphate
90 lb. Chili saltpetre } per acre.

or, instead of 90 lb. high-grade superphosphate, use 225 lb. superphosphate 16 per cent. Mix well.

PINE APPLE INDUSTRY IN INDIA.

(From the *Agricultural Journal of India*, Vol. IV., Pt. II., April, 1909.)

In recent years, the demand for Indian-grown pine apples has so greatly increased that an effort should be made to establish this industry on a commercial scale.

The pine apple is grown extensively in many parts of India and Burma.

On the Malabar Coast, in Northern Bengal, in Assam and in Burma, the pine apple produces fruit of very good quality.

On the Khasi Hills in Assam, it grows excellently and yields a fine fruit.

There has been no particular effort made to develop the cultivation of the fruit on a commercial basis. Therefore, pine apples from the Straits Settlements, Ceylon and Mauritius, find a ready sale in India at remunerative prices.

A warm moist atmosphere, a fairly high rainfall, a friable soil and a porous sub-soil appear to be best suitable for pine apples in India.

Pine apples in India thrive well on soils which have been improved, in forests, by partial clearing and by the natural addition through rainfall of leaf mould. A friable moist soil with a fairly high proportion of organic manure is apparently essential for successful cultivation.

Pine apple plantations, when established 3 or 4 years, should be removed to suitable areas with the view of improving or renewing the vigour of the plant.

When the fruit is formed, numerous suckers grow round the parent stem. These can be used for propagation. Plants may also be raised from the crown of leaves of the fruit, and from the black seeds of the fruit.

In plantation, the suckers should be planted in rows 3 feet apart.

In Bengal, the season for planting out pine apples is August. The plant there flowers in February and March, and its fruit ripens in July or August. In September and October it makes its perfect growth.

Each fruit should be cut off with a sharp knife through the middle of the stock, a little before it is fully ripe, and for export should be very carefully packed in soft material, and in ventilated boxes to avoid fermentation and bruising.

The leaves yield a good fibre. In the London market it fetches about £30 (Rs. 450) per ton. In the Rangpur District of Eastern Bengal and Assam, the fibre is largely used by the shoemakers as string. In the Southern Mahratta country and Goa it is used for necklaces. The Fibre Expert to the Government of Eastern Bengal and Assam is, however, of opinion that the extraction of fibre from pine apple is not likely to be an extensive enterprise in any part of India.

TIMBERS.

TIMBER PRODUCTION.

(From the *Agricultural News*, Vol. VIII., No. 185. May 29, 1909.)

In most countries the question of the world's supply of timber, and its relation to the increasing demand, has received attention of late years. In earlier times the virgin forests that existed in many parts of the world, even in Europe, proved an adequate source of supply of all the timber required. Rapid increase of population, however, has demanded largely extended areas for food-producing purposes, and as a result the primitive forest lands are being increasingly depleted, and applied to agricultural uses. Further, the advance in population has naturally brought about a greater demand for timber of all kinds, to be used in house construction, and in the manufacture of furniture, and many other necessities of modern life. The manufacture of paper pulp is another industry which of late years has drawn enormously upon the sources of timber supply.

The question of a cheap timber supply is a most important one, but of late years there has been a constant tendency towards increase in price, and in most European countries warnings have frequently been given that the planting up of woodlands will have to be undertaken on a much more extended scale if production is to keep pace with demand. Unfortunately for the general consumer, however, the question of time is the most important factor in raising marketable timber, and a number of years must necessarily elapse before the relationship between supply and demand can be placed on a more satisfactory footing.

In Great Britain the total value of the wood and timber imported each year amounts to over £27,000,000, Of this enormous quantity, the great bulk consists of pine, larch, spruce, etc., from Russia, Scandinavia, and Canada. Smaller quantities of more valuable woods, such as mahogany, teak, ebony, etc., are imported from tropical countries.

Since there exists over 20,000,000 acres of waste land in the United Kingdom, the question has repeatedly been urged that portions of this enormous area might well be utilized in the production of a good proportion of the timber now imported. Three Royal Commissions have within comparatively recent years sat to consider this matter, and the third has but lately issued its report. In this the Commissioners state that they have come to the conclusion that of the waste land existing in the United Kingdom, about 9,000,000 acres are suitable for afforestation, and they suggest that about 150,000 acres should be planted up annually. The return obtained in course of time would be sufficient to repay both capital and interest.

In countries where the natural woodlands have been exploited for timber purposes, and adequate replanting has not been done, it is easy to recognize the importance of taking measures that shall ensure an increasing supply of home-grown timber, and lessen dependence on declining foreign sources. But when matters have been allowed to drift for a long period of years, there frequently exist peculiar difficulties in the way of the establishment of systematic timber planting operations. Probably the chief difficulty depends upon the great extent to which the time element enters into the question of the monetary return that may be expected. Re-afforestation is a question of national importance in numbers of countries, but it is also an economic question. The great bulk of the waste lands of Great Britain belong to private land-owners, who in the present depressed condition of agriculture, may well argue that they cannot afford to enter upon an undertaking which will involve great outlay, and from which no return can be expected for from twenty to eighty years or more, and the benefit of which will be reaped by another generation.

These considerations, however, should not weigh with the State, the life of which is continuous, and it is the obvious duty of every Government to see that all the waste lands in its possession which are not adapted to give an adequate return if utilized for agricultural purposes, but which are fitted for growing certain kinds of timber, should be planted up with useful species of trees. Such plantations should serve as an object lesson to private estate owners, and be also useful as Forest Experiment Stations, at which valuable data in regard to the cost of establishing and managing woodlands on the most economical basis could be accumulated.

It should be remembered, too, that a poor soil is, in time, vastly improved by bearing a forest crop, if the trees are maintained in a proper condition as regards density, for the spreading roots permeate the subsoil, draw upon its sources of nutrition, and gradually convert it into soil proper. The fall of the leaves too, and their decay, impart a large amount of humus to the soil, keeping it moist and improving its fertility. The relationship between woodlands and water supply was discussed in the last issue of this journal.

Among European countries Germany has long taken the lead in regard to forestry matters. No less than 26 per cent. of the whole area of that country, or 35,000,000 acres, are under woodland, and the average timber return obtained has been estimated at about 40 cubic feet per acre per annum. By means of University Departments and Forest Academies the German Government has provided excellent facilities for obtaining instruction in the subject. Much the same state of affairs, though on a lesser scale, exists in France. In the Scandinavian countries, forestry is at once an art, and a very paying business. In all those countries, the State forests are making very handsome returns on the capital outlay.

But in no country has the subject of forestry increased so much in importance, or received so much attention, as in the United States during the past ten years. It is stated in the *Yearbook* of the U. S. Department of Agriculture, that since 1897 the National Forests have increased from 39,000,000 acres, practically unused and unprotected, to 165,000,000 acres, used, guarded, and improved in productiveness and accessibility. Though the Government forests have not been under expert control for more than a few years, they are already self-supporting, and will no doubt become highly remunerative with the lapse of time. The facilities for forest education have also largely increased, and regular, systematic courses of instruction, extending over two, three, or four years, are given at seven universities, and a large number of forest schools. Advantage is being taken of these facilities, and the number of graduates from the American forest schools incresaed from three in 1899 to sixty-six in 1907. And yet the article to which allusion has been made calls for more vigorous action in connexion with the national supply of timber, and points out that in the United States as much timber is now being used in one year as can be grown in three.

In the West Indies this matter of re-afforestation has attracted some small amount of attention of late years, although little has been done so far. Large numbers of trees suitable for timber exist in the various islands, and a good deal of useful information in this connexion is contained in two papers entitled respectively, 'The Timbers of Jamaica,' and the 'Timbers of Dominica,' which appeared in the *West Indian Bulletin*, Vol. IX, No. 4, just issued. Useful efforts might be made in the direction of increasing the supply of home-grown timber available for employment in these islands, but the ability to establish an export trade would appear to be limited to particular cases in special islands.

MISCELLANEOUS USEFUL PRODUCTS.

THE PANAMA HAT INDUSTRY.

(From the *Philippine Agricultural Review*, Vol. II., No. 4, April, 1909.)

Owing to the large demand for Panama hats, Americans may be desirous of engaging in the business. I see no reason why the "palmicha" palm would not grow readily in the Philippines. Anyone desiring to start this industry there can get an expert boiler and hatter in Colombia at small cost to teach the art.

These hats are made from the common fan-shaped palm, called "palmicha," which grows wild in abundance, generally in moderate climate and fairly moist ground. Young shoots, uniform in size, are cut from the plant and boiled to a certain stage, being softened thereby and brought to a light yellow colour.

The process of boiling appears to be an art in itself, and only a few people can turn out good straw. The boilers sell the straw at so much a pound, according to the quality and the prevailing prices of hats.

When the proper boiling point is reached, the shoots are put up to dry and the leaves quickly separated. This is done indoors where there is a current of air but no sunshine. When the leaves are nearly dry they are split with a little V-shaped wood instrument, so that every good leaf is the same size. When left alone to dry the leaves curl in at the edges and are then ready for use. At this point the straw is carefully wrapped in clean cloths, as the light and dry atmosphere spoil it. When finished the straw is carefully pared with a pocket knife and then battered all over with a small hand maul, after which it is washed with common yellow soap and a little lime juice and left to dry, away from the sunlight.

In the Suaza district they make the hats on solid wooden blocks, two to four persons—generally women—sitting opposite each other and working steadily. Four women can make an average quality hat in six or seven days, while a fine one requires three to six weeks. The hats made in the Suaza district in Colombia are considered much superior to those made in Ecuador. About a year ago an average Suaza hat cost 45 cents first hand, a good one $1·50, and a very fine one $3; but prices have varied according to the demand, and during the last two years they have been rising steadily, and now, at times, as high as $5 and $6 is paid for them, and not the very finest at that.

The manufacture of these hats is effected to a great degree by climatic influences, an expert hatter being unable to make as good a hat in the dry summer weather as during the raining season; probably on this account hats in some parts of the Suaza district are superior to those made just a short distance away.

Long training is necessary to become a good hatter, and the girls are started at the work at the very early age of ten years, and must practise constantly. Hatters work every day, from early morning, wasting very little time in eating, and often carrying on their work by candlelight so as to finish in time for market, for an hour may mean to them the loss of a market day, and the corresponding inconvenience caused by failure to receive the money which would have been acquired from the sale of the hat.

Consul P. P. Demers states, in a letter from Barranquila, that one of the important industries of the Republic of Colombia is that of making palm hats, known as Panama hats, of which nearly $400,000 in value are exported annually.

This industry follows in importance those of coffee, gold, hides, cattle, tobacco, and rubber, in the order named, and is carried on in the departments of Cundinamarca, Tolima, Antioquia, and Santander, but mostly in the latter where it is the breadwinner of more than one-half the population. There are no regular factories, but the hats are handmade by thousands of peasant women in almost as many households and sold or traded in the local stores in exchange for provisions or articles of clothing, the hat being in these regions a convenient medium of exchange, the housewife exchanging the product of her labour for so many pounds of flour, sugar, etc.

How Panama Hats are Made.

Panama hats are made with the veins or fibres of palm leaf, the tissues of which are scraped off or combed in much the same way as hemp. The palm (*Carludovica palmata*), called locally "jipijapa," is very small in appearance and grows in great quantities on the low and swampy lands of the upper Magdalena. It grows wild but is also cultivated, although to a limited extent, in the largest hat districts, the palm producing in a little over a year. The preparation of the fibre after the tissues have been combed off consists of boiling the same in water containing salt and lemon juice for whitening and rounding its surface; this operation takes a few hours. The straw is then exposed to night air for three consecutive nights, after which it is ready for use. The material employed in the making of a hat is marked at from 15 to 40 cents, or the equivalent thereof, per hat, according to the fineness and whiteness of the straw, the youngest leaves generally giving the best quality. It takes a woman four days to make an ordinary hat, eight days for a good one, and as many as fifteen days for the finest hat made in Colombia. The salary of the peasant woman employed in the making of a "jipijapa" hat is reckoned at 10 cents a day, including her food, which can be calculated at 10 cents additional.

The best hats exported from this country are those called "Suaza," made in the city of that name in the Department of Cundinamarca. The next in order are the "Antioquenos," made in the Department of Antioquia. Then follow the ones made in the Department of Santander, called, respectively, "Zapatoca," "Barichara," "Bucaramanga," and "Giron," from the various cities in which they are made, and varying in quality and price in the order named. But the "Zapatoca," although the most expensive from Santander, are supposed to be less durable.

METHOD OF SHIPPING.

The best Suaza hat exported costs on the premises $5, the cheapest of all being those from the Department of Santander, which range from 50 cents to $2, according to the quality. Indeed, some Panama hats, made at the rate of one a day, sell for less than 50 cents, but these are made exclusively for home consumption and are not exported.

Hats are generally exported by the local merchants, mostly through the agency of a commission house at the port of shipment. In some cases foreign houses buy direct, whereas a few individuals take their own merchandise to the foreign country where it is marketed by them personally. The hats are packed in boxes weighing 132 pounds and containing from 40 to 50 dozens each. The shipping costs, per box, are as follows:—Packing and boxing $2, mule freight to river port $1, river freight to port of shipment, $1, plus one per cent. *ad valorem*, freight to New York, three-fourths of one per cent., or 20 cents per cubic foot, plus 5 per cent., should measurement be more than value; commission, etc., about $1 per box. The box containing 40 dozens of the best $5 Suaza hats, and the cheapest kind exported, 50 cents, will cost in New York the following:—

Item.	Best Suaza	Cheapest.
Purchase price ...	$2,400·00	$240·00
Packing and boxing ...	2·00	2·00
Mule freight to river ...	1·00	1·00
River freight to port of shipment ...	25·00	3·40
Commission, etc. ...	1·00	·50
Freight to New York	18·00	1·30
Total cost of 40 dozens ...	2,447·00	248·20
The cost per dozen in New York ...	61·17	6·20

Panama hats exported from Colombia to the United States may then vary in value from $6·20 to $61·17 per dozen. It is absolutely impossible, without examining the contents of each box, to put the right value on an average shipment, as it is the custom here to include many classes of hats in the same box. It can be rightly supposed, however, that the average hat exported to the United States from this country is at least of a fair quality.

GROWTH OF EXPORTS TO AMERICA.

The first Panama hat sent from this port to the United States was in 1899, and the trade to the present time has increased, as the following statistics of Panama hats exported to the United States from Barranquila alone will show, for the fiscal years which ended June 30: in 1899, $536; in 1900, $518; in 1901, $14,425; in 1902, $84,342; in 1903, $112,649; in 1904, $111,103; in 1905, $79,448; and in 1906, $151,676. The figures given represent the declared value in the consular invoices, averaging approximately 75 cents per hat, a very low estimate.

As above explained, Panama hats are made in a most primitive way. Accordingly, any machinery invented which could increase the output materially and at the same time reduce the number of employees would be a great benefit to the industry which is very attractive, since it needs but a small capital and promises good returns to anyone engaging in it systematically.

[Ten plants of this species (*Carludovica palmata*) were recently imported from Ceylon and planted about March 6, 1909, at the Lamao experiment station, for trial and propagation, if satisfactory.—EDITOR.]

HORTICULTURE.

LABOUR SAVING TOOLS FOR GARDEN WORK.

BY H. SIMMERS.

(From the *Annual Report of the Horticultural Societies of Ontario for the Year 1908.*)

When your Secretary requested me to read a paper at this Convention on this subject, I accepted the same, not realising at the time the difficulty I had before me of preparing an interesting and practical paper.

The title of this paper is somewhat deceptive. At the first blush it has the appearance of a certain sweet simplicity, but when one goes into the subject, the real difficulties appear.

For a practical man to go to work and pick out the tool or tools that he wants seems easy, as, before you commence to work, you have pretty well made up your mind what tools you are going to use on the particular work you intend to do; but to sit down and arrange as many as possible of the labour-saving tools that you would use, is a more difficult task than I thought it would be until I got to work.

I assume that I am to speak on tools most suited for amateur work, because to write on this subject for professionals would enlarge it considerably.

The first, and still the most important tool in the garden, is the human hand, and no doubt in ages past it was the only one. Still, at a very early period, tools of some description had been devised to lighten the labour of the gardener. In our youthful days, also further back than some of us care to admit—a conundrum was propounded. It ran thus, "When Adam delved and Eve span, where was then the gentleman?" Of course, the answer, the obvious answer, is that Adam was the gentleman; and mark you, he was a gardener. Our immediate interest, however, is to enquire what Adam delved with. No doubt he did much work with his hands, still in many gardening operations the very best of tools, but he could not delve very well thus, unless he had something to aid him. The cradle of the human race is in the East, and it is there we can observe customs to-day which had their inception in Adam's time or not long after. The soil there is so sandy and easily worked, that a very primitive stick, sharpened, would be all the labour-saving appliances required. Irrigation is the great problem there. In lands under different climatic conditions, different circumstances naturally arise, and in our own land one must admit that stirring with a pointed stick would not have much effect. Therefore, other labour-saving tools had to be invented. The king of all is still the spade, which is the most inexpensive, and work well done with it produces more crops than any other form of culture.

You will find that among the first and the last things to be done in almost any garden in spring or fall is to have it dug in the spring and again in the fall, and those who are not so fortunate as to be able to employ a man for this work, will better understand the necessity of a pair of good strong arms.

The following is a list of good many articles that I have used myself, that I know are labour-saving tools: Spade, shovel, lawn rake, steel rake, field hoe, Dutch hoe, spading fork, manure fork, garden reel, garden line, grass hook or sickle, pruning knife, pruning shears, pruning saw, half moon edging knife, indelible pencil, labels, appliances for destroying insects, hot bed thermometer garden trowel, tree pruner, watering can, wheelbarrow, lawn mower, hand weeders, such as Hazeltine's, Excelsior, etc,, wheel plow, wheel hoe, hand seed drill.

This is a sufficient list of labour-saving tools for the amateur. It seems to me almost useless to go into the detail and description of all the tools that I have listed, and from which I will refrain, but amongst the list, I would like to draw more attention to the Combination Seed Drill, which has the garden plough, wheel hoe and seed drill combined. Now, to those who have a more pretentious vegetable garden, this modern implement is apt to encourage the amateur to extend his work. I would strongly urge the use of one of these combined machines.

I would also suggest, that all the tools possessed by the amateur be hung up neatly and systematically, and that they should not be thrown in a corner in a careless manner. I see no reason why man's labour-saving tools for garden work should not be kept in the same precise manner that a woman keeps her kitchen utensils. I will add further, that the garden tools should also be kept clean and ready for use.

In conclusion let me add, that many a man can be judged by the orderliness in which he keeps his tools, as also by the way that he keeps his garden free of weeds.

PLANT SANITATION.

ENTOMOLOGICAL NOTES.

BY E. ERNEST GREEN,

Government Entomologist.

It has sometimes been stated by opponents of the burning or burying of tea prunings as a check upon the spread of 'shot-hole borer,' that the mere drying up of the prunings on the surface of the ground is equally efficacious. To settle this question, I obtained a large bundle of freshly pruned tea branches, badly infested by the borer, and spread them on the floor of an open verandah. A few of the branches were examined day by day. The living beetles, in gradually decreasing numbers, were found within their galleries, until the tenth day, when no further insects could be seen in the branches. During the whole of this period I did not find a single dead beetle inside the branches. They simply disappeared, one by one, as the branches became desiccated. It can only be presumed from this that the insects emerged from their retreat, when they found their surrondings unsuitable, and made their escape in search of more congenial quarters. These would be found, in the field, in the nearest living tea bush. It was noticeable that the larvæ also disappeared; but I was unable to trace their migrations. They probably crawled away and died.

Seeds of *Manihot piauhyensis* have been received, with the report that they were being attacked in the nursery, by a species of ant. Specimens of the ants were subsequently submitted and proved to be the common species (*Myrmicaria brunnea*) that throws up circular funnel-shaped embankments around the entrance to its nests. The superintendent writes that he has seen the ants attack the seed and has watched them clean out the shell as soon as it splits. In one instance they bit up and carried off the young germinating shoot. In other instances they devoured all the supporting parts until the shoot fell over. The addition of 'Vaporite' (in the proportion of 2 ounces to the square yard) to the soil, when making up the seed beds, should prevent any trouble of this nature. The nests of this ant, being conspicuous objects, can be easily destroyed in the neighbourhood of the nurseries, either by means of the patent 'Ant Exterminator,' or by pouring dilute Phenol into the nests.

A bad attack of Helopeltis on tea has been reported from the Nawalapitiya district.

I am constantly receiving sections of Hevea rubber stems said to have been killed by Scolytid beetles allied to the 'shot-hole borer.' Sure enough, the bark is riddled by the small beetles and, in some instances, latex has oozed from the perforations. But I have always been sceptical of the ability of any boring insect to penetrate the latex-bearing tissues of a healthy tree. I have recently had the opportunity of examining one such tree *in situ*. I was accompanied by the Government Mycologist who was prepared to detect any signs of the presence of a fungus disease which would account for the original injury. In this case the fungus was apparent even on the surface. A large area of the bark was killed outright and a conspicuous network of mycelium was spreading over the surrounding parts. The presence of latex, oozing from the holes of the borers, can be accounted for by the supposition that the insects have made their entry during a dry spell when the already diseased bark had been deficient in latex. Subsequent wet weather has induced partial revival of the tissues, with a consequent flow of latex from the perforations.

The common cotton-boll worm of Ceylon is the small pink maggot-like caterpillar of *Gelechia gossypiella*. I have recently bred out another moth (*Earias fabia*, Stol.) from diseased bolls grown both at Peradeniya and Maha Illupallama. Both of these moths are well-known cotton pests in India, where yet a third species (*Earias insulana*) also occurs. The Plant Quarantine Ordinance has now been amended to permit of the compulsory fumigation of cotton seed imported for purposes of cultivation.

Specimens of the caterpillar of a Noctuid moth (*C adrina reclusa*) have been received from the Rakwana district where this insect is reported to be defoliating tea plants. This is not one of our common tea pests. I have received it only once previously, from the Talawakelle district, in July, 1903. It is unlikely to prove a serious pest.

Cacao trees of the Nicaragua variety, on the Peradeniya Experiment Station, are being seriously damaged by Helopeltis. This variety appears to be especially susceptible to this particular form of attcak. All the young shoots have been so persistently killed back that the trees are actually dying. It is proposed to coppice them and, upon the first signs of a repetition of the attack, to spray the young shoots with a soap solution.

The same trees, in their weakened condition, have fallen an easy prey to the brown boring catterpillar (*Arbela quadrinotata*).

MISCELLANEA: CHIEFLY PATHOLOGICAL.

By T. PETCH, B.A., B. SC.

In the Supplement to the *Tropical Agriculturist* for May, 1909, it is stated that Dr. Funk, of Apia, has discovered a new parasitic disease which causes the death of Cacao and Rubber trees. It has been named *Hymenochœte noxia*, Hennings. I have not been able to find any further details of this. The description of *Hymenochœte noxia* has apparently not yet been published, and therefore identification is impossible. But it seems most probable that this disease is our well-known "Brown Root Disease." The latter is widely distributed throughout the Tropics, and is easily identified by its habit of cementing sand, soil, and stones to the roots of the trees attacked, by means of its brown mycelium. But while any desired number of specimens can be obtained, these seldom show any approach to a fructification. In one instance I was able to examine three large Hevea trees which had been killed by this disease at intervals of two years; the stump which had been dead four years was almost entirely destroyed by white ants; that which had died two years ago was well decayed but not eaten away; but on neither of these two, nor on the tree just dead, was there any sign of a fructification. Moreover, I have kept diseased stumps under cultivation for four years with equal lack of success. Under these circumstances, it is impossible to say what the fungus really is. In the Report of the Mycologist for 1905, it was referred to *Hymenochœte*, since one sometimes finds bright brown patches, just above the collar, which bear bristles resembling those of a *Hymenochœte*; but, in the light of further experience, I consider this identification very doubtful. It has been assigned to *Hymenochœte*, in Samoa, where it attacks *Cacao*. But in Java, Zimmermann considered that it was a *Sporotrichum*, and named it *Sporotrichum radicicolum;* there are sometimes tufts of branching hyphæ at the collar, which resemble the conidiophores of a *Sporotrichum*. According to Ridley's description, the same fungus occurs in the Straits. It is evident, therefore, that "Brown Root Disease' is common thoroughout the Tropics, and it is most probable that the disease recorded from Apia is not a new disease, but only a new name. Whether its discoverer in Apia has been more fortunate than others in obtaining an identifiable fructification must reamin in doubt until the description of the species has been published. But so long as European Mycologists are willing to give a name to anything that is sent them, and do not take the trouble to acquaint themselves with what has been written on tropical plant diseases, we may expect to be periodically alarmed by reports of "new diseases" which are merely the old diseases under a new name. In Ceylon "Brown Root Disease" attacks Tea, Hevea, Castilloa, Cacao, Caravonica, Cotton, Camphor, and several species of of ornamental shrubs; it is practically omnivorous. But it seldom spreads to any extent, and, as a rule, the removal of the affected tree and the addition of lime to the hole effectually prevents further loss. It is more easily controlled than any other root disease we have in Ceylon.

In the Straits Agricultural Bulletin for July, 1909, a disease of *Hevea* is recorded from Perak. The trees attacked are about two years old. They die back from the tip, down to the base, if the tree is not stumped below the diseased part. A black fungus, with oval spores transversely divided, is found in the dead tissues. This appears to be identical with "Die back," which has been known to occur in Ceylon since 1905, and has been referred to on several occasions in the Annual Reports. The fungus which attacks the leading shoot is a *Glœosporium;* it turns the shoot brown and soft, usually about the middle of its length. Afterwards the shoot becomes hard and grey, and the fungus produces spores in minute pink or white masses. According to my observations, this fungus does not attack those parts of the stem in which the wood is already formed; but, after the death of the leading shoot, other fungi grow on the dead tissue, and these kill off the remainder of the tree. The chief of these secondary fungi is *Botryodiplodia elasticœ*; it forms black patches in the bark, and these produce large numbers of black, oval, transversely divided spores. There is not much doubt that the fungus described in the Straits Bulletin is *Botryodiplodia elasticœ*. This fungus is extremely common on all dead Hevea, no matter what the cause of death was, and it is therefore very difficult to determine when it is parasitic and when it is merely saprophytic. It does not appear to be a very active parasite. It undoubtedly kills off stumps just after they have been planted out, and it has been found to kill *Castilloa* which had been damaged by fire. But in the majority of cases it can only attack the trees after some part has been killed. It grows in abundance on *Hevea* logs in the laboratory, though these may have been quite healthy when cut. Trees attacked by "die back" should be pruned below the diseased parts; and the latter should be burnt. In view of the fact that *Botryodiplodia* will grow on any dead *Hevea* tissue, all dead branches ought to be periodically removed and burnt; there is no doubt that this will have to become a regular practice in Hevea cultivation. Branches die from many causes apart from fungus diseases, *e.g.*, wind, over-tapping, shade, etc., and if these are left on the tree they afford a starting point for fungi which could not otherwise attack it.

It is hoped to issue circulars on Brown Root Disease, Die back, and *Botryodiplodia*, shortly.

Botryodiplodia elasticæ affords another instance of the multiplication of names which results from the transmission of specimens of tropical diseases to Europe. Species of *Diplodia* occur everywhere in the Tropics, on all kinds of dead plants, but the majority of them are merely saprophytic, *i.e.*, they grow only on dead tissues. If a *Diplodia* occurs in masses, it is known as *Botryodiplodia*, and if the masses are surrounded by loose hyphæ, it is known as *Lasiodiplodia*. But, unfortunately, these apparent distinctions break down in practice, for the same species may exhibit all three forms. In that case it usually gets three different names, according to the form which each describer happens to have. *Botryodiplodia* is a convenient name for those species which may sometimes grow in masses and sometimes singly, and distinguishes them from those species which *always* grow singly, but *Lasiodiplodia* is a purely herbarium distinction for which we have no use in practice.

The best known parasitic *Diplodia* is *Diplodia cacaoicola*, which, as its name indicates, grows on Cacao. *Botryodiplodia elasticæ* is also semi-parasitic on Hevea and Castilloa. Another *Botryodiplodia* causes a root disease of tea, and yet another a root disease of the Coconut palm. Now, the *Diplodia* on Cacao (*Diplodia cacaoicola*) was sent to Germany, and was unnecessarily renamed there *Lasiodiplodia nigra*. More recently, a consignment of Hevea stumps was sent from Ceylon to Hamburg, and as some of them died in transit they developed *Botryodiplodia elasticæ*, but the fungus was, in this case also, assigned to *Lasiodiplodia nigra*. We may expect to hear, therefore, of a new disease of Hevea under the latter name, which is really only our old, well-known fungus. But a much more serious question than the mere nomenclature is involved in this bestowal of the name of the West Indian fungus on the Ceylon species, for it has been thereby assumed that the fungus which attacks Cacao is the same species as that which attacks Hevea. This is a most important point which, if correct, will have to be taken into consideration by those who establish mixed cultivations. But while it may be admitted that the diplodias on cacao, Hevea, tea, and coconut show practically no difference in structure, this is scarcely sufficient to warrant the assumption that they are all the same species. The structural characters of a diplodia are very simple, and there is little room for variation. Under these circumstances, it is necessary to prove the identity of the fungi by showing that the species, say on cacao, can be made to grow on the other plants. Until this has been done, the question of their identity must remain unsettled. The point was noted in the Report of the Mycologist for 1908, but since the investigation of the subject would occupy several months, it has not yet been found possible to undertake it.

Opinions with regard to the distances at which Hevea should be planted have now come round to the view which had to be fought for in 1906. It is no longer necessary to contend with the idea that Hevea may be planted eight feet by eight; and it is being recognised that the minimum advocated three years ago is not "wide planting," if the plantation has been established as a permanent investment. But, as I was the first to oppose close planting in Ceylon, I have been asked on several occasions why, if *Castilloa* can be planted about eight hundred to the acre, the same cannot be done in the case of *Hevea*. The answer is, of course, that the trees are of different habit, that is, they have a crown of a different shape. Dr. Ohlson Seffer, who is the chief authority on Castilloa cultivation, described the Mexican methods when he visited Ceylon some years ago. In the course of conversation, he stated that when the trees grew up and were too close some of them would be cut out. He was immediately asked what his criterion of closeness was. The answer was rather startling, even to advocates of a minimum of 20 ft. by 15 ft. "When the crowns of two trees touch, one of them is cut out." It will be evident from this that it is impossible to deduce conclusions re *Hevea* planting from experience with *Castilloa*. Few *Hevea* planters would be prepared to thin out their trees when the crowns meet, though according to the last report of the Bukit Rajah Company it is proposed to thin out trees planted 21 ft. by 21 ft. for this reason. In this matter, my contention that trees which are removed in the course of thinning out should be *uprooted* appears likely to be confirmed at no very distant date. "Uprooting," by the way, does not mean the extraction of every root. Fungi begin to grow, as a rule, on the stump left above ground; and, for the prevention of root disease, the stump, and as much of the main roots as possible, should be extracted to a depth of about two feet. If more can be got out, so much the better.

LIVE STOCK.

THE NURSING OF SICK ANIMALS.

BY J. M. CHRISTY,

Assistant Principal Veterinary Surgeon, Transvaal.

(From the *Veterinary Journal*, Vol. V., No. 409, July, 1909).

Too much attention cannot be given to this subject. My experience is that owners are far too liable to place implicit faith in medicinal remedies, and are either ignorant of how to nurse their patients through serious attacks of illness or are too negligent to do so. Proper medicines intelligently administered play a most important part in combating all forms of disease, but to be successful they must be backed up by good nursing. We have all heard well-intentioned but ignorant people extolling the medicinal virtues of anti-friction grease, paraffin oil, and gunpowder, but seldom hear them speaking enthusiastically about nursing, which is a troublesome thing, calling for energy and patience.

The most important duties of anyone in charge of sick animals is to see that his patients are made as comfortable as circumstances will admit, that proper food only, and at regular intervals, is given, and that any medicine prescribed is administered exactly according to instructions. I do not assume to dictate to any man, but a quarter of a century's experience in dealing with sick animals has impressed forcibly on me the good results following careful, intelligent nursing, as opposed to indiscriminate administration of drugs, each of which is supposed to be a specific for the particular trouble for which it is given. There are few specific remedies for any of the many ills the animal body is heir to. The bodies of all animals undergo disintegration and waste, and their growth and repair require continual recuperation. By digestion and assimilation the food materials are prepared for their special uses, and build up or maintain the body at its normal standard. In health, food must be provided in sufficient amount, of suitable quality, and with its several constituents in fitting proportion to furnish nutriment for every tissue. Water, which constitutes four-fifths of the total weight of most animals, is being constantly removed by the lungs, skin, kidneys, and intestines, and unless restored at short intervals, thirst and impared health ensue. Not only are water and watery fluids requisite for the normal nutrition of the tissues, and for dissolving and carrying away their waste products, but in sick anmials they also assist the removal of the products of disease.

Even more imperative is the need of pure air to oxygenate the blood, maintain internal respiration and normal tissue change, and remove waste products. These requirements, essential in health, are even more important in animals affected by disease. Food, then, requires to be given with especial care, and in an easily digested form, for in all serious diseases the digestive functions are impaired. In many febrile complaints the ordinary foods being imperfectly digested and assimilated are apt to produce or aggravate gastric derangement. Animals suffering from febrile and inflammatory disorders should therefore be restricted to easily digested foods, such as mashes, gruels, &c., given at short intervals, to which extra nutritive value can be given, as required, by addition of milk, eggs, or meat extract. Food should never be allowed to lie long before a sick animal. If not promptly eaten, it should be removed, and in a couple of hours or less time replaced by a fresh supply. During and after attacks of debilitating diseases, patients fed, as they should be, on small quantities of rapidly digested fare obviously require food more frequently than in health. With returning appetite a convalescent occasionally greedily eats more than can be easily digested, and against this contingency well-intentioned attendants require to be warned. Relapses of stomach and bowel troubles sometimes occur by allowing animals, immediately after recovery, their full allowance of food.

There are few diseases, if any, in which animals injure themselves by taking too much water or watery fluids, but they are often rendered uncomfortable and injured by undue restriction. A supply of water should always be within the patient's reach. Cold water seldom does harm, and is more palatable and refreshing than when tepid.

In towns, particularly, much mismanagement occurs with regard to the ventilation and temperature of the habitations of sick animals. Draughts should be avoided, but cool air should be freely admitted, and the stable, kennel, &c., kept scrupulously clean. No restorative or tonic is so effectual as cool, pure air, and it is especially needful in diseases of the respiratory organs, or of a lowering or wasting nature, such as influenza in horses and distemper in dogs.

Sunlight is also an essential factor in the promotion of health, especially in the young. It increases the capacity of the blood and tissues for oxygen, favours healthy excretion, and is an excellent disinfectant. In the Transvaal it would be undesirable to allow the direct rays of the sun to play for any length of time on a sick animal ; if a suitable stable or shed is not convenient, a shade of some kind should be improvised.

A comfortable bed greatly conduces to the restoration of most sick animals. A sick, exhausted horse, who to his disadvantage would continue to stand if kept in a stall, will often at once lie down and rest if placed in a comfortable box or nice shady place with a proper bed. In febrile and inflammatory attacks, and during recovery from exhausting diseases, it is desirable to conserve the bodily heat. For this purpose a warm rug or two, and bandages to the legs, do good. They help to maintain equable temperature and combat congestion of internal organs, but at least twice daily these rugs and bandages should be removed, the skin wisped over, and the clothing at once replaced.

Attention to the position of the patient is frequently important, and must be seen to; thus a horse allowed to lie for any great length of time on one side is liable to suffer from congestion of the lung of the underside; cattle when very sick, if allowed to occupy the same recumbent position for any length of time are liable to become tympanitic, and their chance of recovery is thereby seriously impaired. Sick animals should never be allowed to lie prone in any position for a long period; turn them over occasionally, and hand-rub the parts they have been lying on; this will assist local and general circulation, and contribute materially to their general comfort and ultimate recovery. The feeding of sick and convalescent animals is of the greatest importance; the guides are, give nothing difficult to digest, tempt the appetite, but do not overload the digestive tract.

To sum up, in dealing with sick animals, we should use our common sense, which dictates that we should pay particular attention to the patient's general comfort, his dieting and watering, and only administer medicinal remedies whose action we understand, or that from previous experince we know to be beneficial in the particular trouble with which we have to contend.

SERICULTURE.

ERI OR CASTOR SILK.

BY H. MAXWELL-LEFROY, M.A.

(From the *Agricultural Journal of India*, Vol. IV., Pt. II., April, 1909.)

Eri silk is the cocoon of an insect known to science as *Attacus ricini*, and probably the domesticated form of *Attacus cynthia* which is found in a wild state in Assam and along the outer forested slopes of the Himalayas. Eri silk is domesticated in the Assam Valley, where it is grown for local use and, to a limited extent, for export. With Muga silk (*Antherœa assama*) it forms what is known in India as "Assam silk" as apart from Tusser and from mulberry silk.

At the present time, eri is not generally cultivated outside Eastern Bengal and Assam, Rungpur being about its western limit. During the past two years it has been experimentally grown at Pusa, and it is being grown also at other parts of India, from seed obtained from Pusa.

Eri silk has peculiarities which distinguish it from all other silks cultivated or collected in India. In the first place, the worms require only castor leaves for food ; mulberry is not a food-plant. In the second, the cocoon is not a closed one and is not reelable in the same way as are mulberry or tusser silk cocoons. The caterpillar, in preparing the cocoon, leaves one end closed only with converging loops of silk, so that, while nothing can get in, the moth can push out ; but the cocoon is made in layers, is not composed of a single thread and cannot be reeled by the ordinary process. On the other hand, the silk has its immense advantage, that the cocoons do not require to be "stifled," *i.e.*, killed, to prevent the egress of the moth ; in preparing mulberry and tusser silk, the cocoon is killed, since the moth in getting out so damages the cocoon that it cannot be reeled so well ; in eri silk this is not so ; the moth, as here utilised for spinning, must be allowed to emerge, and the taking of life, so abhorrent to many classes in India, is not necessary.

Another feature, shared with the "indigenous" mulberry silk-worm, is the number of broods ; seven or eight broods are obtained yearly, and as the production of eggs is large, a large brood can be secured from a small quantity of initial seed when castor is plentiful, and several crops of cocoons are obtainable yearly. The insect is completely domesticated in the sense that it will not run wild and become a pest ; the whole life is passed in captivity, and the moths do not attempt to leave the rearing house. Rearing can be done in any building ; the Pusa rearing has been done entirely in a grass and bamboo house. Lastly, the silk cocoons can be utilised just as cotton is, but yield a cloth far more durable and lasting ; the cocoons are boiled, and then spun in the ordinary way that cotton is ; the thread produced can be woven just as cotton thread is, and the cloth produced, while not so fine as machine woven cotton cloth, is white, durable and much in demand. Dyed cloth is produced with ease by dyeing the cocoons, the thread or the cloth ; and E. R. Watson has shown that silk is more easily dyed in fast colours with the ordinary indigenous dyes than is cotton, and that the dyeing of silk is easier than is the dyeing of cotton. With the indigenous and the synthetic (aniline) dyes, a great range of colours can be introduced, and the dyeing offers no special difficulties.

We here discuss eri silk solely from one point of view, its rearing and utilisation in this country by ordinary indigenous methods suited to any part of India. The question of building up an industry in this silk for export or for utilisation in India with power machinery for turning out the beautiful spun silks of commerce, is not here touched on, nor is the kindered question of producing reeled silk from these cocoons. The work of the past two years has been directed to ascertaining how far this silk can be utilised in India, and it is our belief that silk of this kind can be grown, spun and woven in a very large part of India, almost wherever the castor plant is grown. The eventual fabric thus produced is "Assam" silk, a very durable strong cloth, suited to the requirements of this country ; but it must not be assumed that the finer silks of great delicacy and with beautiful gloss can be obtained. Fabrics more akin to cotton cloths are produced, but with the great durability characteristic of this silk, and by methods familiar in this country and requiring no appliances beyond those in ordinary use. It is impossible here to give detailed and complete directions for the cultivation of eri silk, but we deal with some of the more important points ; anyone wishing to commence the cultivation can obtain eggs and fuller instruction from Pusa.

Rearing.—The insect lives, as other insects do, in four stages ; the moth lays eggs, which hatch to worms which feed on the leaf of the castor plant ; the worms moult four times, at each moult increasing in size ; when full grown they retire into hiding and spin the cocoon ; in this they change to the chrysalis, which lies motionless in the cocoon and requires no food ; from this the moth emerges which is of either sex ; the sexes pair and the females lay eggs. The insects require attention in only two stages, the worm and the moth. The eggs are placed on a tray and left till they hatch. In dry weather they are covered with a damp cloth. When they are about to hatch, or when the first one is seen to hatch, they are covered with the youngest and smallest leaves of castor, spread out over them. They crawl up on the leaves and feed, and they can be removed attached to the fine leaves and put in a clean tray. As more hatch, the leaves are lifted and transferred. At first they are fed on the young leaves, washed free from dust if necessary. At intervals, moults occur, the worms ceasing to feed and throwing off their skin. This is a time when, if any are weak, they die. There are four moults before the last, the last occurring inside the cocoon. The full-grown worms, when ready to spin, become restless and move about; they are then placed in baskets filled with any convenient dry packing material, *e.g.*, the finely shredded wood used in packing delicate goods, wood-shavings, torn paper, dry straw or dry leaves. Into this they crawl and spin cocoons, first making a foundation, then spinning the regular cocoon inside. This occupies about three days; the cocoons are left for at least a week and are then picked out by hand and laid out before the moths emerge. The moths emerge with crumpled wings and gradually spread their wings; they void a large drop of excrement, so it is advisable to let them crawl up off the cocoons. The moths are then collected into baskets, where they couple. After twenty-four hours, the couples are separated, and the females put in other baskets to lay eggs, after which they die. The moths make no attempt to escape, and there is no need to confine them; but coupling and egg-laying are facilitated by placing the moths in baskets, to which they can cling and in which the light is not too bright. The moths lay, as a rule, from 200 to 300 eggs each, and if a large brood is required, all the eggs obtained may be kept for hatching; if not, only those from the best moths or only those laid on the first night (80).

In Pusa, seven broods are obtained during the year; in hot weather about forty-five days is the total length required for the egg, worm, cocoon and moth stages. This increases to as much as eighty days in the cold weather of January and February, when the worms feed less rapidly, and the moths take longer to emerge from the cocoons. The worms are resistant to all weather but to a dry, parching heat; in the hot weather when the west winds bring a temperature up to 110°F. with an extremely low humidity and an atmosphere laden with fine dust, the worms are less resistant to disease and may be unable to spin cocoons or to emerge as moths. At this time large numbers also fail to pass through the first moult. This is especially so if one has been rearing from too small an initial stock; "in-breeding" is as bad in this species as in others, and if there is a period of dry, hot weather to be passed through, the stock should be as vigorous as possible. It is, therefore, advisable to be able to introduce fresh stock at intervals, as can be readily done by obtaining fresh seed.

The insect at Púsa is not subject to any of the usual silk worm diseases, but has a peculiar disease, allied to flacherie, but with symptoms and characters which, in the opinion of the Imperial Mycologist, separate it clearly from that disease. The experience at Pusa has been that it is better not to rear it at all during the hot, dry months or, if that is desirable, to rear only from good stock. As a supply of seed from Assam is now readily procurable, there is no reason for attempting to rear during unfavourable seasons. In Assam a parasitic fly attacks the worms, but if only eggs are imported and not cocoons, this pest will not be found and does not occur generally in India. The insect grows most favourably in a moist climate, whether hot or not, and could be grown during the rains practically all over the plains. It is unsuited to the plains of Northern India during April, May and June. Starting on July 1st with 1,000 eggs, one would have 900 moths by August 15th, yielding about 80,000 eggs, which would give a very large brood; the rate of increase is so large and rapid that one can easily start afresh every season.

Appliances.—In rearing, very few appliances are required. The rearing-house may be any roofed structure of grass and bamboos with earth-floor. A large supply of trays, made of split bamboo or similar material are required, some with fine mesh, some with coarse, open mesh; the former may be smaller. In these the rearing is done, and one may keep the largest worms also in large rectangular trays of any size up to four feet by three feet. For the cocoons and moths, baskets are required and a supply of paper, shredded wood, straw or other clean material for the worms to spin in. We have also used the special emergence trays, but it is not essential. The trays are placed upon *machans* of split bamboo which may be covered with matting. The legs of the *machan* should be smeared with some sticky material if ants are a trouble.

Food.—The worms are wholly fed upon castor leaves, plucked as required, and the castor plants must be available close at hand. For young worms small leaves are used, but later the large coarse leaves are required. Varieties of castor have been collected at Pusa from all parts of India; some are better leaf-yielders than others, but all are eaten, the bronze or red ornamental variety grown in gardens being, however, disliked. The varieties in cultivation are apparently all suitable, some yielding more leaf than others. We are not here discussing the question of growing the worm on a large scale for factories, but rather of utilising available castor leaves, at present of little value, for producing silk. The best varieties for growing specially for silk and the best systems of plucking, etc.; are under investigation at present. So far as can be seen at present, an acre of castor, not too heavily picked, should yield fifty to seventy-five maunds of leaf as well as a yearly normal crop of seeds. When castor is not available, the leaves of Ber (*Zizyphus jujuba*) can be used, and in Assam the leaves of Papaw (*Carica papaya*), Gulasiphol (*Plumeria alba*), Cassava and some trees are used, but not for rearing on any scale, only to keep a few worms alive from season to season.

Utilisation of the Silk.—The cocoons, after the moth has emerged, are collected; they sell at present for about Rs. 70 per maund in Calcutta, but can be more profitably grown for local use. Of good cocoons, 2,500 go to a seer; of small ones, as many as 4,000. It requires 75 lbs. of castor leaf to feed the number of worms, large or small, which produce a lb. of cocoons. A seer of cocoons, after treatment, yields about twelve chittacks of thread (75 %). The cocoons are, in Assam, both brown and white; in Pusa, by rearing from white cocoons, or from some other cause, only white cocoons are obtained; the colour is immaterial as, in the boiling off, the brown of the cocoons is dissolved off. The cocoons are boiled in water containing either castor ash or soda. Castor ash, *i.e.*, the ashes of castor stems and branches, contains about 28 % of Potassium carbonate; on boiling the cocoons in water containing a seer of ash to each seer of silk, with enough water to cover the cocoons, the gum on the thread is dissolved and the cocoon becomes soft. In using soda, one takes for each seer of silk a quarter of a seer of soda and boils for three-quarters of an hour, and this is the best treatment.

The cocoons are then washed and are ready for spinning. Spinning may be done on the usual spinning wheel (*Charka*) used for cotton, from either the wet cotton or from the dry one, or on the Taku, used in Assam for this silk. One method is simply to spin from the wet cocoons, the spinner taking a lump of them in one hand. Another is to dry the boiled cocoons, and to cart out the silk into a mass like cotton or wool, loose, dry fibres, and spin from that. The former gives a finer, closer thread of dirty colour, the latter a white, fluffy thread less suited to fine weaving. The latter thread is readily made by those who understand wool-spinning, as in the Punjab. An improvement in spinning has been effected by the use of a new machine, in which the spinning is continuous by means of the "flying needle" and is done on to bobbins direct. The machine has been worked out at Pusa and is in use there. It facilitates the spinning of coarse thread suited to the requirements of the country, and is a simple machine easily made and worked.

The thread produced is woven in the usual way and is suited to the hand-looms of this country. A variety of looms are being employed, but we have nothing original to offer on this subject, and the usual method of weaving may be adopted. In this way, by using either the ordinary spinning methods used for cotton, or by using the new machine, and by utilising the ordinary weaving of the district, one can produce good durable cloth, of white or ecru colour, either fine or thick, with great durability and wearing qualities. The silk has not the appearance of the fine reeled silk; it has not the gloss and the sheen, but is best described as being the familiar Assam silk.

The dyeing of this silk is easy; the indigenous dyes of plant origin are especially suited to it; alizarine or anthracene dyes give brilliant and fast colours; aniline dyes give a large range of brilliant colours; some fairly fast, some fugitive. The cocoons may be dyed or the cloth, and a great variety of colours, fast to light, can be produced. Careful tests have been made of a great variety of dyes, and, while the ordinary methods of using indigenous plant dyes for silk are applicable to this silk, we would urge the use only of fast dyes, whether indigenous or not. It is impossible here to enter further into this question, but there are no special difficulties in dyeing, and full information can be obtained from Pusa. Good fast colours are obtained with indigo, lac-dye, backam, palas, manjista and jakwood, among indigenous colours; with the alizarine (mordanted) dyes with some aniline (acid, direct or developed) colours. The reader may consult Bannerjee's *Dyeing in Bengal* or E. R. Watson's *Fastness of the Indigenous Dyes of Bengal* (*Memoirs*, Asiatic Society of Bengal, Vol. II., No. 7, p. 155).

Eri as an Industry.—At the present time, eri silk is grown in Assam partly to supply clothes to the grower, partly to satisfy a demand for Assam silk cloth, produced at factories in Gauhati and elsewhere. We believe there is a large field for its extension, as a minor or home industry, wherever castor grows in India; the seed is obtainable and is readily sent by post to all parts of India; the rearing is simple and can be done on a large scale once it has been seen; the production of thread and cloth offers no difficulties to people accustomed to spinning and weaving cotton; and there is no inherent difficulty which would prevent its adoption in all parts of India where castor is grown and where the climate is suitable. The culture of the worm on a large scale or its utilisation on a large scale in power looms, is a matter of commercial enterprise and not our immediate concern. Where castor is available, large quantities could be produced and either spun or woven locally, or collected and utilised in a factory.

In Behar, the cost of producing the cocoons, spinning the thread, and weaving the cloth, totals up to much less than the market value of the cloth, though full wages are paid to the rearers and spinners; where the rearing and spinning are done by whole families including women and children in their leisure time when field work is not pressing, it represents a valuable minor industry.

At the present time, the seed is obtainable only from Assam or from Pusa. We would emphasize the very grave danger of obtaining live cocoons from Assam, since they carry the parasitic fly, the most dangerous enemy to the worms; and, as a rule, seed obtained in the ordinary way from Assam is bad. Good seed will be sent from Pusa, and, if notice is given, a large supply of seed is usually available. A limited number of men, trained to the work, are available for starting the industry in new places, and anyone wishing to learn it can be taught in the Pusa rearing house in a short time. The industry is being taken up in different parts of India, and wherever there is a demand for light remunerative work, such as can be done by women and children, if castor is available, the rearing, spinning and weaving of this silk offer many advantages.

SCIENTIFIC AGRICULTURE.

FIXATION OF NITROGEN BY BACTERIA.*

(From the *Gardeners' Chronicle*, Vol. XLV., No. 1172, June, 12, 1909.)

The fixation of nitrogen by bacteria, though a somewhat well-worn subject, is one of the most fundamental problems of agriculture, and one which is constantly receiving new light from one source or another. Nitrogen is not only an essential element in the nutrition of the plant, but the fertilising substance most costly to purchase, although in its free, gaseous state it constitutes four-fifths of the atmosphere. Our ordinary plants, however, are incapable of drawing upon this stock of free nitrogen, and hence they must obtain combined nitrogen from the soil. This fact—the subject of long controversy—may be said to have received its crowning demonstration by the experiments of Lawes, Gilbert, and Pugh at Rothamsted in 1857-8. Despite these and other experiments, it became evident that some factor in the situation had been overlooked, because from many sources—the Rothamsted field experiments among others—it was shown that leguminous crops not only took away an exceptional amount of nitrogen, but left the ground richer in nitrogen compounds than it was before their growth. These difficulties were cleared up by Hellriegel and Wilfarth in 1886-7, when they showed that leguminous plants were susceptible to the infection of an organism which produced nodules upon their roots, whereupon they became able to draw upon the atmospheric nitrogen.

The nodules contain in vast numbers a bacterium which effects the fixation of nitrogen; the combined nitrogen is passed on to the host plant, which in its turn supplies the bacteria with the carbohydrates they require. The nodule bacteria, which have only latterly been isolated in a pure state directly from the soil, exist in the soil in what is called the neutral condition, because they are ready to infect many different species of leguminous plants indifferently. They are very small, about $0{\cdot}8\mu$ long by $0{\cdot}2\mu$ broad, and are in active motion, each possessing a single cilium. Because of this activity they are sometimes said to be in the "swarm" stage, and in this form they infect the host plant by entering through the root-hairs.

Once they have entered the root-hairs, they begin to secrete slime and extend into the cells of the root, near the nuclei of which they begin to multiply rapidly as bacilli, rods about four times the size of the bacteria free in the soil.

Finally, after two or three weeks, the bacilli begin to form still larger entities,

* Lecture delivered on March 11, 1909, by Mr. A. D. Hall, Director of the Rothamsted Experimental Station.

termed bacteroids, protoplasmic bodies, which after the fourth week show a granular structure, and later still disintegrate to allow the bacilli to fall out. The bacteroids show typical Y shapes in the nodules of Clover, Peas, Beans, and Vetches; in some clovers they are also club or dumb-bell shaped, but only of late has it been possible to get bacteroids to develop in artificial cultures. With the formation of bacteroids begins the growth of the nodules and the fixation of nitrogen; when in certain cases abnormal nodules have been found containing only bacilli no fixation has taken place.

The important question then arises as to whether there is only a single species of the nodule-forming bacterium, or whether each leguminous plant does not possess, if not a corresponding species, at least a race specialised to co-operate with it. It was early shown that certain leguminous plants—notably Seradella Lupins, and Lucerne—could not always be infected by soil which would inoculate Clover. It was also shown that, if a particular species like the French Bean were inoculated with bacilli from a Clover nodule, it would not grow as well (in the absence of soil nitrogen) as if it were inoculated with bacilli from a nodule obtained from another French Bean plant. However, when the organisms from the Clover nodule had been for one generation in a French Bean, they then became as effective on the latter as the original French Bean organisms which had had no known connection with Clover. Thus we may consider as established the existence of distinct races of the nodule organism, capable, however, of acclimatisation.

Very soon after Hellreigel and Wilfarth's discovery, attempts were made to utilise it by artificially introducing the organisms into soil on which leguminous plants grew badly. Salfeld, in Hanover, engaged in reclaiming waste heath land by ploughing in successive crops of Lupins, &c., found it of advantage to bring soil from fields where such crops had grown previcusly, and to sow 6 to 8 cwt. per acre before the first leguminous crop was taken. Between 1888 and 1892 he had achieved many successes in this way on the barren heath land manured only with basic slag and potash salts; the crop nodulated and gathered carbon and nitrogen from the air, out of which a fertile soil was eventually built up. In order to save the trouble attached to sowing such quantities of soil, Nobbe and Hiltner in 1896 introduced artificial cultures of the nodule organisms, growing on a jelly made from an extract of the plant stiffened by gelatine. But in such a medium, rich in nitrogen, the nodule organism grows very slowly and becomes inert, so that for practical purposes this "nitragin" proved a failure.

Little by little, however, the methods of growing the bacteria artificially were improved, chiefly by the introduction of media containing little or no nitrogen, and in 1903-4 Hiltner put on the market a very effective series of cultures grown on agar-agar containing a little plant extract.

Moore, of the United States Department of Agriculture, began about the same time to send out cultures in a dry form, prepared by dipping cotton wool into an active liquid culture of the nodule organism and slowly drying it. When required for use, a fresh preparation was made by putting the wool into a solution of sugar and potassium phosphate, in which the bacteria would begin to grow. Into this active liquid the seeds could be dipped befoie sowing. Moore's preparations turned out unsatisfactory because the bacteria did not remain alive for long after drying. However, since that time, various improvements have been made in the methods of growing the nodule bacteria in artificial media, and cultures which retain their activity for a considerable time are now obtainable from all the bacteriological laboratories concerned with agricultural work. Whether solid or liquid, they require to be diffused in a considerable bulk of water or separated milk, which can then be distributed over the land. A better method is to tie the seed in a bag of butter muslin, dip it in the fluid, and then allow the seed to dry somewhat before sowing. The seed should not, however, be allowed to dry for long, or the bacteria are apt to perish. The question now arises whether any practical benefit is to be obtained from such an inoculation of the seed of leguminous crops, and two cases must at the outset be considered. Some soils exist, especially in new countries coming under cultivation for the first time, from which the nodule organism is absent; in such cases inoculation may be of the greatest possible value and may make the difference between obtaining a crop or none at all. Even in these cases, however, the soil is often without nodule bacteria, because in some way its condition is unfit for their survival, so that it is of no use to introduce the organism unless at the same time the soil is made a suitable medium for their growth. Soils entirely without nodule organisms are rarely met with in the British Isles, but not infrequently soils are found on which such special crops as Lucerne, which requires a race of bacteria considerably differentiated from that which is found in Clover nodules, fail to nodulate and grow properly. In such cases a preliminary inoculation of the Lucerne seed may prove very effective in establishing the crop, which otherwise fails, although Clover will grow freely on the same land. Examples have been observed of the value of inoculating Lucerne seed when that crop is being sown in a district in which it has not hitherto been grown.

But in most of our soils, where Clover, Beans, and Peas have been cultivated in the regular way, the nodule organism is present, and the leguminous crop nodulates and begins to fix nitrogen without any artificial inoculation. In these cases the gain from inoculation is not likely to be large, 10 to 20 per cent. at the outside—a quantity only perceptible by careful experiment—and its existence must depend either upon some advantage to be derived from early inoculation or upon the establishment of an improved race of bacteria, more active in fixing nitrogen than those normally in the soil. Neither of these propositions has been established, and, though the work is still being actively pursued, a practical return for inoculation on ordinary field or garden soils is not yet to be expected. The nodule bacteria, either pure or mixed with other organisms, have not been induced to enter into partnership with the ordinary non-leguminous plants, which is not to be wondered at, considering the unlimited opportunities the latter have had in ordinary soil of trying the experiment for themselves. An extensive experiment tried upon Tomatoes seemed to give an increased yield after inoculation, but this was shown to be due to the nutrient salts introduced by the culture medium, for a similar increase was produced when the same culture medium was given to the plants after it had been first sterilised by boiling.

Turning now to other soil bacteria which fix nitrogen without the intervention of leguminous plants, mention must be made of the organism discovered by Beijerinck and called by him Azotobacter. This organism is widely distributed, having been isolated at Rothamsted from virgin soils obtained from all parts of the world. In order to fix nitrogen it must be supplied with some form of carbohydrate, by the oxidation of which it derives the energy necessary to bring the nitrogen into combination. Carbonate of lime as a base in the soil is also necessary for its growth.

The history of a certain piece of land illustrates the dependence of nitrogen-fixation by Azotobacter on supplies of carboyhdrates in the soil at Rothamsted. The land in question has been allowed to run wild for the last 25 years, and has been gaining nitrogen during that period at the rate of nearly 50 lbs. per acre per annum, whereas the adjacent arable land has lost rather than gained nitrogen. On the "wild" land the vegetation every year is allowed to die back, thus the soil is continually supplied with compounds of carbon by the oxidation of which Azotobacter is enabled to fix nitrogen ; on the arable land, however, where the crop is almost wholly removed, there is no return of carbon compounds to the soil.

Certain pot experiments have shown that the application to soil of sugar, a carbon compound containing no nitrogen, is followed by a gain of nitrogen, of great benefit to succeeding crops, but attempts to obtain similar results in the field at Rothamsted have so far yielded negative results. In the Mauritius, however, the treatment of the soil with Molasses has been found beneficial to the following crops, and Azotobacter has been also shown to be abundant in the soil.

The piece of "wild" land at Rothamsted supplies the clue to the accumulations of nitrogen in such virgin soils as the black lands of the North-west of America, the Russian Steppes, the Argentine, Pampas, &c., which are naturally occupied by a luxuriant, grassy vegetation. However long such land has been growing grass, the plants themselves could not increase the stock of nitrogen ; they could only take up what was originally in the soil and restore it again. But when the carbonaceous matter they have assimilated from the atmosphere falls back to the soil, material is provided by means of which Azotobacter, present in all these soils, can proceed to fix nitrogen. The low ratio of carbon to nitrogen in the organic matter of these virgin soils is in itself evidence that very active oxidation of the vegetable debris had been going on ; in this respect the organic matter of the virgin soils resembles that which had accumulated on the "wild" plot at Rothamsted, but differs from that which is found in soils devoid of Azotobacter. The gain in fertility of land laid down to grass, where a mass of stubble and roots accumulate, is also probably in part the work of this nitrogen-collecting micro-organism.

MISCELLANEOUS.

LITERATURE OF ECONOMIC BOTANY AND AGRICULTURE.

By J. C. WILLIS, Sc.D.

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NOTES AND QUERIES.

BY C. DRIEBERG.

G. A.—There are two methods of extracting oil from seeds of castor, sunflower, &c.:—

Cold drawn Method.—The seeds are broken between rollers, set so that the outer hard covering is cracked off. The whitish kernels are then separated, placed in hempen bags, and submitted to heavy pressure in powerful screw or hydraulic presses. The oil which runs out is then boiled with water to separate the mucilage and albumen. The clear oil is finally drawn off, strained through flannel and put into tins, barrels, hogsheads or dubbers for exportation. A dubber is a globular leather vessel or bottle used by the natives of India to hold oils and such like.

Expression by Heat.—The seeds are first scorched in an earthernware pan over the fire and then pounded in a mortar; the husks are sometimes removed and sometimes left, but their separation produces a better oil. The broken seeds are then tied in a linen bag and boiled with water in a large pot, and the oil is skimmed off as it rises to the surface.

T. M. (FIJI).—Ghee or Ghi is clarified butter. That is to say, the butter is heated for about twelve hours or until the greater part of its moisture is evaporated. An oil is at the same time formed that rises to the surface, and the refuse (mostly casein) forms below as a sediment. Too much heating is said, however, to cause the ghi to assume an acid taste, while imperfect heating renders it liable to putrefaction. Great skill is thus required, but the ghi sold in the market has usually been undercooked owing to the loss in weight which takes place when fully cooked. Butter loses about 25 per cent. in the process of clarification. The yield of ghi from the butter of the buffalo is higher than from that of the cow. The boiling butter is allowed to be partially cooled, when the ghi may be decanted off the top of the sediment. The ordinary ghi of the bazaars is principally derived from buffalo milk. One quart of buffalo milk yields about 3 oz. of ghi, while the same quantity of cow milk may only afford about half that quatity, or, with extra fine qualities, three quarters of the ghi mentioned. Ghi from goat milk is very inferior owing to the disagreeable odour it possesses, while that of sheep milk is often spoken of as superior even to buffalo butter.

C. D, C.—The Acting Director of the Royal Botanic Gardens writes with reference to your enquiry :—"Your correspondent writes of the 'interplanting of Cocoa with Rubber,' but the remainder of his letter seems to refer to the interplanting of rubber with cocoa. I do not consider cocoa a suitable crop to plant with rubber in the Kelani Valley districts. Rubber may with advantage be planted in old cocoa where the latter is not a success with the object of eventually supplanting it."

L. P. E.—With reference to your report of the death by the "bleeding" of orange trees, resulting as you thought in the death of one, the Government Mycologist says :—"Gummosis of orange trees may occur from any wounds, and can be stopped by cutting out the decayed tissue and tarring the wound. It is not likely to have killed the tree; death was probably due to exhaustion. It may be pointed out that the orange is *not* a tropical fruit, and that there are very few localities in Ceylon in which it will flourish continuously."

B. M.—The following from the Jamaica bulletin (New series No. 1) gives information as to how the mango should be budded :—Plant out seeds of a woody sort to be budded when 18 months or 2 years old. Buds from wood 1½ to 2 years old showing leaf scars on the bark should be selected. The bark should lift freely. Buds can be inserted either by cutting out a corresponding piece on the bark of the branch to be treated, or the bud can be slipped under a T-shaped incision in the ordinary way and then securely tied with fibre. In budding old trees, do not cut the whole tree at once, or it will die. Cut the main branches about a foot from the stem, smooth and protect with tar, When the new growth is 1 to 1½ inches in diameter it is fit to make a bud. When the buds have started to grow the other branches can be cut down and similarly treated.

F. D.—Dried blood for pine-apple, at the rate of 200 lbs. per acre, has been found very satisfactory in Porto Rico, where the pine-apple is grown extensively. An all-round fertilizer recommended for young plants is a mixture of dried blood, bonemeal and potash, which would analyse something like 5 % Ammonia, 30 % Bone phosphate, and 5 % Potash. This may be followed later on, when the plants are ready to blossom, by an application of Bonemeal and Potash.

CEYLON AGRICULTURAL SOCIETY.

MINUTES OF THE GENERAL MEETING JUNE 8TH, 1909.

Minutes of a General Meeting of the Ceylon Agricultural Society, held at the Council Chamber at 12 noon on Tuesday, the 8th June, 1909.

His Excellency the Hon'ble Mr. Hugh Clifford presided.

There were also present :—The Hon'ble Mr. H. L. Crawford, C.M.G., the Hon'ble Mr. J. N. Campbell, the Hon'ble Mr. S. C. Obeyesekere, the Hon'ble Mr. P. Arunachalam, Sir S. D. Bandaranaike, Messrs. C. M. Lushington, A. Fairlie. J. S. Paterson, W. D. Gibbon, R. H. Lock, T. Petch, A. Bruce, G. E. Piachaud, G. Harbord, S. Rothwell, J. D. Vanderstraaten, T. Rajapakse (Mudaliyar), J. H. Meedeniya, R. M., J. P. Obeyesekere, Francis L. Daniel, R. C. Proctor, M. Suppramaniam, Alex. Perera, W. A. de Silva, Drs. H. M. Fernando and G. H. de Saram, and Mr. C. Drieberg (Secretary).

The minutes of the General Meeting held on 15th June, 1908, were read and confirmed.

The Secretary presented his Annual Report (previously circulated) which was taken as read.

The Hon'ble Mr. Crawford, Acting Colonial Secretary, moved, and Mr. Lushington, Government Agent, Southern Province, seconded :—That the paragraph referring to Branch Societies be omitted.—Carried.

The report in its amended form was adopted on the motion of the Hon'ble Mr. Crawford, seconded by Dr. H. M. Fernando

The Secretary submitted the Auditors' Report on the accounts of the year, a statement of which had been circulated. The Hon'ble Mr. Crawford moved and Dr. H. M. Fernando seconded its adoption.—Carried.

Mr. T. Petch, Government Mycologist, next addressed the Board on the subject of the Stem Bleeding Disease in the Coconuts, and announced the results of his scientific investigations into the disease.

A vote of thanks to Mr. Petch, proposed by H. E. the President, was carried with acclamation.

Mr. Lock, Acting Director, Royal Botanic Gardens, submitted the resolutions of the Committee appointed to report on the question of improving the cultivation and curing of tobacco.

At the suggestion of H. E. the President, the discussion on this matter was postponed for a special meeting of the Board fixed for July 5th, 1909.

MINUTES OF THE SPECIAL MEETING OF THE BOARD OF AGRICULTURE, JULY 5TH, 1909.

Minutes of a Special Meeting of the Board of Agriculture to consider the resolutions of the Tobacco Sub-Committee, brought up by Mr. Lock, Acting Organising Vice-President, at the annual meeting of the Society held on June 8th, and postponed for further consideration at the suggestion of H. E. the Acting Governor.

Present:—His Excellency Sir Hugh Clifford (in the chair), the Hon. Messrs. H. L. Crawford, C.M.G., Bernard Senior, I.S.O., L. W. Booth, S. C. Obeyesekere, A. Kanagasabai, Sir S. D. Bandaranaike, KT., C.M.G., Messrs. W. D. Gibbon, J. Harward, R. H. Lock, A. N. Galbraith, J. D. Vanderstraaten, W. A. de Silva, G. W. Sturgess, Tudor Rajapakse, Daniel Joseph, Dr. H. M. Fernando, and Mr. C. Drieberg (Secretary).

Mr. Lock, in moving the resolutions, briefly traced the history of the proposal for the employment of a tobacco expert.

Mr. J. D. Vanderstaaten seconded.

Among other speakers were the Hon'ble Mr. Crawford, Mr. W. D. Gibbon, Dr. H. M. Fernando, Mr. A. N. Galbraith, the Hon'ble Mr. Bernard Senior, the Hon'ble Mr. S. C. Obeyesekere, the Hon'ble Mr. A. Kanagasabai, Mr. W. A. de Silva and Mr. Daniel Joseph.

H. E. the Acting Governor summed up the discussion and suggested that the recommendation of the Tobacco Committee be referred back for further deliberation (a suggestion which was unanimously approved of) along with a recommendation made by Mr. Bernard Senior with reference to the terms of the proposed appointment.

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

CEYLON AGRICULTURAL SOCIETY.

PROGRESS REPORT XLV.

Membership.—Since the meeting of April 7, the following members have joined the Society:—Stephen Smith, W. M. Hall, C. C. Sheppard, Edwin Pate, A. C. Morrell, C. A. Hewavitarne, R. G. Shaw & Co., Carl C. Halling, Ernest Hamilton, N. Dwarkadas, G. G. Simon de Silva, A. Balakrishna, W. Suppramaniam, A. Cochrane, W. H. Sinclair, A. van Starrex, R. M. Peiris, and G. E. Colin de Silva. The newly-formed branch Society for Pasdun Korale East has been affiliated.

Branch Societies.—The Harispattu Branch has been re-organized with the appointment of Mr. James R. Nugawela as Secretary and Mr. P. B. Ottanpitiya as Treasurer, the Ratemahatmaya, (Mr. Nugawela) continuing to act as President. Since the appointment of an Agricultural Instructor for the Central Province, the prospects of this and other branches in the Province have improved considerably.

The Katunayaka Branch has undertaken to cultivate cassava on a commercial scale, and paddy with special fertilizers generously provided by the Chairman, Mr. A. E. Rajapakse Mudaliyar.

The new Magam Pattu Branch has decided to establish an experimental garden at Hambantota, for which the Assistant Government Agent is to select a Crown site.

Official Tours.—The Acting Organizing Vice-President visited Matara, Galle, Anuradhapura, and Kegalla. The Secretary made inspections in the Northern, Southern, North-Central, North-Western, and Uva Provinces. Agricultural Instructor Wickramaratne toured in the Bentota-Walallawiti, Pasdum, and Rayigam korales; Mr. L. A. D. Silva in the Chilaw and Puttalam Districts; Mr. Molegoda in the Walapane, Hanguranketa, Uda and Pata Hewaheta, Dumbara, and Harispattu districts; Mr. Chelliah in the Jaffna, Vavuniva, and Anuradhapura Districts; and Mr. Breckenridge in Sampanturai, Potuvil, and Panawa pattus in the Eastern Province.

Agri-Horticultural Shows.—Shows were held at Anuradhapura, Galle, Hanguranketa, Kegalla, Mannar, and Welimada. The reports of the judges at these Shows are reproduced in the

Society's magazine, but it may be stated here that they were all successfull exhibitions, Kegalla being deserving of special mention for its excellent arrangements.

The Shows so far fixed for the latter half of the year will be held at Telijjawilla on August 25, Pannala on August 21, Mirigama on October 30, and Hettipola on December 4.

The Curator of the Royal Botanic Gardens has kindly undertaken to draw up a set of special instructions regarding the arrangement of exhibits.

Arrangements are being made for securing a permanent exhibit of Indian cereals and dry grains for local Shows.

School and Experimental Gardens.—So far, owing to the paucity of Government schools in the Northern and Eastern Provinces, and the difficulty of reaching these areas with only two inspecting officers available, no gardens have been opened in connection with Tamil schools; but, with the appointment of two Agricultural Instructors stationed at Jaffna and Batticaloa, it is now possible to make a beginning in this work which will be encouraged as much as possible in the aided schools.

The teacher of Weragala, 11 miles distant from Karawanella and only accessible by a footpath, is deserving of special mention for the excellent garden he has established there.

The Vavuniya experimental garden will, with the permission of the Assistant Government Agent, be in future worked under the supervision of the Agricultural Instructor of the Northern Province.

Paddy Cultivation.—The great loss of cattle through death by rinderpest has brought the paddy cultivator to a serious pass, particularly in the Hambantota District, where the preparation of fields has from time immemorial been done by the primitive method of "mudding" or "puddling." At the request of the Assistant Government Agent and on instructions received from Government, the Society has taken up the question of whether it would not be possible to get the fields ploughed with the aid of implements, and with a view to its practical solution a *posse* of Agricultural Instructors is being sent on special duty to Tissa, with a collection of suitable implements kindly lent by Messrs. Walker, Sons & Co., to make trials and hold demonstrations. A special report on this subject will be issued later.

The loss of cattle has also interfered with the threshing of the last crop in the Eastern Province. The use of a simple contrivance has been suggested by Mr. Bamber, which may be found to meet the difficulty.

In April-May the Society supplied 117½ bushels of 60 days' paddy and a large quantity of vegetable seeds at the request of the Assistant Government Agent, Puttalam, to help the cultivators of that district, who were threatened with distress as a result of the serious drought that prevailed there.

Four new paddies were secured from India for Bibile Ratemahatmaya; samples of twenty other varieties were received from Nagpur, and information regarding quick-growing varieties procured from Burma. A quantity of Carolina golden paddy has come from the Agricultural Department, United States of America.

Reports of paddy cultivation by transplanting seedlings from a nursery instead of sowing the seed broadcast have come from various quarters. In Rayigam korale planted out seedlings raised from one seer gave a yield equal to 96 bushels per acre.

Mr. J. K. Nock inspected the transplanted plots entered for competition in connection with the Welimada Show. He reports that "the very superior condition of the portions transplanted over those sown broadcast was remarkable both as regards general growth and crop prospects." This was my own experience at Baddegama in the Southern Province.

Transplanting has also been carried on at Maragoda by the Paraduwa school in the Weligam korale, with very satisfactory results. Seedlings from a nursery sown with 4 measures of seed paddy were transplanted in a field of 1 bushel sowing extent (½ an acre) and gave a crop of 21 bushels, making an average of 42 bushels per acre and a return of 168-fold on seed paddy used. No other fertilizers were used than the leaves of the ordinary Keppetiya (*Croton lacciferus*) and the ashes of spent citronella grass. Similar experiments are being tried at Marambe and Dampella schools.

Experiment with Artificial Manuring.—The Hon. Secretary of the Dumbara Agricultural Society reports as follows under date July 20:—"I annex a report made by Mr. M. B. Rambukwella, Korala of Teldeniya, who was entrusted with the trial of artificial manure kindly supplied by Messrs. Freudenberg & Co. in the cultivation of paddy during the last maha harvest. The report, which appears to be a very satisfactory one, will be submitted at a meeting of this Society to be held at Teldeniya on the 29th instant. I shall make a further communication on this subject after the meeting. The report states that "The artifical manure was applied to a field 2 pelas in extent, which was sown with 'hatiyal' paddy on the same day as another lot of the same extent adjoining the manured portion. Both the fields (manured as well as unmanured) were reaped on the same day, but threshed separately. The manured field yielded 122 bushels of paddy, while the unmanured portion yielded only 62 bushels. In straw, too, there were 175 bundles more in the manured portion than in the other."

Grafting and Budding.—Mr. Alex. Perera conducted practical classes for Stock Inspectors and Agricultural Instructors for the purpose of instructing them in these methods of propagation, with a view to teachers and others being trained. The Instructors have been supplied with the necessary tools.

Cotton.—A communication has been received from the British Cotton Growers' Association with reference to the working of the ginning plant which the Association sent out to Ceylon and is at present lying idle. Arrangements will probably be shortly made for resuming work.

The Agricultural Instructor stationed in Batticaloa makes a favourable report on the growth of cotton in the Eastern Province. Two plantations are said to have given promising results. A member in Uva who has planted cotton wrote last month asking for the loan of one of the Society's hand gins. He has taken in 6,000 lb. seed cotton, and expects another 15,000 lb. This is said to be Caravonica.

A correspondent from Galgamuwa writes hopefully of his Sea Island cotton, but is anxious to try Egyptian also.

The pity is that it has not yet been possible to make a definite pronouncement as to the variety that should be cultivated in Ceylon. I understand that in Uganda, where cotton is doing very well, the Uplands variety has been selected, and that it is illegal for any other variety to be cultivated.

Ginger.—The cultivation of this product is very much neglected in Ceylon, and, in order to extend and improve it, the Society addressed the Director of the Imperial Institute, London, on the subject, with a view to getting precise information as to best varieties to cultivate, and the most approved methods of cultivation and curing. Professor Dunstan has favoured the Society with an interesting report, which will appear in the Society's magazine.

Orchella.—Inquiries made at the instance of the Imperial Institute as to the possibility of reviving the trade in orchella weed (*Rocella montagnei*) has resulted in the offer of a Jaffna merchant to supply up to 12 tons per annum at £12 or Rs. 180 f.o.b. Jaffna.

Seeds and Plants.—Special distributions of seeds of new introductions have been made at intervals. The most important of these is *Cenchrus biflorus*, the fodder grass introduced by me from India. This grass bids fair to be one of the most useful of our introduced fodders.

The biennial supply of vegetable seeds has just been indented for and will be distributed early in October.

The Acting Director of Royal Botanic Gardens supplied the Society with a large quantity of Hickory King maize seed for distribution at the recent Shows held at Welimada and Kegalla. The giving away of this seed has been much appreciated by cultivators. A supply of selected durian seeds is shortly expected from Singapore, and from Egypt a consignment of seeds of cottons recommended by Mr. McCall.

Through the U. S. A. Department of Agriculture the Society has secured a couple of bushels of the famous Carolina golden rice.

Bengal gram, indigo, and senna seeds have been obtained at the request of members.

Tubers of the cluster sweet potato sent by the Agricultural Department of New South Wales arrived in good condition, and cuttings will soon be available for distribution.

An order has gone forward for nearly 1,500 grafted fruit plants booked to the order of members. These are expected about the end of September.

A consignment of mangosteen and nutmeg plants presented by Mr. Martin D. S. A. Wijenayake, Stock Inspector and Agricultural Instructor, has been distributed among the schools of the North-Western Province with the assistance of the Government Agent.

Plants of a species of Pandanus were received from Mr. Prautch of Manila, and the specimens of the woven materials sent with them show the possibilities of the screw pine so common in the Island.

Implements and Appliances.—The patent hand maize-sheller introduced from Nagpur has been found very serviceable, and six more have been imported.

The "Meston" plough stocked by Messrs. Walker, Sons & Co., Ltd., is now in demand; a number of other light implements for paddy land have been imported by the same firm. The latter will be reported on after trial. Both Messrs. Walker, Sons & Co., and Messrs. Brown & Co. sent exhibits of implements to the Galle Show held on 16th June and following days.

The irrigation of fields by means of a steam pump for raising water from the Deduru-oya is being tried by Messrs. Fernando Bros. of Marawila.

The set of Duchemein fibre machines imported by the Society has been sent for trial to the Experiment Station, Peradeniya.

Inquiries from Burma about rice hullers have elicited some useful information, which has been placed at the disposal of a local firm dealing in agricultural implements and appliances.

Sericulture.—The Society's operations at the Peradeniya Mulberry Silk Farm have been entirely suspended, and the farm leased for a nominal sum to Mr. Percy Braine, the local expert in sericulture. In the meantime a proposal to establish an eri silk farm in the low-country is under consideration. A further sample of 200 lb. of eri cocoons has been sent to Paris, in addition to the previous consignment of 200 lb. forwarded to Switzerland, both the French and Swiss firms already referred to being favourably impressed with the possibilities of the silk. In the meantime a communication has been received from the Imperial Entomologist of India inviting the co-operation of this Society to establish eri silk as an industry for India as well as Ceylon, and inquiring for the address of likely buyers which, after persistent efforts, the Society has succeeded in discovering. The Sericulture Committee have advised that all information be placed at the disposal of the Indian authorities.

Reports and Analyses.—Specimens of a resinous substance received from the Agricultural Instructor, Batticaloa, was first submitted to Mr. Fredrick Lewis, who reported:—"The sample you sent of leaves and wax I think without doubt is *Gardenia latifolia* (Gallis S.), which occurs in the dry country as well as the wet up to about 1,200 feet elevation. The wax is obtained from the top of the leaf buds, and often forms quite an appreciable mass." On being forwarded to the Imperial Institute, the Director reported:—"The material appears to resemble the "dikemali" resin obtained from *Gardenia gummifera*. The latter has been known from a long time, and has been frequently investigated. It was at one time held in high repute as a drug, but is of no commercial importance at present. If the exudation from the *Gardenia latifolia* is obtainable in large quantities, it would be worth examination with a view to its possible commercial utilization. At least 2 lb. of the resin would be necessary for this purpose."

The following analyses have been kindly made for the Society by the Government Agricultural Chemist:—

Analysis of a Fodder Grass (*Cenchrus biflorus*) introduced by the Secretary from South India.

		Per Cent.
Moisture lost in sun ...		... 68·78
Sun-dried Sample.		
Water ...	...	... 24·60
Solids ...	...	... 75·40
		100·00

On Dry Sample.

Solids containing—	Per Cent.	Per Cent.
Carbohydrates ...	34·26	... 45·43
*Proteids ...	7·18	... 9·52
Woody fibre ...	23·46	... 31·11
Oil	0·78	... 1·03
†Ash	9·72	... 12·91
	75·40	100·00

	Per Cent.	Per Cent.
*Nitrogen ...	1·15	... 1·52
Water soluble extracts	20·60	... 27·30
†Ash analysis—		
Lime ...		... 3·40
Magnesia ...		... 2·40
Phosphoric acid		... 4·80
Potash ...		.. 13·40
Insoluble ...		... 30·50
Carbonic acid, &c.		... 45·50
		100·00

Analysis of Chou Mœllier (a Species of Cabbage recommended as a Fodder Crop) introduced by the Secretary from Australia.

Received—		Grammes.
Leaves ...	...	... 261
Stalk ...	...	... 334
Root ...	...	... 50
		Per Cent.
Moisture lost in sun ...		... 89·5

Analysis of the Sun-dried Sample.

Moisture at 212° F.	...	... 14·5
*Organic matter	...	... 74·5
†Ash ...	...	... 11·0
		100·00

	Per Cent.
*Containing nitrogen...	... 1·89
†Containing—	
Lime	... 6·0
Magnesia ...	... 15·8
Potash	... 28·5
Phosphoric acid ...	... 5·2

Edible Part, Leaves only.

	Per Cent.
Moisture ...	... 18·0
Oily matter ...	... 3·5
Proteids	... 24·3
Carbohydrates ...	... 29·4
Woody fibre ...	... 13·4
Ash	... 11·4
	100·00
Nitrogen ...	3·8 per cent.
Sugar	Trace
Water soluble ...	31·4 per cent.

Analysis of *Sesbania Aculeata* (a Green Manure and fibre plant).

	Per Cent.
Moisture lost in sun	... 69
Sun-dried Material.	
Moisture at 100° C....	... 13 5
*Organic matter ...	... 80·3
†Ash	... 6·2
	100·00
*Nitrogen... ...	... 2·8
†Containing—	
Lime	... 31·2
Magnesia ...	... 4·8
Potash... ...	... 15·6
Phosphoric acid ...	... 6·9
Small Leaves.	
Nitrogen... ...	... 3·44
Moisture... ...	... 13·50

Sunflower Oil.—The Trincomalee Branch, under the belief that the oil of the sunflower, if grown extensively, might be employed for tinning "sardines," applied for information on the subject. Inquiries were made from various likely sources as to the methods employed in the sardine-tinning industry, and the London Board of Agriculture and Fisheries gave it as its opinion that sunflower oil would not be suitable for the purpose for which olive oil is utilized. In view of the fact, however, that the so-called olive oil is largely made up of groundnut oil (from *Arachis hypogoœa*), it may be worth while growing this crop, for which conditions are suitable at Trincomalee, where already the Voandzia groundnut is regularly cultivated.

C. DRIEBERG,
Secretary.

Colombo, August 2, 1909.

GALLE AGRI-HORTICULTURAL SHOW, 1909.

REPORT BY H. F. MACMILLAN.

Report on Classes A.B.C.D. & E. in Section 1.

Class A. (FLOWERING PLANTS IN POTS) was disappointing; the exhibits were few and of poor quality, and in many cases there were no entries for the prizes offered. It must be admitted, however, that this is not a popular class for such a district as Galle.

Class B. (CUT FLOWERS).—This was an improvement on Class A as far as the number of entries were concerned, but the arrangement left much to be desired. Possibly no more unsuitable corner of the buildings could have been assigned to these delicate exhibits than that which they occupied, and the Judges had the greatest difficulty in distinguishing between these for the purpose of judging.

Class C. (FOLIAGE PLANTS IN POTS).—The entries in this class were on the whole creditable, though doubtless better specimens could have been produced by many residents in Galle. There were no entries for a "Tastefully arranged group."

Class D. (FERNS IN POTS).—The entries were few, and with two or three exceptions, of indifferent quality. But here again it was evident that the local residents were not induced to send their best.

Class E. (FRUITS).—In this class the display was unusually disappointing. With the exception of Oranges, Kamarangas and Bilings the paucity of exhibits was remarkable, and has been explained as being due to the fact that this is an unusally poor season for fruits of all kinds. There was only one exhibit each (and this of poor quality) of Mangosteens, Durian, Sapodilla, and Nam-nam. It would be interesting to have a reliabie report on the condition of fruit crops this season in the Galle district and low-country generally,

REPORT ON GALLE AGRI-HORTICULTURAL SHOW, 1909.

REPORT BY G. W, STURGESS.

Section III. Class D.—DAIRY PRODUCE.

Exhibits fewand hardly worth mentioning, except buffalo ghee and cow ghee. Of the former there were nineteen, and of the latter eleven exhibits. Several of each kind were clear and fresh and of good quality, the majority were dirty looking and exhibited in bottles not properly cleaned, showing want of care in preparation.

Section IV. Class B.—POULTY AND DOMESTIC AN IMALS.

Entries were few and nothing calls for special mention.

Cattle were not shown owing to the prevalence of cattle disease.

In Class C., PONIES, four were shown. Those awarded 1st and 2nd prizes were quite nice ponies. It is a pity entries were not larger.

REPORT BY C. DRIEBERG.

In submitting the following notes on the exhibits judged by me at the Galle Show, I should wish to state that there was considerable room for improvement (1) in the compilation of the catalogue, and (2) in the arrangement of the exhibits. Had the draft catalogue been forwarded to the Secretary of the Ceylon Agricultural Society, as required by the rules for the conduct of Agricultural Shows, and application been made for assistance in the arrangement of exhibits, this would not have been the case. I may here mention another irregularity in connection with the Galle and other recent Shows, viz., that application for the services of expert judges was made direct to the judges and not through the Society, which pays their expenses.

As regards the catalogue, I would draw attention to the grouping of Flowering and Foliage Plants under one section, and the omission in most cases to state the number or quantity of exhibits required to be shown. As regards arrangement it is essential for purposes of judging that all exhibits of one kind should be placed together in spaces previously marked out (as accurately as possible) for them, so that the exhibits may be put into their proper places as they come into the shed. In the case of fruits and vegetables, the exhibit of each exhibitor should also be kept quite distinct, and for this purpose it is advised that the common flat bamboo basket employed for carrying fruits and vegetables be used. Branch Societies would do well to apply for the services of an Agricultural Instructor, trained to such work, to assist in the arrangement of exhibits.

Section III. Class C.

(*A.*) *Vegetables.*

English vegetables made a poor show but native vegetables were fairly well

represented, among the best exhibits being sweet potatoes, which are largely cultivated in the district.

Special Prize for School Gardens.

There were seven entries for this competition. The three best displays were from Angunakolapilessa (Hambantota district), Kimbiya (Galle district), and Mandaduwa (Tangalle district), The first was awarded the Ceylon Agricultural Society's silver medal, and the two latter were recommended for extra prizes of Rs. 10 each.

Class D. (DAIRY PRODUCE.)

The competition was poor, but there were a fair number of entries under buffalo and cow ghee of which some very fine specimens were shown.

KEGALLA SHOW, 1909.

REPORT BY C. DRIEBERG.

The most noticeable feature about this Show was the excellent arrangement on the grounds and in the sheds. The exhibits were correctly placed and properly exposed, and provision was made for necessary assistance to the judges.

In the vegetable section the collection of chillies—garden and chena—was very striking, though all the exhibits (except English vegetables) were well represented.

The show of fruits was remarkable considering the time of the year, and the three most important classes—mangoes, oranges, and pineapples—were very well filled. Some good "rupee" mangoes were shown, and there were particular fine specimens of the "Colombo" mango of Jaffna (the prototype of the "Jaffna" mango of Colombo) which went to prove that the soil and climate of the North are essential for the development of the finest flavour of this fruit. The excellence of the oranges made the task of the judges a most difficult one.

The special collections of ripe fruits were all good, and needed very careful judging before a decision as to the award could have been arrived at.

School Garden exhibits were housed in a special shed and elicited interested enquiries from His Excellency the Governor. The exhibits sent in by Hettimulla and Weeragalla were most creditable.

"Grains and other products" (class XII) were all well represented. The collections of paddy and fine grains were nicely got up, and betel leaves of phenomenal size, together with sugar-cane and maize of good quality, helped to fill a particularly interesting little shed.

THE RATE OF GROWTH OF PALMYRAS.

(From the *Indian Forester*, Vol. XXXV., Nos. 6 & 7, June and July, 1909.)

SIR,—I read with much concern Mr. A. W. Lushington's article on the above in the March number of the *Indian Forester*. A great portion of this district depends almost entirely on the palmyra for its timber, and if it really takes 300 years to grow a palmyra tree, we are indeed in a parlous state. I, however, derived some consolation from the fact that palmyra trees, in this district, do not attain a height of 100 feet. They probably are never allowed to do so, as they usually give mature timber when 50 to 60 feet high. Still a tree of 60 feet would take about 200 years to grow, and that is more than three times as long as I had reckoned on.

A short time before, when making enquiries about the age of palmyra trees, I had been informed by one of my Rangers that a tree planted in his father's back-yard when he was a little boy, is now about 40 feet high; that is, it had grown 40 feet in about 30 years. According to Mr. Lushington's estimate, and allowing for the formation of underground stem, the tree would not have been 10 feet high in the time. Of course one must take statements of this sort *cum grano salis*, but it requires a deal of salt to digest 30 feet of palmyra tree.

I, therefore, began looking about on my own account. One of the first things that I noticed was that some trees, 20 to 25 feet high, retained the dead sheaths and leaf stalks right down to the ground. I marvelled greatly; for the bottommost of these dead stalks must be 80 to 100 years old! Next I examined some leaves freshly removed from a tree by toddy tappers. It struck me that the sheath looked, uncommonly, as if it had completely surrounded the stem when first formed, and that it had split up the back as the stem expanded. I then examined the "spiral" annulations on the stem, and to my great surprise I discovered that they are not spiral at all, but a series of separate rings, each quite distinct from the one above and below it. Now, if the tree produces twelve leaves during the year—there are three leave to each ring—why should there be a gap after each set of three? One could understand it if the three leaves were produced simultaneously at intervals of three months, but that is not the case. Mr. Lushington says that a fresh leaf is formed every month, and this I believe to be the fact. If then, three of these leaves form an annulation, there is no reason why that annulation should stop after the third; it must go on as a continuous spiral, at all events, until the year's growth is completed. The only explanation that occurs to me is that each separate leaf forms a separate annulation, and as there are twelve leaves formed in a year, twelve annulations correspond to a year's growth. The annulations average roughly 1 to 1½ inch each, and a tree therefore grows about a foot or more in the year. This rate of growth corresponds to the popular belief that a palmyra tree matures at about 60 years.

A. B. JACKSON.

THE INTERNATIONAL AGRICULTURAL INSTITUTE.

(From the *Journal of the Board of Agriculture*, Vol. XVI., No. 4, July, 1909.)

The International Agricultural Institute was established at Rome in 1905, and an account of its formation, and of the objects aimed at, appeared in this *Journal* in June, 1906 (p. 129). A Parliamentary Paper has now been issued which supplies information as to the steps which have since been taken in regard to its establishment. This publication contains a report by Sir Thomas H. Elliot, K.C.B., who was one of the British delegates to the General Assembly of the Institute, together with the correspondence which has passed between the Board of Agriculture and Fisheries and the Foreign Office on the subject.

By the munificence of His Majesty the King of Italy, a beautiful building has been erected for the purposes of the Institute in the grounds of the Villa Umberto I., formerly the Villa Borghese. This building contains large rooms for meetings in the central portion, while the wings contain the offices, library, and the rooms which will be occupied by the foreign delegates. It was opened by His Majesty in person on 23rd May, 1908, and subsequently the Permanent Committee held several meetings at which the work of the Institute was discussed, and various sub-committees were appointed.

The first meeting of the General Assembly was held on November 27th, and of ninety-one delegates who had been appointed by their respective Governments, nearly all were present. His Excellency Signor Tittoni, the Italian Minister for Foreign Affairs, was elected President, and the Hon. Sydney Fisher, Canadian Minister of Agriculture, and His Excellency M. Yermoloff, Secretary of State and a Member of the Council of the Russian Empire, were appointed Vice-Presidents. The Statutes defining the functions of the Institute were settled at this meeting, and the organisation of the Institute was completed.

M. Louis Dop, delegate for France, was elected Vice-President of the Permanent Committee, which will be divided into three Permanent Sub-Committees to deal respectively with (1) Administration, (2) Statistics and Technical Information, and (3) Co-operation and Labour.

At the conclusion of the meetings of the Permanent Committee, Sir Thomas Elliot intimated that it had been decided that he should retire from the Committee, and that for the present pending a definitive decision as to the manner in which this country should be represented on the Committee, his place would be taken by Mr. Percy C. Wyndham, Councillor of the British Embassy at Rome.

The following extracts from Sir Thomas Elliot's report may be quoted as indicating generally the position now occupied by the Institute, and the work which it proposes to perform:—"The magnificent generosity of His Majesty the King of Italy, in the endowment of the Institute, coupled with the almost complete support which has been accorded to the project by the various Powers concerned, have placed the Institute in a position of exceptional stability, and the only question now is as to the manner in which its resources can best be utilised in the interests of agriculturists all the world over, within the limits of the field of action defined by the Convention.

"It may be said generally that the object of the Institute is to do internationally what the Intelligence and Statistical Branches of the various State Departments of Agriculture endeavour with greater or less success, to do in their respective countries. The work of the Institute will mainly consist in the collection, arrangement, co-ordination, and publication—with the utmost despatch possible—of the material which those departments can supply. This material differs very considerably in value, in character, and in extent, and if the work of the Institute is to be carried out in its entirety, and with accuracy and thoroughness, it must enlist the active support and co-operation of the various Governments with regard to the extension, completion, and in some cases the modification of their existing machinery. The task of the Institute will in this respect be an exceedingly difficult one, but it may be hoped that through the exercise of the influence of the various delegates on the Permanent Committee, obstacles may gradually be overcome and the necessary information obtained in gradually increasing value and volume. Happily for the immediate success of the Institute, well-organised Agricultural Departments exist in a large proportion of the countries whose agricultural position is of importance, and the area from which accurate information as to agricultural matters can from time to time be obtained will even at the outset be considerable.

"In this connection, I may mention that the Government of Roumania, being persuaded of the importance of the objects of the Institute, has organised a special Statistical Department for the purpose of supplying to the Institute all the information it requires, and that the Belgium, Danish, and Hungarian Governments have established departments for the express purpose of furthering its interests. These departments will place themselves in communication with all the various public and private organisations concerned, with a view to obtain information likely to be of service to the Institute.

"I had opportunities of explaining to the Committee that in the opinion of the Board it was essential that every possible effort should be made to issue information of such a character, and at such times, as to be of value not only to the publicist, the statistician, and the historian, but also, and mainly, to those by whom agricultural operations are actually being carried on, and to those whose industry depends upon the product of those operations. In this connection I may say that during the three years which have elapsed since the Convention was signed, I have been greatly impressed by the interest displayed in the establishment of the Institute by the International Federation of Master Cotton Spinners' and Manufacturers' Association, of which Mr. C. W. Macara is the distinguished and trusted President, and by others, for whom at first sight the work of the Institute would appear to be a matter of but little concern. It has been pointed out that the agricultural product of one country is the raw material of industry elsewhere, and that consequently the prompt collection of complete information as to agricultural prospects and production is of great value not only to agriculturists but to many other important classes of the community. It is essential, however, that such information should be published in such a way and with sufficient rapidity as to enable business men—whether producers or consumers—to make full practical use of it.

"The bibliographical work to be done by the Institute should also be of great service to those who are engaged in scientific and technical investigations bearing upon agriculture. A periodical bulletin giving information as to the work of this character which is carried on in various countries of the world would often economise time and labour and enable more satisfactory results to be obtained.

"It is easy to foresee the demands made upon the Institution, for information and assistance will steadily increase, but its ability to respond to those demands will largely depend upon the extent to which it can command the services of practical and experienced men possessing both energy and ability as members of the Permanent Committee and as members of the staff. As regards the Permanent Committee which will practically control and direct the operations of the Institute, it is to be noted that several of the adhering States, including the United States, France, Germany, Austria, Hungary, Belgium, Norway, and Spain have already appointed representatives who will be permanently resident in Rome, whilst others, principally the smaller States, will be represented either by the chiefs or other membeis of their respective Diplomatic Missions. It is certain that in the conduct of the affairs of the Institute the influence of men possessing special technical qualifications taking part continuously in the direction of the work of the Institution will be very considerable. It was decided that meetings of the Permanent Committee should be held at least once a month, and that for the control of the work of each of the three sections into which it is proposed that the staff of the Institute should be divided, a separate sub-committee should be constituted. If, therefore, the United Kingdom is to take any effective part in the work, some definitive arrangement must be made for our representation on the Committee by a competent expert on the questions to be dealt with by the Institute, willing and able to take up his residence in Rome, so as to enable him to attend and take part in the meetings of the Permanent Committee and of the various sub-committees appointed in connection with the various branches of the work. The arrangements to be made for this purpose will require to be very carefully considered."

Among the appendices to the report are the Statutes of the Institute, which comprise the Convention of the 7th June, 1905, and the Regulations of the Institute; the latter define the procedure of the General Assembly, and deal with the administration of the Institute, the constitution of the Permanent Committee, the appointment of Committees and of the Staff.

THE EFFECT OF FORESTS ON RAINFALL.

(From the *Indian Forester.* Vol. XXXV., Nos. 6 & 7, June and July, 1909).

SIR,—In the December number of the *Indian Forester*, you published a communication from me in which an endeavour was made to show that, far from the evaporation from a forest area being 600 times as large as from an equal area of water, as had been asserted in a publication to which you drew attention in the October number, such evaporation was indeed considerably less. In an editorial note to my communication, you stated that you thought I had over-estimated the amount of the evaporation from a water surface; however, a reference to the source quoted and other authorities shows that such was not the case; a low estimate was puposely chosen.

In the April number you published a communication from Mr. A. W. Lushington, Conservator of Forests, in which the writer gives reasons for his inability to accept any results. He stages: "Does Mr. Bachelor mean to say that the huge underground stores of water which are found in wells and springs come from this 42 inches? There is an enormous underground perennial supply which the annual rainfall supplements but only to fractional extent; and as the roots of trees penetrate deep into the soil they come across this perennial supply as well as the annual supply near the surface, and can pump up many times more than the 42 inches referred to by the agency of the evaporation of the leaves." I have no hesitation in giving my opinion that, speaking generally, there are no underground supplies available for forest growth which have not been derived from the rainfall of the few years immediately preceding; and that such supplies are, in comparison with the annual supply, small. I see no reason to modify the conclusion to which I came in my previous letter of the forces which change the hygroscopic condition of the soil, the chief are gravity, capillarity and friction: the two latter retard but do not neutralise the action of the former. Water cannot disobey the law of gravity under, any more than on, the surface of the land, and were the rainfall to cease, the water underground must find its way eventually to sea-level, and consequently the water underground above sea-level must have been derived from that portion of the rainfall which has not evaporated from the land, or flowed away to the sea. No matter, therefore, how large the underground supplies may be, the land cannot lose more annually than it receives; and hence the evaporation from a forest area cannot be greater than that portion of the rainfall which is not evaporated from the surface and sinks into the soil.

It may be of assistance to endeavour to make some estimate of the underground supplies of water. The quantities which it is generally assumed in India remain in the soil with a rainfall of 60, 30, and 20 inches, are 30, 22 and 16½ inches respectively. It will be noted that the proportion increases largely as the rainfall decreases. I have not been able to find a reliable estimate of how much of this is evaporated before it sinks into the soil, but will assume it is not much different from 10 inches. Leaving out of account the favoured localities immediately bordering on rivers and reservoirs, the area of which is relatively very small, the effect of a succession of dry years, indeed very frequently of two or even one dry year, is the drying up of even deep wells, and widespread destruction to the forests, in which the deepest rooted species are not spared. This indicates that the underground supplies available cannot be much larger than the yield on the rainfall of at most a very few years, or, in view of the above figures, more than a few feet. Were the operation from a forest area many times larger than that from a water surface, a loss of a few inches in the supply to the soil would have no material effect.

I have not been able to find very detailed information on the subject; but it would appear to be the case that generally throughout India, in those tracts where well irrigation is highly developed, and where the subsoil water-supply is not increased by canals, no matter what may be the depth and number of the wells, or nature of the soil, or nature of the crops, in no place where the area irrigated from wells is large compared with the unirrigated area is the average amount drawn from the wells equal to the average amount of rainfall retained in the soil. This is in accordance with the theory above given, and is indeed a deduction from it. One conclusion is that, as the roots of trees cannot draw up more than the wells can supply, the evaporation from a forest area is less than the amount of rainfall retained in the soil. Another conclusion, though one not germane to the present subject, is that in tracts where the rainfall is small, and where, as would be expected, the wells are invariably deep, it is impossible to protect against famine by means of wells alone more than a fraction of the whole area, a fraction that will decrease with the rainfall.

These are some of the reasons which confirm me in the conclusion to which I came in my previous letter, that over by far the greater part of India, or for that matter of the globe, the evaporation from a forest area must be considerably less than from an equal area of water.

E. BACHELOR, I.C.S.

CO-OPERATIVE CREDIT IN BENGAL.

(From the *Indian Agriculturist*, Vol. XXXIII., No. 11, November 2, 1909.)

In some respects the most interesting movement in Bengal at the present time is that which is gradually popularising the idea of co-operative credit and is thus preparing the way for the emancipation of the cultivator from the system of usury that now cripples his energies. The growth of Co-operative Societies in this Province during the twelve months ending the 30th June last has been most encouraging, and Mr. Gourlay has reason to feel gratified at the promising results of the reform to which he has devoted so much energy and enthusiasm. Of course we are still in the day of small things. The total share capital of the urban societies is only Rs. 19,000, and the assets even of the rural societies is little more than £13,000. These are modest figures for a Province which has 50 million inhabitants. But the significant fact at present is not the actual extent of the movement, but the evidence afforded that the principles of co-operation are gaining hold of the people. The number of rural societies has almost doubled in twelve months, rising from 165 to 326. Their membership has at the same time grown from 6,903 to 11,076, and their assets likewise have more than doubled, the total now being Rs. 1,95,409 as compared with Rs. 85,740 with which the year began. This progress does not, however, represent the potentialities of the movement. In the opinion of the Registrar, Mr. Buchan, "the number of societies could be enormously increased in a very short time." Why, then, it may be asked, does this increase not come about? The answer is one which needs to be impressed on the minds of the large class of men in Bengal who have both the means and the leisure for public service. The expansion of the Co-operative movement is checked mainly by the lack of suitable means of controlling and organising the Societies as they are formed. The machinery which the Government can provide for the purpose is strained to the utmost. The Registrar, having nearly 400 Societies under his charge, can necessarily give only a limited attention to each, and, while the Government are willing to assist by appointing a certain number of local inspecting clerks—of whom there are now ten—this form of help must obviously be restricted to areas in which the movement is making rapid progress. What is wanted, then, is a large number of competent honorary organisers. The number of these benefactors has risen from three to eight in the course of the past year, and it is acknowledged in the Government Resolution on the subject that they have "rendered the greatest assistance." But their ranks need to be largely recruited, and we are loth to think that a work of such incalculable usefulness to their poorer countrymen will be left to languish for want of an adequate number of public-spirited helpers in Bengal. Would that half the energy expended upon the Boycott had been devoted to this sure and safe means of increasing the wealth and happiness of the community! There is a stimulating lesson for the zemindars and other leading men of this Province in the career of Raiffeisen, the philanthropist, whose labours lifted a large part of rural Germany from a condition of pitiable indebtedness to one of independence and prosperity. Raiffeisen was not a wealthy man. On the contrary he is described as having been of slight estate, of very poor health, with no particular property, but of unbounded energy. He was forced by ill-health to retire from the public service in 1860. Though sick and nearly blind, he then devoted the remainder of his life to this work, dying in 1888 after his societies had been thoroughly established on a successful basis. He had to deal with conditions closely resembling those which prevail in India. A peasantry struggling to keep body and soul together was in the grip of a remorseless system of usury. Confidence, thrift, and self-help had died out. From these unpromising circumstances Raiffeisen evolved courage, prosperity, and independence, by the scheme of popular banks that will be for all time associated with his name. It is this same scheme which is now proving so successful in Bengal. But Raiffeisens are required to foster and direct the working of the system in new areas; and the appeal for the aid of competent men ought not to be in vain. As an additional method of supplying the necessary control over the societies, it is proposed to combine them in local unions, and the experiment which is to be made in this direction in the coming cold weather should be a very interesting test of the capacity of the societies for mutual control and of their readiness for evolution from their present condition of so many isolated units into one great and thoroughly organised co-operative system. The increasing confidence of the people in co-operative principles is shown not only by the actual and potential expansion of the movement, but by the readiness of investors to supply the necessary capital, and the willingness of the societies to contribute a substantial share. Forty-five per cent. of the capital now comes from investors and thirteen per cent. from the societies themselves. The one weak point in the finance of the new movement is that local capitalists have not yet been attracted in sufficient numbers by the field of investment which it offers. The Government take the view that the rate of interest offered is not too low; but it would be prudent, we think, to await Mr. Gourlay's survey of the rates generally prevailing in the Province before a final opinion is pronounced. The rate of interest offered by some of the societies, for example, is only 6 per cent., whereas the lowest rate charged by money lenders is $18\frac{3}{4}$ per cent. and the most common rate is $31\frac{1}{4}$. It is not, of course, suggested that these high rates should be taken as models, for the very object of the Societies is to avoid anything approaching to usury. But it will probably be found that, if local capital is to be secured, interest must be paid at rates approximating to those which prevail locally. The urgent need of the co-operative principle as a help to the peasant is shown by the uses to which the Societies put their funds. They are not yet, we gather, in a position to lend for the purpose of enabling their members to buy improved implements or to purchase seed at wholesale rates. The repayment of old debts and the purchase of cattle are now the common objects of borrowing—a fact which throws a flood of light on the financial incumbrances of the ryot.

WATER IN AGRICULTURE.

(From the *Louisiana Planter and Sugar Manufacturer*, Vol. XXXXII., No. 16, April, 1909.)

In a recent able editorial in the *North-western Agriculturist*, the use of water in dry agriculture was discussed, and incidentally such references were made to the use of water in agriculture as would interest us in this country, where we have so considerable a rainfall. In the extreme north-west parts of the United States summer fallowing is done to a considerable extent. We had been taught to think that summer fallowing, which was an old method of destroying weeds, would also destroy the land by the incidentalexposure of the bare land to the sun and the volatilization and loss of its contained ammonia. In the editorial referred to the point is brought out that such summer fallowing, taken together with the deep ploughing and the absence of any growth on the land, results in the conservation of a considerable amount of water that would otherwise be dissipated into the air without useful effect. In order that the water shall be conserved in the summer time it is held that the top of the fallow land must be in fine tilth, or have a dust blanket, as its covering, which will break the lines of evaporation and result in the retention of the water in the soil.

Next, the destruction of the weeds in the land would result from this process of fallowing, and where there is any scarcity of water it is held that the land must be kept free of weeds, as every weed or plant out of the place uses up the water that is so much needed. Such plants are parasites living on the water that should be retained in the land for its betterment and for the use of subsequent industrial crops. The conservation of the water demands the mulching of the land at the surface and the destroying of all weed growths.

Here in Louisiana we frequently find fall planted cane injured by the very considerable growth of winter weeds, or grasses as we ordinarily term them, and unless these weeds are removed in due season, the fall planted canes are frequently killed. We thought for some time that this disaster was brought about by the shading of the land and the retention in the land of an excess of moisture during the winter season. On the other hand, all plant physiologists admit that wherever a plant is living on the land it makes the land drier than it otherwise would be. The action of the sun on the leaves of the plant produces a constant evaporation, and the water is pumped out of the soil so positively and so continuously that it is now generally admitted that land covered with weeds is drier than the same land left bare, and much drier than the same land if, in addition to being left bare, it was carefully mulched at the surface.

We were quite struck with the use of the word "parasite" as applied to weeds or plants out of place, in our fields, their parasitism consisting in their consumption of the water needed by the growing crop. We seem to have a good many things to learn concerning plant life, just as our most skillful doctors seem to have yet a good many things to learn concerning our human lives.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 18th August, 1909.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	85s a 90s
Zanzibar & Hepatic ,,	Common to good ..	40s a 70s
ARROWROOT (Natal) lb.	Fair to fine ..	2⅞d a 4d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ...	£6 10s a £6 12s 6d
Bombay bleached ,,	Fair to good	£7 10s a £7 12s 6d
,, unbleached ,,	Dark to good genuine ..	£5 10s a £6 5s
Madagascar ,,	Dark to good palish	£6 7s 6d a £6 12/6
CAMPHOR, Japan ,,	Refined	1s 6¼d a 1s 9d
China ,,	Fair average quality ..	137s 6d
CARDAMOMS, Tuticorin	Good to fine bold	1s 9d a 2s 2d
	Middling lean	1s 4d a 1s 6d
Tellicherry	Good to fine bold ..	1s 9d a 2s
	Brownish .	1s 3d a 1s 7d
Mangalore ,,	Med brown to fair bold	2s a 3s
Ceylon.—Mysore ,,	Small fair to fine plump	1s 6d a 2s 7d
Malabar ..	Fair to good ...	1s 4d a 1s 6d
Seeds, E. I. & Ceylon ,,	Fair to good ..	1s 7d a 1s 8d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 6d nom.
CASTOR OIL, Calcutta ,,	Good 2nds ..	2 15-16d a 3⅜d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	35s a 40s
CINCHONA BARK.—lb.		
Ceylon	Crown, Renewed	3⅜d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts	Good to fine quill	10d a 1s 4d
per lb. 2nds	,, ,,	9d a 1s 2d
3rds	,, ,,	7½d a 11½d
4ths	,, ,,	6½d a 9½d
Chips, &c..	Fair to fine bold	2⅝d a 3⅜d
CLOVES, Penang lb.	Dull to fine bright pkd.	1s 1d a 1s 3d
Amboyna ..	Dull to fine	8d a 8½d
Ceylon ..	,, ,,	7½d a 9d
Zanzibar	Fair and fine bright	4⅝d a 4¾d
Stems ..	Fair	1½d
COFFEE		
Ceylon Plantation cwt.	Medium to Bold	nominal
Native	Good ordinary	nominal
Liberian ,,	Fair to bold	43s a 55s
COCOA, Ceylon Plant. ,,	Special Marks	60s a 73s
	Red to good	54s a 59s
Native Estate ,,	Ordinary to red	38s a 54s
Java and Celebes ,,	Small to good red	30s a 85s
COLOMBO ROOT ,,	Middling to good	15s a 17s 6d
CROTON SEEDS, sift. cwt.	Dull to fair	30s a 35s
CUBEBS ,, ,,	Ord. stalky to good	80s a 90s
GINGER, Bengal, rough,,	Fair	30s
Calicut, Cut A ,,	Small to fine bold	60s a 85s
B & C ,,	Small and medium	52s a 60s
Cochin Rough ,,	Common to fine bold	38s a 42s
	Small and D's	37s 6d
Japan ,,	Unsplit	34s
GUM AMMONIACUM ,,	Sm. blocky to fair clean	25s a 60s nom.
ANIMI, Zanzibar	Pale and amber, str. srts.	£16 a £18
	,, ,, little red	£13 a £15
	Bean and Pea size ditto	75s a £12
	Fair to good red sorts	£9 a £13 10s
	Med. & bold glassy sorts	£7 a £9 5s
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d nom.
Turkey sorts ,,		27s 6d a 47s 6d
Ghatti ,,	Sorts to fine pale ...	20s a 42s 6d nom.
Kurrachee ,,	Reddish to good pale ...	20s a 30s ,,
Madras ,,	Dark to fine pale ...	15s a 25s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	120s a 140s ,,
	com. stony to good block	15s a 100s ,,
KINO	Fair to fine bright	6d a 9d
MYRRH, picked cwt	Fair to fine pale	80s a 115s
Aden sorts ,,	Middling to good	55s a 70s
OLIBANUM, drop ,,	Good to fine white	40s a 50s
	Middling to fair	25s a 35s
pickings ,,	Low to good pale	6s 6d a 17s 6d
siftings ,,	Slightly foul to fine	13s a 15s
INDIA RUBBER lb.	Fine Para bis. & sheets	7s 4d
	,, Ceara ,, ,,	7s 4d
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	6s 6d a 7s 6d
	Fine Block ..	8s
	Scrap fair to fine ..	5s 1d a 5s 3d
Assam	Plantation	4s 10d a 5s 2d
	Fair II to crd. red No. 1	4s a 4s 8d
Rangoon	,, ,,	3s 2d a 4s 2d

	QUALITY.	QUOTATIONS.
INDIARUBBER. *(Contd.)*		
Borneo	Common to good	1s 6d a 2s 8d
Java	Good to fine red ..	2s 6d a 4s 4d
Penang	Low white to prime red	2s a 3s 3d
Mozambique	Fair to fine red Ball ...	3s 8d a 5s 2d
	Sausage, fair to good ..	3s 6d a 5s
Nyassaland	Fair to fine ball ...	3s 8d a 4s 8d
Madagascar	Fr to fine pinky & white	2s 10d a 3s 8d
	Majunga & blk coated ..	2s 3d a 2s 9d
	Niggers, low to good ..	1s 6d a 3s 2d
New Guinea	Ordinary to fine ball ..	3s 2d a 4s 6d nom
INDIGO, E.I. Bengal	Shipping mid to gd violet	2s 10d a 3s 8d
	Consuming mid. to gd.	2s 6d a 2s 10d
	Ordinary to middling	2s 2d a 2s 5d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	1s 5d a 2s 4d
MACE, Bombay & Penang	Pale reddish to fine	1s 11d a 2s 4d
per lb.	Ordinary to fair	1s 8d a 1s 10d
Java	,, ,, good pale	1s 7d a 2s 1d
Bombay	Wild	5d
MYRABOLANES, cwt	UG and Coconada	5s a 5s 6d
Bombay ,,	Jubblepore	4s 9d a 6s 9d
	Bhimlies	4s 9d a 7s
	Rhajpore, &c.	4s 6d a 6s 3d
Bengal ,,	Calcutta	5s a 5s 6d
NUTMEGS— lb.	64's to 57's	1s 3d a 1s 6d
Bombay & Penang ,,	110's to 65's	4¾d a 1s 2d
	160's to 115's	4d a 4½d
NUTS, ARECA cwt.	Ordinary to fair fresh	14s a 16s
NUX VOMICA, Cochin	Ordinary to good	9s a 11s 6d
per cwt. Bengal	,, ,,	6s a 6s 6d
Madras	,, ,,	6s 3d a 8s
OIL OF ANISEED ,,	Fair merchantable	4s 5d
CASSIA ,,	According to analysis	3s 8d a 4d
LEMONGRASS ,,	Good flavour & colour	2d a 2¼d
NUTMEG ,,	Dingy to white	1¼d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2¼d a 1s
CITRONELLE ,,	Bright & good flavour	1s 0½d a 1s 1¼d
ORCHELLA WEED—cwt		
Ceylon ,,	Mid. to fine not woody...	10s a 12s
Madagascar ,,	Fair ...	10s
PEPPER—(Black) lb.		
Alleppee & Tellicherry	Fair ...	3¼d
Ceylon	,, to fine bold heavy ..	3½d a 3¾d
Singapore ...	,, ...	3¼d
Acheen & W. C. Penang	Dull to fine	3d a 3½d
(White) Singapore ,,	Fair to fine	4¾d a 8d
Siam ,,	Fair	5d
Penang ,,	Fair	4¼d
PLUMBAGO, lump cwt.	Fair to fine bright bold	—
	Middling to good small	—
chips	Dull to fine bright ..	—
dust	Ordinary to fine bright	—
SAGO, Pearl, large ...	Dull to fine	15s a 16s 6d
medium .	,, ,,	14s a 15s
small ...	,, ,,	11s 6d a 13s 6d
SEEDLAC cwt.	Ordinary to gd. soluble	50s a 65s
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 7d
	Fair greenish	3¼d a 4½d
	Common specky and small	1¼d a 2½d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ..	37s a 97/6 nom.
Bombay ,,	,, ..	36s a 80s
Mergui ,,	,, ,, ...	£7 a £8 2s 6d
Manilla ,,	Fair to good ..	£5 5s a £9 7s 6d
Banda ,,	Sorts	25s a 30s nom.
TAMARINDS, Calcutta..	Mid. to fine bl'k not stony	11s a 13s
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	12s 6d a 26s
	Pickings ..	6s a 24s
TURMERIC, Bengal cwt.	Fair .	18s
Madras ,,	Finger fair to fine bold bright	17s a 18s 6d
Do. ,,	Bulbs	14s a 15s
Cochin ,,	Finger ..	15s
	Bulbs ..	13s 6d
VANILLOES— lb.		
Mauritius .. 1sts	Gd crystallized 3½ a 8½ in	9s a 16s
Madagascar ... 2nds	Foxy & reddish 3½ a ,,	8s 3d a 12s
Seychelles ... 3rds	Lean and inferior ...	8s 3d a 8s 9d
VERMILLION ..	Fine, pure, bright ..	3s
WAX, Japan, squares	Good white hard ...	45s

THE SUPPLEMENT TO THE

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THE PLANTING INDUSTRY OF CEYLON.

184,000 ACRES UNDER RUBBER CULTIVATION.

OUR DIRECTORY RETURNS.

The printing of our "Ceylon Handbook and Directory" for 1909-10 closed last week and copies of the book are now (August 12) being made available to those who have booked orders, as fast as our binders can overtake the work. We have spared neither pains nor expense to bring the information up to end of last month, as far as it lay in our power, although we are not unconscious that, with constant changes occurring, absolute accuracy is unattainable. We have once again to acknowledge our obligation and tender thanks to all the Heads of Government Departments and other officials, as well as to members of the Planting and Mercantile Community, for the aid readily and courteously afforded us in the compilation—without which it would have been impossible for us to present the book with the high degree of reliability that we now do. As usual we now furnish our readers with the results of the analysis of our Estate Returns, showing that our Planting Industry in all products is in as sound a condition as ever. There has not been much new planting during the past year, although an addition of 11,606 acres to the cultivated acreage is shown; but, perhaps, much of this may be due to more precise rendering of estate returns. The total area under rubber is now returned at 184,000 acres. A good deal of this extent is interplanted in tea throughout 67,056 acres, while 18,698 acres of cacao are also intermixed with rubber. Our summary for all the products is as follows:—

	Acres.
Total area of 2,091 plantations and planting properties ...	957,749
do 1,731 plantations in cultivation (with 1,661 Superintendents and assistants)	625,629
Total approximate extent under Tea	389,600
do Cacao	30,016
do Rubber ...	179,956
do Coffee (Arabica and Liberica) ...	950
do Cardamoms ...	7,738
do Cinchona ...	196
do Camphor trees ...	1,200
do Grass (cultivated) ...	3,500
Of Annatto, Coca, Kola, Ramie, Vanilla, Pepper, Cloves, Citronella grass, Divi-Divi, Croton, Castor oil, Aloes, Cinnamon, Tobacco, Cotton—in our plantations' list	7,000
Coconuts, Arecas, Nutmegs, Fruit trees (on the cacao, tea or other plantations)	22,500
Of Fuel, Timber, Sapan and Kapok (on the tea, cacao or other plantations)	6,050

The aroa of tea as given above is apart from, perhaps, 5,700 acres in native gardens of small extent—Kegalla District alone has nearly 2,000 acres—so that the grand total under tea in Ceylon at end of July last must be about 395,000 acres. But, nevertheless, we feel considerable allowance must be made for the enormous number of rubber trees now growing among tea in certain districts; and we would, allowing for this, consider the extent in tea to be the same as last year, although our returns show an increase of 3,000 acres. The acreage in cacao is apart from 5,800 acres, say, in native gardens, thus giving a total of about 36,000 acres. The Ceylon Planting Enterprise may then be summed up for July, 1909, as follows, and the comparison with last year—middlo of 1908—stands thus:—

Product.	Acres. Middle 1908.	Acres. Middle 1909.	Increase or Decrease.
Tea ...	392,000	395,000	3,000 inc.
Cacao ...	35,000	36,000	1,000 inc.
Rubbor ...	180,000	184,000	4,000 inc.
Coffee	873	950	77 inc.

Product.	Acres. Middle 1908.	Acres. Middle 1909.	Increase or Decrease.
Cardamoms ...	8,350	7,738	612 dec.
Cinchona ...	173	196	23 inc.
Camphor ...	1,200	1,200	—
Other products on plantations, including grass & timber trees ...	38,641	39,500	859 inc.
Total area ...	944,403	957,749	13,346 inc.
Cultivated area	614,023	625,629	11,606 inc.
No. of plantations (cultivated) ...	1,722	1,731	9 inc.
No. of Superintendents and Assistants ...	1,600	1,661	61 inc.

Rubber planting was represented by an estimate of 750 acres in March, 1898; and by May, 1901, we estimated 2,500 acres; while the return to the middle of 1904 gave an equivalent of 11,000 acres. Planting went on very rapidly in subsequent years, until last year when a halt was made, save for a clearing here and there. Of the 184,000 acres at present under Rubber, no less than 131,800 acres are in separate clearings, the rest being intermixed with other products. It must be remembered that we have calculated the equivalent acreage for each product by dividing where products are intermixed and by allowing 175 rubber trees as the equivalent of an acre where only number of trees was returned; the latter aggregated nearly 800,000.

It is of interest to note the leading Rubber-growing Districts in Ceylon, in their order, according to acreage, viz:—Kelani Valley, Kalutara, Ratnapura, Kegalla, Galle, Kurunegala, Matale East, Matale North, Matale West, Haputale, Monaragala, Madulsima, Matale South, Rakwana, Kadugannawa, Alagalla, Nilambe, Ambagamuwa, Passara, Dolosbage and Galagedara. Kelani Valley returns 30,321 acres rubber alone, beside 22,839 tea and rubber; Kalutara 29,902 and 12,016 respectively; Ratnapura 12,963 and 2,352; Kegalla 10,000 and 3,437; and Galle 7,322 and 2,327—to name only the first five districts.

As regards the oldest regularly cultivated tea field in Ceylon, that of 19 acres (Assam-Hybrid) on Loolecondera, planted by Mr. James Taylor (for Messrs Harrison and Leake of Keir Dundas & Co.) in 1868-9, we are glad to hear it is still in good heart. On 9th ult. Mr. G F Deane was good enough to write to us as follows:—

"It gave 395 lb. made tea per acre last season It is to be pruned again shortly and I expect to give a better result in 1910-11 as there is nothing much wrong with it. It is still without manuring in any form." For 1907 the return was 230 lb. per acre, owing to pruning in January to June.

For many years our Directory recorded the wonderful yield of tea from the famous Mariawatte garden of the Ceylon Tea Plantations Co. and more especially from the special and oldest field of 101¼ acres on which plucking first began in 1880 and which was regarded as in full bearing in 1884 when the crop equalled 1,078 lb. made tea per acre, rising to 1,384 lb. in 1890 and 1,357 lb. in 1900. But from 1901 onwards the yield has been as follows:—

Year.	Per Acre. lb.	Year.	Per Acre. lb.
1901 ...	1,092	1905 ...	864
1902 ...	1,009	1906 ...	863
1903 ...	868	1907 ...	968
1904 ...	801	1908 ...	789

It will be seen that since a regular system of more or less up-to-date cultivation was adopted, as opposed to the former method of occasionally applying manure carted from Gampola, the vigour of the old tea has been gradually built up and the yield increased; but Mr. D J Blyth, the present Manager, is of opinion that the crop in 1907 cannot fairly be ascribed entirely to up-to-date cultivation, but chiefly to pruning being delayed that year, and that this delay has affected the yield of 1908. The yield from the whole estate—458¼ acres—averaged 678 lb. last year against 756 lb. in 1907 and 792 lb. in 1906. We take it that such figures are without parallel in the history of Tea Cultivation in India or Ceylon; and long may Mariawatte and our Premier Tea Company continue to break the record. It is sad to contemplate how both coffee and cinchona have dwindled. Finally we give the six largest tea factories in Ceylon with the outturns for 1908, as supplied to us by the Managers direct:—

	Outturn in 1908. lb.
Galaha	1,610,569
Demodera	1,500,000
Diyagama	1,283,000
Spring Valley	1,048,366
Meddecombra	957,431
Sunnycroft	864,858

A BARK DISEASE OF HEVEA, TEA, &C.

TEA.

The most serious attacks of "Corticium javanicum" on tea occur on an upcountry estate. The disease makes its appearance fairly regularly towards the end of the south-west monsoon after "three months cold, dull, wet weather." The rainfall is 100 to 105 inches per annum. It is said to occur only on good jat tea, China tea never being affected, and it does not appear until the tea is two-and-a-half years or more from pruning; these phenomena are probably dependent on the density of the bushes. The estate is surrounded by jungle on three sides.

The growth of the pink fungus on the smaller twigs is the first sign of the disease. It spreads from these down to the thicker branches, but, in this instance, it is said that it is not found on the old wood. The branches lose their leaves and die back, either over the whole bush or only on one side. As in most cases on Hevea, the fungus is at first quite superficial, but when it has become established on the twigs its hyphæ penetrate the bark and kill both bark and cambium. In very many cases, however, the fungus travels along one side of a branch only, usually the under-side or it may completely encircle the branch for a length of a few inches, but be confined to one side elsewhere. In such cases the bark is killed only where the fungus grows, and the subsequent ingrowths from the surrounding living bark produce a "canker." Instances of such cankers can be found on twigs one-tenth of an inch in diameter; and, as far as is known at present, "Corticium javanicum" is the only fungus which produces "branch canker" on branches less than half-an-inch in diameter. The dead bark is not cast off; it remains within the canker, ragged and fibrous on the younger twigs, or smooth and blackened internally on the larger. As a rule, the pink fungus tissue dies during the dry weather and disappears, but examination with a hand lens will generally reveal minute patches still adhering to the dead bark. There is no danger of any further infection from these cankers when the pink tissue has disappeared; the branches should be cut off and burnt when they are covered with the fungus. All the evidence points not to a continuous infection from the cankered branches, but to a re-infection from external sources during each monsoon.

Examples on the older branches of tea from other estates show that the

FUNGUS GROWS ON THE UPPER SURFACE

of these and kills the bark over a comparatively small area. When the fungus ceases to grow, the ingrowth of a swollen margin from the surrounding healthy tissue takes place as before, resulting in the formation of the typical branch canker of thick branches. The dead bark persists for some time within the canker, and often shows the superficial fungus patch, generally bleached white. If the bush is vigorous, the wound may heal over completely, and experience proves that an excess of potash in the manure applied is of great assistance in promoting this recovery. But in most cases water lodges in the wound and induces decay, while fungi, otherwise harmless, grow on the dead bark and wood and assist in the gradual hollowing out of the branch.

The commonest saprophytic fungus in such situations is "Hirneola polytricha," Mont. This occurs in abundance on dead wood all over the Island, and naturally the dead wood in the branch canker does not escape. It does not, as a rule, produce any fructification when growing in these cankers, but that can readily be induced to grow from them under suitable conditions in the laboratory. The fructification is circular, either flat or cup-shaped, sometimes on a short stalk, sometimes sessile; the upper surface is bluish purple or violet, usually with a whitish bloom; the under surface and stalk are covered with close set white hairs; it differs from most of our common fungi in its consistency, being midway between leathery and gelatinous; internally it has the same colour as the upper surface. The white strands, one form of "Thread Blight," which are often seen issuing from the canker and spreading over the healthy tissue, are the mycelium of this fungus. The description of this species is inserted here merely as a matter of interest; the fungus does not *cause* branch canker, and its white mycelium spreading from the decayed tissue does no damage. There are, of course, other forms of "Thread Blight," many of which cause serious damage, but in Ceylon the dangerous parasitic species have not been found except on nutmeg and jungle trees. The "Thread Blight" which grows from a branch canker is, as far as is known at present, harmless.

It must be borne in mind that the branch canker here described begins with the killing of the bark by "Corticium javanicum," and that when this fungus has disappeared, as it does, there is no danger of further infection from that particular wound. The subsequent decay of the wood is in a great measure caused by rain, &c., though it may be assisted by saprophytic fungi. It is not necessary, therefore, to cut off all the cankered branches, since, as a rule, they are not noticed until long after the cause has disappeared. In many cases badly cankered fields yield a large crop (up to 1,000 lb per acre) and it would be absurd to sacrifice this unless there was grave danger of infecting other fields. It would be quite sufficient to tar the wounds in order to arrest further decay.

The above account of branch canker is applicable to the majority of cases on estates at an elevation of more than 4,000 feet. In the neighbourhood of Peradeniya, branch canker is caused by quite a different fungus, a species of "Physalospora" which kills the bark. But even here it appears that the fungus is only concerned in the initiation of the canker, and is not present in the hollowed stems. In other districts, what is known as branch canker is frequently the result of white ants following shot-hole borer, and the treatment in these cases must deal with the latter.

GENERAL.

The periodic infection of tea and rubber during the south-west monsoon points to an influx of spores of the fungus from some external source during that period. The fungus has been found in the jungle on bushes, and the fact that the worst affected tea estate is surrounded by jungle on three sides tends to confirm the view that the spores are blown from there. There is no doubt that we are dealing with a native, not an introduced fungus.

Mr. Ridley states that the "Corticium" so common in the Straits on Ramie and "Strobilanthes," when overcrowded and too damp, is probably this species. It has been found in Ceylon on "Hevea brasiliensis," (tea up-country), plum (up-country), orange (low-country), and cinchona. In Java, where the disease is known as "Djamoer Oepas," it attacks coffee, ramie, cacao, cinchona, nutmeg, tea, "Eriodendron," pepper, coca, cinnamon, kola, "Castilloa elastica, Hevea brasiliensis," dadap, "Bixa orellana," mango, and many other trees or shrubs of minor importance.

It has been suggested that the "cankers" previously described on Hevea and cacao, as well as the undescribed Ceylon canker on cinchona, are all caused by "Corticium javanicum." But in the original "cankers" of Hevea, cacao, and cincona, the diseased bark is moist, whereas, when killed by "Corticium," the bark is dry. This difference indicates a totally different agent in the two cases.

T. PETCH,
Government Mycologist.

June 25, 1909.

—R. B. Gardens Circular.

RUBBER IN MALAYA.

MR. J, B. CARRUTHERS' FINAL REPORT: AN EXHAUSTIVE AND INFORMING REVIEW.

Although it is now some considerable time since Mr. J. B. Carruthers relinquished his duties as Director of Agriculture and Government Botanist, F. M. S., to take up his present appointment in Trinidad, the report on Agriculture in the Eastern Colony during 1908, which has just been issued and is to hand today (Aug. 16), is from his able and facile pen. The report mainly deals with the great young rubber industry. We must at once say it is the most exhaustive, thorough and informing statement we have yet seen of the progress and position of the plantation rubber industry in the Federated Malay States or any other Colony. It reveals in every line evidences of careful observation and investigation and a perusal of it cannot fail to intensify the regret universally felt in rubber-growing circles in Malaya and Ceylon that the services of so able and active an officor should be lost to the East. We publish the report, as far as it relates to rubber, in full, containing admirably compiled tables of statistics on acreages, outputs, labour employed—and in fact on every conceivable subject on which statistics may be of profit or of interest. It will be seen that in Malaya at the end of 1908 the number of rubber trees is calculated at 37½ million, the planted acreage being 241,138. The output of dried rubber was 1,580 tons against 1,017 tons in 1907—an increase of 56 per cent—and representing an oxport of over $6,000,000 in value. The number of estates is 417 and the planted acreage is given at 241,138 acres. [This is different from the 168,000 for 1908 mentioned by the Resident-General and alluded to in our Directory !] 60,000 acres planted in 1908 is surprising; we wonder how it is arrived at? Thero is still 762,408 acres alienated from the Crown but not planted so that there is plenty scope for development ! Mr. Carruthors predicts that the present year will show a return of produce worth more than a million sterling. "Yields of Dry Rubber per tree" is then dealt with. The average yield per tapped tree all over the Peninsula has risen from 1 lb. 2 ozs, to 1 lb. 15¾ oz., an increase of 11 per cent. An interesting experiment with rubber trees sevonteen years old round the Churchyard at Parit Buntar gave an average of 28½ lb. per tree, while the average yield of tapped trees in Negri Sembilan is 3 lb. 2 oz., an "extraordinarily high figure." Johore is a fraction under 2 lb. and Perak 1½ lb. "The passing of *Ficus Eaica*" is reluctantly noticed in an interesting paragraph. Planters in Ceylon who have Rambong (which Mr. Carruthers says gives a larger yield of dry rubber than Para) will profit by a careful study of the results attending Mr. Carruthers' two year's experiments in regard to the proper methods and instruments for tapping this species. "Market prices" are referred to; and then follows an exhaustive deliverance on "Rubber Tapping," dealing in a most interesting manner with many points upon which opinion is at present divided, and giving many hints which the most experienced planter cannot fail to find informing and helpful. Mr. Carruthers thinks this whole question of tapping "requires careful invesigation"; that there is a large field for ingenuity and experiment and that the next few years should prouce an instrument which will be a marked improvement on the present weapons. Among the questions discussed under this head are "the periods which should be allowed to elapse between tappings in order to get maximum yields" and "how far it is advisable to rofrain from tapping rubber trees after a period of tapping"—two points upon which opinion is by no means undivided. Under "Preparation of Rubber for Market" tho fact is noted that there is still no agreement on the best form ; but practical advice is given as to the qualities to be aimed at in order to secure the favour of the buyers. The question of sale of rubber seed for oil purposes is dealt with, and detailed estimates given which show a profit of $7 per acre from this source. Health of coolies on estatos has during the year shown a marked improvemont, while we learnt that there are in Malaya 80,000 coolies engaged on rubber ostatos, of whom 50,000 are Tamils, 15,000 Chinese, 7,500 Javanese, and 4,500 Malays. Valuable hints as to the prevention of diseaso and pests aro followed by an interesting paragraph on the still unsettled point as to what is the proper distance apart to plant rubber. Mr. Carruthers, as is well-known, has long been an advocate of the cultivation of cover plants on rubber estates as against the system of clean weeding and his views are being adopted and amply justified by results in the F.M.S. What he writes on this point will well repay the close perusal of all Ceylon planters. The final paragraph deals with the future of rubber, from which we may quote as follows:—"In 10 years (1919) presuming that 25,000 acres are planted annually during the next five years (a very reasonable estimato, considering that over 40,000 acres were planted during the year in both 1907 and 1908), the rubber trees of the Federated Malay States should yield not less than 50,000 tons of dry rubber, which at 3s per lb. represents a value of $144,000,000. This amount, should the demand for rubber increase at the rate it has been annually rising for the last nino years, will probably at that time be less than 25 per cent of the world's consumption. . . . The fear of over-production is to some extent pardonable on examining the magnitude of the figures relating to rubber planting in Malaya, but a consideration of the possibilities of the world's future requirements takes the student into figures beside which those of Malaya are but small."

MR. J. B. CARRUTHERS' REPORT.

FULL STATEMENT OF PRESENT CONDITION FUTURE AND PROSPECTS.

The progress of rubber cultivation in tho Malay Peninsula continues to be unique in its rapid progress and in the success of the areas already planted, and which have come into bearing. At the end of 1908 there were 37,440,020 trees as compared with 27,558,369 a year before; 60,636 acres were planted during 1908, an increase of over 33 per cent. on the previous year, giving a total of 241,138 acres of rubber on the 31st December for the whole Peni nsula. The output of dry rubber increased in 1908 by 56 per cent.: 3,539,922 lbs., or 1.580 tons, being produced as against 2,278,870 lbs., or 1,017 tons, in 1907. This 1,580 tons represents probably about 1½ per cent. of the world's supply for last year. The average at which this was sold was not less than 4s per lb., representing an export of over $6,000,000 in value or over £700,000; eight years ago the value of rubber exports was about £1,700, a large and profitable industry having been created within that time, which will next year show a roturn of produce worth more than £1,000,000 or $8,500,000.

RUBBER STATISTICS, MALAYA, TO 31ST DEC. 1908.

	Federated Malay States.	Straits Settlements and Kedah.	Johore.	Kelantan.	Total.
No. of estates	300	81	27	9	417
Acreage in possession	455,596	158,553	127,959	20,300	762,408
Acreage planted up to 31st Dec., 1908	168,048	50,121	20,944	2,025	241,138
Acreage planted during 1908	41,813	7,255	10,818	750	60,636
No. of trees planted up to 31st Dec., 1908	26,165,310	7,743,322	3,224,388	307,0.0	37,440,020

RUBBER IN FEDERATED MALAY STATES.

The advance of rubber planting in the Native States was as rapid in 1908 as in 1907: the drop in prices not causing the cessation in opening up and planting that some expected: 41,813 acres were planted during the year as compared with 40,743 in 1907, an increase of 33 per cent, one-third more than the total acreage. On the 31st December, 1908, there were 168,048 acres of rubber, containing 26,165,310 trees, in the Foderated Malay States, as against 126,235 acres and 19,628,957 trees on the same date of the previous year. Within the last ten years the acreage of rubber has increased 100 times, and it has practically doubled during the last two years. The output of dry rubber increased by 60 per cent.: 3,190,000 lb., or 1,425 tons, as against 1,980,000 lb., or 885 tons, in 1907. These figures of output are slightly higher than those given by the Commissioner of Trade and Customs of the amount of rubber exported; this is due to the fact that rubber recorded as produced on the estate before the 31st December, is exported later and comes into tho export returns for the following year. There is no better proof at the present time of the energy and grit of the British planter in the tropics than the excellent manner in which this large acreage of rubber in the Federated Malay States has been felled, cleared and planted, and is now in a healthy and vigoreus condition, and where old enough yielding handsome profits. Great credit is due to the managers of rubbor estates and their assistants for carrying out their varied and arduous duties, under conditions frequently unfavourable, with so much success.

RUBBER STATISTICS, FEDERATED MALAY STATES, UP TO THE 31ST DEC., 1908.

	Selangor.	Perak.	Negri Sembilan.	Pahang.	Total.
No of estates	130	114	42	14	300
Acreage in possession ..	215,509	140,675	79,625	19,787	455,596
Acreage planted up to the 31st Dec. 1908	82,246	56,706	27,305	1,791	168,018
Acreage planted during 1908	20,694	10.539	9,649	931	41,813
No. of trees planted up to the 31st Dec. 1908 ..	12,499,331	8.5(0,321	4,923,745	181,913	26,165,310

Comparative tables of rubber acreages and trees in Malaya, 1907 and 1908:—

	State,	Rubber acreages. 1907.	1908.	No of trees, 1907.	1908.
F.M.S.	Selangor	61,572	82,?46	.9,648,(93	12,499,33
	Perak	46,167	56,706	6,648,957	8,560,321
	Negri Sembilan	17,656	27,305	3,165,388	4,923,741
	Pahang	860	1,791	1?6,590	181,913
S.S.	Malacca	36,946	41,324	6,019,940	6,556,790
	Province Wellesley	5,920	8.797	767,276	1,186,532
	Johore	10,1 6	20,914	1,142,196	3,224,388
	Kelantan	..	2,025	..	307,(0)
	Total	179,227	241,138	27,258,440	37,440,020

In Province Wellesley is included two estates in Singapore, eight estates in Penang and five estates in Kedah. These figures are approximate.

YIELDS OF DRY RUBBER PER TREE.

It is difficult to decide whether it is better to record yields per acre or per tree; both methods are in some ways misleading. The yields having been given in my last report per tree, this seems to me to be the better way to continue. The average yield per tapped tree all over the Peninsula has risen from 1 lb. 12 oz. to 1 lb. 15¾ oz., an increase of 11 per cent. Considering that the majority of the trees tapped are in their first year of bearing, this is a most encouraging figure and shows that the yields estimated in looking forward to the future production of rubber trees have, as a rule, been extremely moderate if not unnecessarily small. The average yield of tapped trees, in Negri Sembilan amounted to 3 lb. 2¼ oz., which, being tho average of nearly one million trees, is an extraordinarily high figure. This State has much higher yields per tree because tho proportion of trees in their first tapping period is much loss than in the other States, but this high figure is interesting as pointing to the averages which may bo looked for in trees after two or three years tapping. An interesting tapping experiment with eight 17-year old trees growing round the churchyard at Parit Buntar, in the Krian District of Perak, has given after one year's tapping every other day an average of 28½ lb. of dry rubber per tree. The average girth of the trees was 54.87 inches at three feet from the ground, and they had been growing in unweeded land containing lalang and other grasses.

Comparative Tables of Rubber Crops, Malaya, 1907 and 1908.

State.	Number of trees tapped. 1907	1908	Rubber yields. 1907 lb.	1908 lb.	Average yield per tree. 1907 lb.	ozs.	1908 lb.	ozs
Selangor*a*	772656	1172383	1131086	1846384	1	7½	1	9 1·5
Perak*a*	132556	251613	272804	383073	2	1	1	8¾
Negri Sembilan*a*	240401	306376	586864	963253	2	7	3	2⅓
Pahang*a*	..	..	...	..	...		..	
Malacca*b*	12455	56846	23490	52980	1	14	..	
Province Wellesley*b*	48000	65100	82131	92600	1	11	..	
Johore	94159	101772	182495	201632	1	15	1	15¾
Kelantan	..	...	..	..	..		...	
Total	1300227	1954(9)	2278870	3539922	..		..	

In Province Wellesley is included two estates in Singapore, eight estates in Penang, and five estates in Kedah.

a F. M. S.; *b* S. S.

The Passing of Ficus Elastica.

Four years ago the question of tho relative advantages of planting *Hevea brasiliensis* (Para rubber), or *Ficus elastica* (Rambong), was considered an opon one, and the fact that the latter was a native tree and grew freely in Malaya induced some to prefer it to the Brazilian plant. Thero are various difficulties attending the treatment of Ficus in regard to pruning it or allowing it to form its aërial roots unchecked, in relation to tapping and prevention of entrance of boring insects and fungi into the wounds; also the direction and shape of the branches and stems make the collection of latex no easy matter. The yields of dry rubber from rambong are larger than from Para and market prices excellent. The symmetrical stem of the Para, the facilities for running the latex into a single cup at the base of the tree, regularity of its growth and its reaction to a wound, have especially commended this tree to the rubber grower, so that rambong is no longer considered as an alternative on equal terms, and no further estates have been planted with the native plant. From a practical planter's point of view this choice must perhaps be considered wise; but it is to be regretted that a tree yielding so well and suited to local conditions should have beon entirely abandoned. I have been carrying on experiments for some two years past in regard to the proper methods and instruments for tapping *Ficus elastica* (Rambong), and consider that a rotary prickor in which the pins are at such a distance apart that the latex which runs from the puncture joins that from those adjoining is a more practical way of extracting tho latex than the making of a cut with a knife. If the rubber which flows from the various punctures made with the roller pricker all over the surface of the stem and branches is pulled off directly it has coagulated, it will be found that the flow will occur again and a second crepe-like film of coagulated latex can be pulled off. The absence of wound prevents tho attacks of borers and tho tree can be again pricked after a short time has elapsed. When the flow from the puncture is too great to allow it coagulate and it runs down, it can be caught at the base of tho tree by means of rubber band or a metal ledge round the tree to lead the latex into a cup or other receptaclo. If a flow of latex is preferred to the crepe-like scrap I have described, then an application of water by a brush or spray will run the latex down to the base of the tree where it can be caught.

These questions are, however, becoming of minor importance in the Federated Malay States, as the passing of *Ficus elastica* has begun, and each year sees less of this interesting and profitable tree cultivated. On some estates the trees are being actually cut out to make way for its more desired rival, Para.

Market Prices.

The market price of rubber during 1908 showed an extraordinary variation, dropping in the beginning of the year to the lowest price previously paid for good plantation Para—viz., 3s per lb. From that point the price steadily recovered, until before tho end of the year it had reached 5s 9d per lb., an increase of almost 100 per cent in nine months. This recovery showed that that the drop in the price of rubber, as was stated in my last year's report, was not due to any alteration in the ordinary "supply and demand," but was an effect of the financial depression which existed at that time, chiefly in America, and which led to a cessation of purchases by manufacturers of rubber in that country. The average price per lb. of rubber sold from the Malay Peninsula during 1908 was about 4s 3d, while the cost of production was between 1s and 1s 6d, so that the industry in passing through the worst year it has experienced, was at tho same time exceedingly fortunate in a very large margin of profit.

Rubber Tapping.

The Rubber Curing House was completed during the year, and machinery for curing rubber, consisting of an oil engine, a roller and a hydraulic press, have been obtained. There are 900 trees of ovor nine years old, on which a series of experiments will be made and all data recorded. Many problems of groat economic importance await solution. The climate of Malaya differs so greatly from that of Ceylon and other rubber-growing countries that the results of experiments carried on there cannot with safety be used as giving reliable information for treatment of trees in this country. The whole question of tapping requires careful investigation. The results given by thin paring of cuts at an angle to the axis of the treo are so good that planters are apt to consider the matter solvod, but it is not improbable that punctures instead of cuts may yet be found to give as good or better yields and involvo less skilled labour. All the "prickers" which have up to the present been exploited are instruments not for making a puncture but a short deep cut, and consequently damaging relatively more cells of the tree than a cylindrical or sharply conical pricker. There is a large field for ingenuity and careful experiment; and the next few years should produce an instrument which will be a marked improvement on the present weapons. Excellent work with regular shavings, as thin even as 20-25 to the inch, have been done with the gouge, the Farrier's knife, and with more modern specially adapted tapping knives. It is important to make certain of the periods which should be allowed to elapse between tappings in order to get maximum yields. After having collected figures of yields on a large number of estates it is difficult to lay down an absolute rule as to the procedure which experience shows to be the best. Carefully kept data on some estates show that after a period of some three months alternate days' tapping the amount of latex per tree decreases to an amount which is of less value than the cost of tapping, but after a rest of two months the trees again on the fourth or fifth tapping yield the maximum, which after some 40 tappings begins to rapidly decrease. The reverse of these observations is to be found on other estates where accurate figures of yields show that after continuous tapping for some two or three years, the amount obtained varies only slightly, never steadily decreasing. The variation is caused by climatic conditions, short periods of little or no rainfall reducing the yield and periods of excessive rainfall producing somewhat the same result. This is

DUE TO THE RELATIVELY LESS ACTIVE FUNCTIONING OF THE ROOTS

owing to drought or excess of water. Many planters believe in stopping tapping when the trees are leafless, a period of some three weeks each year. The experiments which have been continuously carried on for some 18 months by this department on 17-year old trees at Krian show a slight decrease of yield during the leafless period. The notion is also prevalent that tapping should be discontinued during the fruit-bearing period. The figures obtained at Krian show a decrease during the time the trees were in fruit, but no sufficient decrease to seriously increase the cost of tapping. The figures relating to these tapping experiments will be published in the "Agricultural Bulletin." Careful records have been kept of the weight and bulk of latex each day from each tree, and the ensuing weight of dry rubber. The question of

HOW FAR IT IS ADVISABLE TO REFRAIN FROM TAPPING RUBBER TREES AFTER A PERIOD

of tapping is one upon which planting opinion differs very greatly. On some estates, after a period of some weeks or months of tapping, a period of about equal length is allowed to elapse without tapping. On others and the majority of places tapping is continued without cessation, in some cases trees having without any reduction of yield been tapped for 3½ to 4 years every other day without cessation. On the question of daily or alternate days' tapping planters are also divided, and experience of yields points somewhat to the advantage of the latter practice. There is no physiological reason why the tapping should cease during the leafless or fruit-bearing period; the cutting of the small portions of the bark which tapping implies being in the case of a tree of 20" or more in girth so slight an injury as to be negligible. The best and simplest criterion for deciding how long to continue tapping is found in keeping a record of the amount of latex from each tree from 1,000 trees or from a field. If these figures show no serious and continuous decline, there is no reason to stop tapping. On the other hand when, after a series of tappings, say 40 or 50, the amount of latex obtained decreases in a marked manner and this decrease is constant, the yield being less and less, than it is advisable to stop for a period of a month at least, and not to begin again until by an experimental tapping it is found that the flow is again large. On one estate the tapping for a number of cuts was habitually stopped when the yield had attained the maximum, and after some weeks tapping again produced less yield which increased till the arbitary time of ceasing. This method, which is adopted to a great extent from fear of using too much bark, is most unprofitable as it leads to stopping before the best yields have been obtained. It is naturally wise to so arrange tapping operations that it will not be necessary to retap renewed bark for some considerable period, but we do not yet know by experiment in the Malay States what length of ime is necessary for a healthy tree, carefully tapped, to produce new bark containing a large number of well-filled latex vessels. The time of four years has been arbitarily fixed by some planters and their tapping schemes are arranged in relation to that period. That four years, three years, or two years are necessary for the formation of bark suitable for tapping cannot yet be definitely stated, but it is highly probable from isolated cases where such experiments have been made that four years is unnecessarily long. Experimental work and observations on tapping and yield of rubber made in Ceylon are unfortunately of little value for Malaya. The climate of Ceylon rubber districts, with its periods of dry weather, is not comparable with the conditions in Malaya, where rubber trees are in active growth of root, leaf and other tissues practically every day of the year, and where, even when they are leafless, the growth of trees is not entirely stopped. On one estate in Perak the yield of dry rubber per acre was 800 lb., a little less than 4 lb. per tree, even though the trees were crowded together 220 to the acre; this rubber was sold at an average price of some 4s per lb., thus realising about £160 gross profit per acre, of which more than 50 per cent. must have been net profit.

PREPARATION OF RUBBER FOR THE MARKET.

There is still no agreement as to the best form in which to prepare rubber for the home market; block, crepe, sheet and biscuit are made by different planters for different reasons. One reason which makes it difficult for the producer to make up his mind as to the best form in which to make his rubber is that it is not easy to find what the broker and the manufacturer like best. A big price for a break of crepe gives the impression that this form is desired and will fetch a better price than block or sheet. Shortly after a purchase of block rubber at a price higher than the rest on the market seems to imply that this kind of rubber is wished for. The leading brokers, buyers and manufacturers themselves when asked as to their opinions are found to differ, and so for the present it must remain an open question whether block, crepe, or sheet will get the best reception on the European Market.

Light colour and uniformity all through the sample are beginning to be considered as qualities to be aimed at, though the former character is probably only desired by the manufacturer for a class of goods which can never consume a very large quantity of raw rubber, and, therefore, if all prepare to this standard too much may be supplied. All who have studied the matter, or who have technical knowledge and experience, are agreed that the most important quality to be arrived at in plantation rubber is "nerve," "fibre," "pull," "strength," or whatever other terms may be used for the possession of elasticity and resilience to a high degree. If this character of Malayan plantation rubber is continued and improved, there is no reason to doubt that the manufacturer will in a short time begin to set a value on it equal and perhaps better than that given to the wild Para of Brazil. The exclusion of all latex which may contain too much viscine, resin, etc., since it is obtained from young trees, when "bulking" latex is strongly to be recommended; there is always a market for poorer values of rubber by themselves, and the inclusion of a small quantity of inferior latex may considerably reduce the value of the whole break, and at the same time do harm to the good name of the estate for sound rubber. Block rubber has great advantages over the other forms, in that it is less bulky and costly for storage and transport, and less liable to any damage by damp or heat in transit. Many leading manufacturers and technical experts in Europe consider that the block rubber possesses more of the desirable qualities of the Brazilian Para than crepe or sheet; and the only objection which any of them make to block is the fact that it cannot always be examined for internal impurities without cutting each block. This drawback is obviated if the blocks are made only 1 to 1½ inches thick, when they are transparent and any opaque object included in them can be detected by holding them up to the light.

Rubber Seed.

The question of the sale of rubber seed for oil purposes should be carefully considered by every careful planter. The crop of seed in the Peninsula was probably not less than 300,000,000, or 1,200 tons in weight, valued in the London market at over $100,000. This amount of available seed will increase annually very rapidly, and in five years' time more than 30 times this will be produced. The following figures show that there is a fair profit from the collection and export of these seeds, even at the rates which are at present offered for decorticated seed, and it is not improbable that when sufficient quantity is placed on the market a higher price will be obtained :—

Weight of Hevea Brasiliensis Seed, Cotyledons and Shell.

Number.	Total Weight. Gr.	Shell. Gr.	Cotyledons. Gr.	Percentage of Cotyledons to total weight. Per cent.	
1	3.18	1.69	1.58	50	
2	5.14	1.84	3.28	66	
3	4.26	1.63	2.61	62	
4	4.41	1.70	2.70	61	
5	4.19	1.33	2.86	68	
6	4.46	2.05	2.41	52	
7	3.50	1.65	1.85	53	
8	3.86	1.96	1.89	49	
9	3.14	1.41	1.73	55	
10	3.21	1.48	1.72	53½	
11	3.26	1.35	1.90	58	28
12	4.65	1.89	2.49	53	54
Total	47.286	19.88	27.02	..	
Averages	3.938	1.656	2.25	59	7

The following will enable an estimate to be made of probable profits from this source :—

111 Para rubber seeds eql. 1 lb.
12,432 ,, ,, ,, eql. 1 cwt.
248,640 ,, ,, ,, eql. 1 ton.

The kernel—*i.e.*, the decorticated seed—is 60 per cent. of the total weight of seed, therefore 414,400 seeds makes a ton of decorticated seed. At 400 seeds—*i.e.*, 133 fruits to the tree—414,400 seeds will be the crop of 1,036 trees, which at 193 trees to the acre—*i.e.*, 15 feet apart—is the produce of 5.4 acres. One acre will therefore give 3 cwts. 79 lb., value £1 17s. or $15.88.

		$	c.
Cost of putting on market :	..	$	c.
Freight, 40s. per ton (say $18)	..	18	00
Collecting at 4 cents per 1,000, per ton	..	18	64
Decorticating, per ton	..	2	50
Packing, per ton	..	15	00
	..	54	14
Value on market £10 to £12 (say $93.50—*i.e.*, £11)	..	93	50
Cost of putting on market	..	54	14

Total net profit per ton, $39.36—that is 5.4 acres gives $39.36 profit—*i.e.* $7 per acre.

Synthetic Rubber.

Reports of rubber substitutes and synthetic rubber during 1908, as in previous years, continued to alarm greatly and frighten many faint-hearted believers in rubber cultivation; but the end of the year brought us no nearer the production of a substance which will take the place of rubber at a cost less than the present market price. Rumours of rubber to be made from peat, rosin-bearing woods, wheat and other substances are current periodically; each case causing great alarm at the time, in a few months is forgotten, and the fears of the timid investor in rubber planting are calmed until a new paragraph in the daily paper suggests to him that at last the much-dreaded catastrophe has come. Those who can best judge of the probabilities of rubber being manufactured synthetically at such a price as to make it a commercial success—chemists and physicists—still consider it most improbable. The rubber planter continually finds his trees giving increased yields, and with the cost of production becoming less and less, the price at which it will pay to make synthetic rubber gradually sets below the horizon of profit.

Health on Estates.

The average health of coolies on estates has during 1908 shown a marked improvement, and with medical aid and hospitals which have been built in all planting centres, the cooly is well looked after. The health of the managers and assistants did not show the same improvement. Malaria is in some cases constant, and the fact that this is so makes the excellent condition of estates and their labour forces the more creditable. The period of rapid opening of estates in order to get a large area planted in the shortest possible time has to some extent stopped, and this has led to improvements in the working of estates in many details. Every practical planter realises that for the future prosperity of his estate, to obtain healthy conditions for master and cooly is as necessary as to plant and tend carefully the rubber trees; and moneys spent in such sanitary measures are as profitably expended as in purely agricultural operations.

Labour.

There are about 80,000 coolies employed on rubber estates in the Malay Peninsula, and of these over 50,000 are Tamils, some 15,000 Chinese, 7,473 Javanese and 4,416 Malays being employed. On estates where I have seen Chinese employed in tapping there has been every reason to be satisfied with the skill of their work. The supply of Chinese is unlimited, and if it is found that they can be used as labour generally on rubber estates this will relieve to a great extent any anxiety about future demands for labour. The Immigration Commission have now got into their stride, and it is becoming generally recognised that such a body, with a continuous and recognised policy, will be of great use in the future.

Estate Labour, Federated Malay States, 1908.

	Selangor.	Perak.	Negri Sembilan	Pahang.	Total
Tamils	29,103	13,635	3,443	334	43,515
Javanese	1,662	2,276	1,023	38	4,999
Malays	627	995	260	79	1,961
Chinese	1,121	3,12	2.203	145	6,595
Total	29,513	20,032	6,929	596	57,070

Estate Labour, Malay Peninsula, 1908.

	Federated Malay States.	Straits Settlements and Kedah.	Johore.	Total.
Tamils	43,515	6,476	1,418	51,409
Javanese	4,999	1,336	1,138	7,473
Malays	1,961	1,724	731	4,416
Chinese	6,595	5,819	2,624	15,068
Total	57,070	15.385	5,911	78,366

Prevention of Disease and Pests.

The Department of Agriculture has now a staff of Scientific Officers who are investigating the causes of disease and experimenting with methods of prevention and cure. All efficient measures for the preservation of health rest upon exact knowledge of the causes of disease and the effects they produce on their victims, and we have now an immense number of instances of accurate tracing by observation of the causes of plant diseases. These have been accompanied by experiment, and it needs no argument to convince anyone in the least acquainted with inductive science that experiment is as essential as observation. During the past twenty years, the discoveries in plant doctoring have made almost a revolution in agriculture, though this is seen more in Europe and America than in tropical countries. The general laws of sanitation for plants do not differ to any great extent from those laid down for man and animals. They consist in the removal and destruction by burning of all dead plants and dead parts of plants, the prevention of conditions which favour the progress of the disease, and the isolation by means of trenches of plants whose roots are diseased. These methods cannot be adopted without an intelligent watching for the appearence of disease. And the importance of a stitch in time is in nothing more evident than in the fight against plant diseases.

A case was brought to my notice of an outbreak of a caterpillar which had taken some time to entirely destroy all of leaves on the "blukah" adjoining a rubber clearing, and only when the caterpillars, which were in immense numbers, had been driven to eat the rubber was any action taken. The aid of the technical experts of the Department of Agriculture should be sought as soon as any pest is observed, but the destruction of as many of the caterpillars, insects, larvæ, cocoons, etc., which can be found should be at once put in hand. Every properly equipped estate should possess the means of combating as early as possible all diseases and pests, and should possess implements for pruning back the branches of big trees. For this purpose handy machines are made at the cost of a few dollars which easily cut at a height of thirty feet branches three or four inches in circumference. Efficient spraying machines should be found always in working order in every estate store, just as the fire apparatus in a gallery of valuable pictures. The cost of even the most expensive steam power spraying apparatus, capable of reaching trees of eighty feet or more in height, bears an infinitesimal proportion to the value of the trees on even a small rubber estate. The materials for spraying should also be kept in stock, so that no delay is experienced when such work has to be done. My experience of over ten years' eastern planting has been that the delay caused in getting weapons to fight the disease has often caused the task of getting rid of the pest to be much more difficult and expensive than it would have been had the estates been forearmed.

Fifty years ago the conditions favourable to the rapid spread of disease caused by insect, fungi, or bacteria were not so great as at the present day, and the presence of 35,000,000 trees in an area of some 26,000 square miles is in itself a danger; but the weapons which the planters of that day possessed for an intelligent fight against these organisms were of little use and yielded without confidence. In India the loss by wheat rust was some time ago estimated at £91,000,000, and in Ceylon the leaf disease of coffee caused the extinction of that industry a loss of at least £15,000,000. The work done by sanitation and preventive medicine in preserving human life are now historical facts; 200 years ago the mortality of London was 80 per 1,000, it is now about 20. Until a few years ago contagious pleuro-pneumonia and foot-and-mouth disease caused immense losses of cattle, estimated at 2,000,000 per annum, worth probably £3,000,000; they have now bern almost exterminated. Plant sanitation and preventive measures can, if invoked, do as much for the preservation of cultivated plants, and with the knowledge we now possess it is improbable that any disease could so seriously damage a big agricultural industay as has been the case in the past.

Distances Between Trees.

The average number of trees per acre on rubber estates in Malaya in 1908 was 168, or 16 feet by 16 feet apart; the statistics for 1907 showed that on the 31st of that year the average was 153, or 17 feet by 17 feet apart. This, for many reasons, is an improvement. It is to be regretted that the cultivation of rubber is too young an industry to have sufficient experience of old trees planted at different distan es apart to judge of this important question. The

REASONS AGAINST CLOSE PLANTING IN RUBBER

—12 ft. by 12 ft., or 302 per acre, or closer—are: That it prevents the tree from growing with full vigour and to the greatest possible size, forcing it to run up to the light and giving it no room for lateral branches. That it increases the cost of collection of rubber, since a larger number of trees have to be tapped for the same amount of rubber. That if it is found necessary to give the trees more room, the cutting out of a proportion of them is fraught with much danger to the remainder, inasmuch as each dead rubber tree, root or portion of root, is a potential centre or root disease, and may harbour white ants. That the spread of fungal and insect disease is helped by the crowding together of the trees.

ADVANTAGES CLAIMED FOR CLOSE PLANTING

are: That it gives for the first years of tapping a much larger yield of rubber. There is not a great amount of evidence on this point, but such evidence as there is seems to point to it being true that a larger yield of latex and of dry rubber can be obtained at any rate in the first three or four years of tapping. It is also claimed that the closeness of the trees more quickly produces shade over the ground and so prevents the growth of weeds. The whole question of weeding is being considered at the present time; if it is believed that to cover up the ground with a green manure is the best method of cultivation, then the fact that close planting reduces the cost of weeding is of no value. That in order to compensate for the casual losses of trees, which in the course of time must necessarily occur, more trees should be planted than are wanted. The answer to this is that where trees are planted at large distances 30 or more feet apart, supplies come on without difficulty, and it is only in crowded estates that difficulty is found in replacing casualties. To plant more rubber trees than it is intended to permanently keep on the estate, and afterwards by cutting out to reduce the number, is a dangerous policy. No one acquainted with diseases in plants would deny that to leave the dead roots of trees of the same species in close proximity to the roots of living trees is most likely to encourage root fungus and insect pests, while the cost of removing the roots, even if the trees are cut out when quite young, is prohibitive. If a planter finds it necessary to give more growing room—*i.e.*, space for the branches and leaves of some of his trees—it is preferable to pollard some of the trees, and allow them to grow slowly underneath the branches of the unpruned trees, rather than to leave the decaying roots of dead rubber trees, which he has cut down, dotted all over his fields.

Cover Plants Instead of Clean Weeding.

The question as to the relative advantages of clean weeding and the use of cover plants (the use of which has been advocated in my annual reports for the last three years) is gradually being seriously considered by the practical planter, and many thousands of acres of rubber, certainly not less than 15,000 are now cultivated with various cover plants. It needs but little observation of rubber clearings to decide that an immense amount of top soil, containing a large proportion of humus, has been washed away from sloping land to the detriment, both present and future, of the rubber. An examination of the water in the drains of flat land, which is dark-coloured when the clearing is first opened and gradually becomes clearer when many tons of water have passed through the soil, will show that this same process of exhaustion of the soil is going on very rapidly on clean weeded flat lands though not to the same extent as on the hillsides. Most practical planters have observed that the roots of plants in the tropics grow more quickly and vigorously when the earth where they are growing is shaded from the sun, and for this reason the surface of nurseries is covered with a thatch of grass or other convenient covering. These arguments seem in themselves sufficient to induce a trial of cover plants; but the additional argument that the process of clean weeding is continuous and the most costly of all the work on a rubber estate before it comes into bearing should be a further reason for the adoption of the system of cover plants. Various cover plants have been used on acreages varying from 400 acres, practically in all cases with successful results. It is unfortunate for the increase in the belief in this method of rubber cultivation that a large number of the planters who tried cover plants did so on the weediest and worst-drained parts of their estates. It would be as fair to test a food, which is recommended for supporting working men, on emaciated and abnormally weak persons, and when it did not produce the results hoped for, deeming it a failure. Another reason for some planters not finding the use of cover plauts so perfect a substitute for weeding as they hoped was that the cover plant (very often crotalaria) was sown broadcast, and it has been found by experience over large areas that this method of planting cover plants is wasteful and very much less effective than

SOWING THE SEED BY DIBBLING,

planting in furrows, or similar methods. The loss may be due to the exposure of the germinating seed to the sun, or to its being washed along when the tender rootlets are beginning to form, or birds may eat the seed; but whatever is the cause, it is always found that the proportion of seed producing plants is very small indeed. On the other hand, the planting in lines, the seed being slightly covered, results in 80-100 per cent. of the seed-producing healthy plants. In planting cover plants on steep land it is imperative that the lines should follow the contour of the land; when they are made to run up and down the hillside the seed will be washed down with the loosened earth. This result in the seeds being massed in one place, and the young plants growing closely together in clumps at the foot of the lines. The use of cover plants in place of clean weeding is now, after three years' constant advocacy, very generally considered as an economical and practical practice, which I have no doubt will greatly increase when the benefit to the rubber and the saving in expense have been proved on a large number of estates. The relative advantages of various plants as "cover plants" for rubber clearings is an important question to decide before proceeding to lay down fields with one or other. Leguminous plants possess the property of increasing the amount of available nitrogen in the soil by means of bacteria living in their roots which obtain nitrogen from the air, and in this respect should be preferred to other plants. The

CHIEF THING TO CONSIDER IN LAYING DOWN A COVER PLANT

is rapidity and cheapness in thoroughly establishing it, and if a plant is found to quickly take possession of the soil and cover it to the exclusion of all others, the fact of its not being leguminous should not weigh against it. The ideal plant for the purpose of protecting rubber land and eliminating or reducing very considerably the weeding bill is a plant which grows not more than a foot to 18 inches high, is permanent or persistent for three or four years, producing shade over the ground, growing so luxuriantly as to exclude weeds without forming a thick turf, is leguminous, has no thorns or spikes to interfere with coolies walking, has no leaves, fruit, or flower which will attract vermin or other animals. None of the plants at present in use, or being tried in the experimental plots of the Agricultural Department, fulfil absolutely all these requirements, and it is probable that a plant will yet be found better than any at present tried. The conditions on different estates in Malaya do not vary very greatly, but the differences are sufficient to make some places specially favourable to one cover plant and other places to other plants. In different districts on sloping and flat land with different soils and some estates it is found that in some passion flower will thrive and rapidly cover the land where the sensitive plant or crotalaria do not grow vigorously. On other places the crotalaria or sensitive plant may do much better than passion flower.

It is easy to decide as to the most suitable plant by planting one or two trial plots. The

FOLLOWING PLANTS ALL HAVE ADVANTAGES IN DIFFERENT WAYS,

and if any one of them can be made to entirely cover the ground in a short time, say four or five months, its acquisition will be a great gain to the estate in improving the growth of the rubber and in reducing the wages bill.

Abrus precatorius, a native of India, where it is used for cover, is leguminous with a free creeping habit; it grows about one foot above the ground and the branches from one plant will spread to 15 or 20 feet from the main stem. The pods contain 6 or 8 seeds. The seeds are bright vermilion, about the size of buckshot, with a small black mark at one end; they are used as the carat or standard weight for precious stones and metal in India.

Passiflora fœtida (passion flower creeper), a creeping non-leguminous plant having purple flowers and yellow fruits about the size of a walnut, grows very freely on nearly all soils and smothers many other plants of a less vigorous habit. This creeper never gets more than about nine inches to a foot high, and very quickly covers the ground. It has to be kept from twinning round young rubber plants, but as it is very soft this can be done at extremely small cost. It is a native plant and common all over the Peninsula.

Crotalaria striata and other species of the same genus, *Crotolaria incana*, are leguminous plants, possessing usually very numerous and large bacterial nodules, and growing freely, when not cut, to 7 or 8 feet high. It has a yellow flower and a light green leaf, and affords a good cover if not allowed to grow high and scraggy. It should be kept cut to a height of about 2 feet 6 inches. The cutting is not a costly process as it is only necessary to slash over the tops, leaving the cut part to remain as a mulch on the soil, The seed is obtainable in almost any quantity as a large acreage is already planted.

Tephrosia purpurea and *T. candida* are both vetch-like leguminous plants which grow freely on almost any soil, and give perhaps a better cover than crotalaria. They must, however, be slashed over at a height of 2·3 feet, and not allowed to run up; otherwise the light, and with it the weeds, will gain an entrance.

Mimosa pudica, the "sensitive plant," a leguminous plant with red spherical flower heads and spiny fruits, is in many ways the most suitable plant as yet tried for cover. The chief reason which makes it disliked by planters is the presence of thorns on its stems which are unpleasant to coolies walking through it.

The habit of this plant of shutting its leaves in heavy rain and at night is an advantage as no rain is lost and dew falls on the ground. It never grows more than about two feet high; it persists and makes a dense cover over the ground when the leaves are not shut—*i.e.*, when the sun is shining and the plant is not disturbed. It is, though a native of S. America, common in all the planting districts and one of the first plants to take possession, and keep possession, of the roadsides. In addition to these plants I have recently been shown a creeping leguminous plant which was found by Mr. H. F. Browell of Damansara estate. It is a species of Vigna, having dark green leaves and making a dense cover which refuses to allow any weeds to exist. I have seen a patch of about half-an-acre on Damansara estate, and there it appears to be the best plant for the purpose of cover that has been used in the Federated Malay States.

The Future of Rubber.

The Federated Malay States produced about three-fifths of the tin supply of the world, and in a few years time Malaya should supply a very large proportion of the world's demand for rubber. In 10 years (1919) presuming that 25,000 acres are planted annually during the next five years (a very reasonable estimate, considering that over 40,000 acres were planted during the year in both 1907 and 1908), the rubber trees of the Federated Malay States should yield not less than 50,000 tons of dry rubber, which at 3s. per lb. represents a value of $144,000,000. This amount, should the demand for rubber increase at the rate it has been annually rising for the last nine years, will probably at that time be less than 25 per cent of the world's consumption. It is 70 years since the discovery of vulcanisation by Goodyear made rubber available for economic purposes. It is now a necessary of civilised life, and it is only by means of rubber that we can solve the difficult problems of transport and communication. Without it electric wire insulation for telegraphy and lighting, pneumatic and cushion tyres, and the air brakes of railways would all be impracticable; and in tho purposes for which it is used in medicine and surgery it is an absolute essential. The optimistic view that the demand will before long exceed the supply is not more unlikely than the more usual view of the pessimist that the continued planting of rubber will result in a supply larger than the demand and consequently a considerable drop in prices. That the market will be overstocked with rubber is still a haunting fear of the owner of rubber property, but as each year brings new uses for rubber, and increases the amount used in directions where its value is already known, the possibility of over-production seems less probable.

Many expert authorities expect the developments in the direction of rubber street-paving, covering for decks of ships, etc., may be looked for in the near future. Some two or three years ago, when I was looking into the question of rubber pavement, I estimated that two-inch-thick rubber of the quality which the London and North-Western Railway had so successfully used in the rubber pavement at the entrance of Euston Station if used for paving the streets of London, which are at present laid with wood or asphalt, would require about 90,000 tons of crude rubber. If the prophecies so frequently made by experts as to the increase in the use of motor cars are fulfilled, we have another large and increasing demand for rubber of good quality, and wherever the future possibilities of expansion in the rubber market is studied it is found to be more than hopeful. The purposes for which rubber can and will be used economically are unlimited, and we may look forward to a coming rubber age on which all the most suitable rubber planting areas of the world, of which Malaya can claim to be the best, will be required to supply a firm and increasing demand. Malaya possesses the finest climate in the world for the rapid and healthy growth of Para rubber, and, since millions of acres suitable for this cultivation are still available, there is every probability that this country will be in the future one of the largest producers of rubber in the world. The fear of over-production is to some extent pardonable on examining the magnitude of the figures relating to rubber planting in Malaya, but a consideration of the possibilities of the world's future requirements takes the student into figures beside which those of Malaya are but small.

J. B. Carruthers,

Director of Agriculture and Government Botanist, FM.S.—*Administration Report.*

PARA RUBBER.

BRAZIL'S FUTURE AND MALAYA METHODS.

An Expert's Views.

Mr. D Sandmann, whom we mentioned in our Saturday's issue as paying a visit to these States, has been kind enough to accord an interview to a representative of this paper during his brief stay in Kuala Lumpur. Mr. Sandmann has been

DEPUTED BY THE GERMAN COLONIAL OFFICE

to make a thorough study of tropical products; but, as he pointed out, rubber has come so much to the fore of late that a large part of his time has been employed in investigating it. In this respect he has previously visited Ceylon and Burma, and has also made a somewhat lengthy stay in Brazil, though he has never before been in the F.M.S. Mr. Sandmann says that his work is mainly that connected with the chemical side of the question. Last year, he went to Brazil to study tho condition of the Para rubber industry along the Amazon and its numerous tributaries. He was the first to approach the matter there from the economic side, though there had been several botanists before him. One question especially interested him; namely, whether Para rubber from Brazil could be placed on the market if the price fell to a fairly low figure; and, as the result of his investigations, he states that he is convinced that the production from that country will never be less than it is today, for,

IF THE PRICE DROPS, THE PEOPLE WILL WORK HARDER.

Now they work about six hours a day for from four to six months in the year, according to length of season of heavy rain; this lasts six months; while for the remainder of the year the rainfall is comparatively light. This work is intermittont, as they have many holidays, and, besides, always rest in the afternoons. An important factor in the matter of production is, of course, the question of communications, and Mr. Sandmann states that these aro about to be improved. For instance, Brazil is under obligation to Bolivia to build a railway along the route of tho Rio Madeira to the Acre country, which Bolivia handed over to Brazil on condition that the latter carried this enterprise through. This territory is, Mr. Sandmann says, the most important of all from the point of view of rubber, and already produces a large quantity, even though so far back in the hinterland. At the present time, however, the burning question there is food supply. In the past there has been a large export of rice from the Amazonas, but

THE COLLECTION OF RUBBER PROVED SO REMUNERATIVE

that cultivation was abandoned. The result is that living has become so expensive that collectors are unable to take their families there. Mr. Sandmann states that he reported to the Brazilian authorities on this matter; he read extracts to our representative from a letter that he had received from Dr. Huber, Director of Botanical Gardens at Para, in which the latter says his Government is now taking steps to better the state of affairs. The letter also mentioned that the Brazilian authorities intend opening

A PERMANENT EXHIBITION OF RUBBER AT THE TOWN OF PARA.

Mr Sandmann emphasized the fact that the price of rubber there is largely dependent upon the food supply, and pointed out that he had already written upon this matter in the German agricultural journal, *Tropenpflanzer*, last September. Another sign of the times is that, whereas proprietors of stretches of rubber forest were formerly content to live in the towns, they were now proceeding to live on their property and overlook the work. This was especially the case along the Rio Madeira. One important result of this supervision was that young trees were now getting attention that they lacked before—an important factor as regards future production.

No Taxes on Enterprise.

Coming to the question of the procedure involved in taking up rubber country, Mr Sandmann stated that it was a very simple matter, since it was only necessary to make an application to the requisite authorities and pay a small sum by way of registration fee. The applicant could then proceed to work, and his property would cost him about £1 sterling per acre for the cutting of the necessary paths in the dense forest to enable his men to have access to the trees to be tapped. There were no questions of waiting weary months for a title, of heavy quitrent, of a lengthy interval prior to production, or of a good or bad burn. There were the trees, many of them magnificent ones, merely awaiting the arrival of the tappers and the cutting of rough approaches. Of course, since the rivers at present are the only means of communication with the market, it has naturally followed that selectors have turned their attention to country having a water frontage. Questioned as to the

POSSIBILITY OF THE EXHAUSTION OF THE FORESTS.

Mr Sandmann was emphatic that this cannot possibly occur, as apart from the vast area at present discovered, there are enormous areas that have never yet been explored at all, and it is only reasonable to expect that rubber exists there in at least something approaching the same abundance. Also it must not be forgotten that big trees can be tapped there for 30 years continuously—*i.e.* in the season—and that young trees are coming on all the time. There they do not tap trees under, say, 10 ins. in diameter. Most of those being tapped have a diameter of about 2ft., but in some cases the measurement reaches well over 3ft.

While on this part of the subject, our representative questioned Mr Sandmann concerning the statement that so often appears in the Press that the Brazilian rubber-tappers are in the habit of cutting down trees to obtain the latex with greater speed. The reply was that there was absolutely no truth in this, as regards Brazilians and Para, but Castilloa was cut down because it was not so valuable. This was not done, however, by Brazilians, but by Peruvians, for the former found it more profitable to deal only in Para. They (the Brazilian tappers) were known as *seringueros.* They were not very careful in their methods, but it was not necessary for them to be so, since the trees were of such great size.

F.M.S. Rubber.

Asked how the F.M.S. industry compared with that in Brazil, he replied that generally speaking it appeared to be about the same, but that some of our trees seemed to have made greater progress than those of a similar age in the gardens at Para. As regarded yield, Mr Sandmann considered it about the same in the two countries for trees of the same age. The average in Brazil was usually about 3 lb. of dry rubber per tree per annum (many of the trees there being very large), but in the Acre country the figure rose to 10 lb. One *seringuero* in that region obtained during one of the 4 to 6 month seasons 1,000 kilos (about a ton) of rubber!

Questioned as to the methods in vogue here, Mr. Sandmann was of opinion that we were not careful enough in the matter of selection. It was very necessary, he stated emphatically, to choose seed not from what appeared to be the best trees, but from those that yielded the most and the best latex. This course had not been possible, he recognised, at the outset, but seed was now so abundant that the necessary selection could well be made. He had spoken to several planters on the subject, and, as far as he had been able to gather, he found that the policy he advocated had not been adopted. The matter was not perhaps so very pressing at the present moment, but it would prove to be of very great importance if the price of rubber fell considerably, and especially so if that of labour rose coincidently. Again, he considered that our planters were not careful enough in tapping to use the right kind of cups. The production of clean rubber was very essential. In his opinion, metal cups should not be employed, as

THE SUBSTANCE OF WHICH THE CUP IS COMPOSED GIVES ITS COLOUR TO THE LATEX.

Iron and tin, Mr Sandmann said, give a bad colour to the rubber, while copper troubles the manufacturer later. He advocated the use of porcelain cups for tapping, and of wooden machinery afterwards in the factory. The porcelain cups should be white, finely glazed inside (to avoid the possibility of the latex adhering to the sides), and well glazed outside, to prevent the development of fungus which would penetrate the earthenware. If this plan were adopted, quite another quality of rubber would result.

In Brazil, matters were quite different, said Mr Sandmann, as they smoked their rubber, and that acted as a disinfectant. That system would, however, be impossible to work here with large quantities of latex. It was easy enough in Brazil, because each *seringuero* only had a small amount to deal with at a time. For this country he advocated the use of Purub, a preparation of hydrofluoric acid, instead of acetic acid. The results from this were very good as the preparation did not attack the rubber in any way, whereas acetic acid had its bad qualities. For instance, when it was used, fermentation and oxidation continued after treatment, whereas with Purub such fermentation and oxidation were impossible. The method was simpler in working and produced rubber of a wonderful quality. He was exhibiting a specimen at the Penang Show.

Questioned further as to what other of our methods he considered might be improved upon, Mr Sandmann mentioned briefly that he had noticed cases here where trees had been topped to get more branches. This was a mistake, as the branches then became too heavy, and were liable to break during heavy weather.

Coming to the subject of

PESTS,

the information was that in Brazil they experienced no trouble from white ants, their chief enemy being the boring beetle. Tappers there, on noticing holes, drove in plugs, thus causing the insects to die of starvation. Asked as to whether he considered that we had much to fear from white ants here, Mr Sandmann replied that he thought we should have to be very careful, but that, if due caution were exercised, we ought to be able to keep these pests at bay. He did not anticipate any other serious trouble and our plantations looked very sound. The question of distance in planting was then alluded to, and Mr Sandmann expressed the opinion that our planting was frequently too close. If he were opening an estate, he would plant not more than from 120 to 150 trees to the acre.

Finally, Mr Sandmann expressed his conviction that we had a wonderful future before us. There was no fear, he said, of overproduction in this generation at least. Even if the output reached 200,000 tons, as compared with the present 70,000, rubber would still pay well, though, of course, at a much lower figure.

GUTTA-PERCHA.

In the course of conversation, Mr Sandmann mentioned that he had been making some experiments, in conjunction with Mr Derry, at Singapore, in an endeavour to obtain good results from jelutong, our wild getah. In this they considered that they had been successful, and they hoped to be able to get this product brought into increased use. Up to the present the difficulty had been that it had not been found possible to coagulate the matter in such a way as to get it clean; but now, by their process, the getah could be coagulated with very little foreign matter. The world's supply of gutta-percha was very limited, said Mr Sandmann, but there appeared to be plenty in Malacca, and a still larger supply in our new territory up north. Para rubber had nothing to fear from this, as its uses were quite different. —*Malay Mail*, Aug, 10.

THE EFFECT OF GREEN MANURE ON RUBBER.

Mr. J. Stewart J. McCall, Director of Agriculture, Nyasaland, who will be remembered as a recent visitor to Ceylon, has just issued an official circular dealing with green manuring in the tropics. One section of his paper deals with the "Effect of Green Manure on Rubber," and from it we quote as follows:—"It has been proved that the flow of latex from a Rubber tree is affected by endosmotic pressure which practically means the amount of water in the plant roots. It is the practice to tap Rubber in the early morning and evening, and to discontinue during the heat of mid-day and early afternoon. During the heat of day much water is evaporated by the leaves and latex flows slowly, but in early morning and evening water wishes to enter by the root quicker than it is evaporated with the result that there is an internal pressure which helps the flow of latex; therefore it is practical to assume that there is an intimate connection between the presence of water in the surface soil surrounding the roots, and the flow of latex from the Rubber tree. For half the year in Nyasaland there is no rain, and daily the sun is strong enough to evaporate water from the plants, and from the soil. The question arises where does this water come from? The answer is from the lower layers or subsoil by rising to the surface in the form of water vapour and water liquid (capillarity). In the surface soil of a clean weeded estate the water during day is principally in the form of water vapour, the water being vaporised to a considerable depth by the direct overhead rays of the tropical sun. In the surface soil of an estate growing a green manure-crop there is a large proportion of the water in the liquid form, as the covering of vegetation reduces the temperature of the surface soil and prevents the direct penetration of the sun's rays. Therefore when Rubber is growing surrounded with vegetation, its roots have actual access to liquid water through the greater part of every day. If we examine the same soils during the dry season after the green manure crop is dead, we still find more moisture in the latter, as the dead remains of the green manure crop absorb and retain water more firmly than ordinary soil, but delivers it freely to the rubber roots although not as freely to the atmosphere."

THE F.M.S. AGRICULTURAL SHOW.

TERMES SPECIES OF ANTS.

Previous to their departure for Penang, we have been afforded an opportunity of seeing the exhibits of the F. M. S. Agricultural Department that are to appear at the forthcoming Agri-Horticultural Show. One of the principal features will be a series of long tablets on which will be arranged glass tubes containing specimens of the various kinds of the *termes* species of ants. The king, the queen, winged individuals (mature and immature), soldiers, workers and young—all will be represented, while their nests will be shown apart, but adjoining. In addition, a brief description of each species will be found written at the base of the tablets.

These practical illustrations will probably be a revelation to many, for in the case of the *termes pallidus* they will see that the queen is well over two inches in length, while the soldiers of the same variety are only about a quarter of an inch long. Again, some of the specimens of nests to be exhibited are of special interest, some of the honey-comb patterns being very dainty and well marked. In this connection a section of a fairly large rubber tree, riddled by *termes gestroi* (white ants) is being shown, and also a nest, oval in shape, and about double the size of a Rugby football. This is constructed of mud and consolidated by means of some substance which, we believe, the ants exude for the purpose.

Tapping Rubber.

Section of rubber trees, tapped in various ways, are to be shown to illustrate what are the right and wrong methods, and as far as we can see, no doubt should remain after seeing them that the old spiral system some of the elaborated herring-bone ones are fit only for abandonment. The rubber tree needs a continuous flow of life-giving matter down the whole length of its stem, and anything in the nature of the spiral system that tends to check this, must be detrimental to its yield of latex. One specimen to be shown will illustrate a system whereby the tree is tapped on one of four sides every year, thus ensuring complete tapping in the requisite period of four years, while ensuring rest to the outer layers during three-quarters of the period. This, it is believed, will be the system that will ultimately meet with general adoption.

In addition to the above, the diseases that attack the branches of rubber trees are also to be dealt with, and particularly interesting specimens are to be shown of the right and wrong methods of cutting off injured members, the line of argument to be followed being, in the first place, that clean cutting is advisable to avoid the encouragement of fungus growth ; and in the second, that lopping should be done as close to the stem as possible.—*Malay Mail*, Aug. 5.

BRAZIL RUBBER VALORISATION SCHEME SHELVED.

The high prices at present ruling have indefinitely shelved the Brazilian rubber valorisation scheme; producers are too happy to bother about it.

The above statement is the substance of the reply made to a representative of the *India-Rubber Journal* by a well known London importer of rubber who had been approached regarding the state of Brazilian feeling towards the valorisation scheme. In fact " Brown's dog is dead; high feeding killed it." From an economic point of view, the question to be asked is whether if the scheme had been adopted in the times of moderate rates, the price of rubber would be lower now. As we view it, the ideal valorisation scheme—that is the best for all parties, supposing interference with natural laws to be justified—would aim at an approximate equalisation of prices ; extremes would be avoided, and the effect upon prices of the recurring depression and revival of general industry would be minimised. If this were the definition recognised by those responsible for the rubber valorisation scheme, it would have been their duty, supposing as we have said that the scheme had been adopted in the times of moderate prices, to have essayed the task of keeping the quotation within reasonable limits. Now,

IN THE FACE OF INCREASING CONSUMPTION

and stationary or (possibly) decreasing supply, it is extremely improbable that the partakers in the scheme would have had the *means* to do this; further public opinion does not at present credit them with the *will*. Taking into consideration the fact that syndicates adopting the scheme are promised the financial assistance of the Banco do Brazil it is, however, just possible that the scheme might, in times of falling consumption be made to operate in favour of the producers by maintaining prices above the minimum. Thus if increase in prices cannot be checked, though decrease can be to some extent alleviated, the scheme from the standpoint of the producer exemplifies the time-honoured principle, "Heads I win, Tails, you lose." It is not in human nature, certainly not in Brazilian human nature—by which we intend no innuendo—for the seller to manipulate a scheme favouring the buyer. At the precise point where the advantage ceases to be on his side, he will drop it. This leads to the conclusion evident enough to be taken as an axiom, that arrangements mutually affecting buyer and seller should not be solely controlled by either. In other words the ideal valorisation scheme to be carried out properly must be under the joint management of the producer and the consumer or (better) of an outsider. For such a scheme we will have to wait a long time; to carry it out would require a commercial organisation far in advance of present attainments. In the meanwhile we must struggle along with the old laws of supply and demand.

A Rubber Congress.

A rubber congress will be held at the town of Senna Madureira, on the Upper Purus, on the 8th August. The exploitation of rubber and the various aspects of "valorisation" are to be discussed.—*India-Rubber Journal*, July 26.

PLANTATION RUBBER IN AMERICAN FACTORIES.

By Dr. Philip Schidrowitz.

During a recent visit to America I had the privilege of seeing a number of leading factories and also some of the chief Government Institutions. I was much struck by the cordial and open manner with which I was received in the various works and by the ready permission granted to inspect practically anything that I wished to see. . . I was astonished at the apparently very large quantity of Guayule employed in the American works. Most of it seems to be in semi-purified loaves containing 20 to 30 per cent. of resin. There is also a commercial article purified to 2 to 3 per cent. of resin, but I did not come across much of this. It will be of interest to people on this side to know that rubber manufacturers in the States are very favourably inclined to the better qualities of clean plantation rubbers or to rubbers prepared on the plantation system. I came across a good deal of Ceylon and Malay Hevea and also some fine Funtumia from Uganda, which were all well liked. A complaint was made regarding some of the Eastern rubbers which I think deserves the attention of planting companies, and it was that frequently numerous bits of bark, twigs, etc., are found between the biscuits, crepe and sheet. This involves wasbing, which operation, for this class of raw material, should be quite unnecessary. I need scarcely say tbat I am not referring to "bark scrap." What is required is a little more care in packing. American manufacturers, like their English colleagues, are very emphatic on the point that planters should mark all their goods in some simple fashion, as this enables the manufacturer to know exactly what be is buying—a matter, in view of the considerable differences between various plantation rubbers, of some importance to him. Certainly there is a very large field in the States for the plantation product.—*India Rubber Journal*, July 26.

NEW GUINEA AS A RUBBER COUNTRY.

Opinion of Sir Rupert Clarke.

Sir Rupert Clarke, Bart., passed through Colombo recently on his way to England. A short time before his departure from Australia Sir Rupert returned from New Guinea, where he is largely interested in rubber cultivation, being the director and the largest sbareholder in the Papua Rubber Plantations Co., Ltd. This private company has already about 500 acres under rubber, some three-year old, and he expects in a few years to have 5,000 acres planted.

"I am a great believer in the future of New Guinea as a rubber country"—remarked Sir Rupert (to our contemporary). "Our three-year old rubber, according to our manager, Mr Wallace Westland, excels the growth of the best trees in Ceylon, and we have a

PLENTIFUL SUPPLY OF CHEAP LABOUR.

Land is obtainable very easily and cheaply. You get a ninety-nine years' lease from tbe Crown, free of rent for tbe first ten years, and then at a rental of half-a-crown per hundred acres, increasing every year at a definite rate of progression. At the expiration of the lease Government have the power to take the land back, but only at an independent valuation." "What do you think of the prospects of Plantation rubber? Do you tbink the price is going to keep up?" "I think so, but we are quite safe in any case. We can beat any place in the world in cheapness of production. If rubber goes down to a shilling, we can still work at a profit. Our labour is cheap, and transport is remarkably easy. There is a net-work of fresh-water creeks all over our estate. There are twelve feet of water right up to the bank and we can bring a schooner up to any part of tbe plantation. We use boats to take plants from tbe nursery to any part of the estate, and boats will be used to bring the latex down to a central factory or factories."

Mr. Wallace Westland.

Sir Rupert Clarke spoke with great enthusiasm of his manager, Mr Wallace Westland, who is so well-known in Ceylon. Those wbo have read Cutcliffe Hyne's delightful Captain Kettle stories, will remember how the Captain, who was nothing if not a very orthodox Methodist, was embarrassed by the irrepressible inclination of tbe natives to make a God of him. In spite of stern warnings, driven home by exemplary punishments, he would now and again in the early mornings surprise some one in the surreptitious act of offering up a village fowl as a sacrifice at his door. Judging by what Sir Rupert said, Mr Westland appears to be making rapid strides in the direction of apotheosis. His name is a household word in the Papuan villages all over the interior, and is moreover the synonym for fair dealing and good treatment, witb the result tbat he can get as much labour as he likes. Only the otber day four or five boats had gone up the river for over a month without being able to secure any labour, but tbe first day a vessel arrived to recruit for the Papuan Co. it was filled by clamorous recruits. On the estates tbe labour will do anytbing Mr Westland wants. In addition, the ex-Ceylon planter is very popular with the white community, and is consulted by Government on all planting questions. So well-known is he, Sir Rupert added, that if anyone wishes to communicate with him from Ceylon "Westland, New Guinea," is a perfectly adequate address.

THE OUTLOOK FOR MEXICAN RUBBER

Some favoured place in Mexico, says the American consul at Vera Cruz, can make a fair profit on their actual costs of producing rubber; but when rubber falls to 50 cents or less, there is nothing in it for tbe stockholders. It is stated on good authority that the Mexican planters get more rubber per tapping than the Para people and that tbe tapping cost is lower per pound of rubber produced, but they can tap only once a year, wbile tho Para planter can tap many times in a year. Tbe Mexican planter loses, because of his greater capital invested, more than he gains in lower tapping cost, and because he must have ten to twenty times as many trees to produce tbe same amount of rubber as the Para planter, so that the odds are against him, even if he can produce Mexican trees for half or a quarter of what the Para tree costs, which is doubtful.—*India-Rubber Journal*, July 26.

CEARA RUBBER IN SOUTH COORG.

Pollibetta, Aug. 9.—Nothing much is being done in rubber clearings, except some supplying up of vacancies and weeding. The branches of Ceara trees planted in 1906 now form almost a complete canopy overhead. It will be necessary to eliminate alternate trees by exhaustive tapping later on. Ceara is making most encouraging growth in tbese parts, except in exceptionally poor soil.—*M. Mail.*

ANOTHER RUBBER CROP.

London Asiatic Rubber and Produce Co.

The managing agents cable the rubber crop harvested during July as 6,322 lb. dry, against 2,354 lb. dry for the corresponding month of last year. Total for first seven months of 1909 33,200 lb. dry, against 13,704 lb. dry.—London *Times*, Aug. 5.

CAMPHOR IN THE F. M. S.

PRELIMINARY NOTES ON PREPARATION.

[In view of the Agricultural Show at Penang this month, Notes on investigations carried on in the preparation of Camphor from the Common Formosan or Japanese Camphor, tree together with notes on the cultivation and growth of the plant in the Malay Peninsula, have been published, and we extract as follows from the August *Straits Agricultural Bulletin*]

THE FIRST EXPERIMENTS

in camphor by the F.M.S. Agricultural Department were initiated in Batu Tiga 5 years ago by Mr Stanley Arden. The seeds of the Batu Tiga trees were obtained from the Yokohama Nursery Company and sown in May, 1904. They were planted out in their permanent quarters 10′ x 10′ in December of the same year. The growth as a whole is very good, while the growth in some cases is exceptional. The average height of the trees is now about 18 feet, the tallest tree being over 26 feet. A further supply of seeds and young plants was received from Japan in May, 1907, and planted out in the Experiment Plantation, Kuala Lumpur, in September of the same year. The growth of the plants in this case has also been good, the trees averaging in one plot 5 ft. 6 inches in height and 4 feet 6 inches in breadth ; this plot was cut over, bringing all the trees to one even height of five feet and leaving the sides untouched and yielded a crop of clippings averaging 1,226 lb. per acre; the actual yield of camphor from which amounted to 0.6 per cent.

PREPARATION OF CAMPHOR.

Method of distillation :—

The first experiments were made on a very small scale in a small copper still of 7 litres (=12·3 pints) capacity and capable of holding only about 1½ lb. of leaves or about 4 lb. of twigs, using an ordinary glass Liebig condenser to condense the camphor and oil.

Steam was generated in a separate boiler and passed through the leaves or twigs in the still.

PREPARATION OF MATERIAL.

Experiments were made with material prepared in the following manner: (1) the unbroken leaves, (2) leaves cut up into small pieces, (3) air dried leaves, (4) mouldy leaves, (5) twigs cut up into small pieces about an inch long. The leaves and twigs used in these experiments were cut by coolies using parangs (knives) only.

On a commercial scale some kind of chaff cutting or other similar machine could be used for the purpose, to save labour, either worked by hand, by bullocks, or machine driven as circumstances necessitate.

PRELIMINARY EXPERIMENTS.

11.5 kilograms = 26 lb. of prunings, consisting of 64.9 per cent. leaves and 35.1 per cent. twigs, were received for experiment from the Superintendent of Experimental Plantations (Mr J W Campbell)—being the part prunings from a five year old tree at the Experimental Garden, Batu Tiga, Selangor. As only the small apparatus (described above) was at the time available for the experiment, the distillation had to be extended over a number of days and the results of each distillation were kept separate for comparison and carried on under different conditions as described above, entirely for experimental purposes, in order to ascertain if these conditions gave different results. [The results obtained are then described.]

CONCLUSIONS.—These experiments show: (1) that a much larger percentage of camphor and oil is obtained from the leaves than from the young wood or twigs.

(2) That air drying has no detriminal effect on the yield :—if air drying be resorted to however. it should not be carried out in direct sunlight.

(3) That the principal product is camphor with a small percentage of oil.

(4) That a yield of at least 1 per cent of camphor with a small percentage of oil may be expected from the prunings of trees of this age viz : 5 years, and probably from trees younger than this.

FURTHER EXPERIMENTS ON A LARGER SCALE.

It was decided to erect a large still on a more practical scale. A plant was constructed on our design by the the Federated Engineering Co., Kuala Lumpur, and although satisfactory, experience has shown that it can be improved in many ways. [The large Still and Condenser are then described.]

The following are the dimensions of the apparatus and the capacity of the still in terms of fresh camphor leaves, prunings, and wood (the latter cut up into small pieces) :—

BOILER.—Length 2 feet 9 ins. ; Diameter 1 foot 9 ins.

STILL.—Length 2 feet 6 ins ; Diameter 1 foot 9 ins ; Capacity in terms of camphor leaves 30 lb ; Capacity in terms of camphor wood 90 lb ; Capacity in terms of prunings 50 lb.

CONDENSER.—Length 2 feet ; Diameter 9 ins ; Length of copper condensing tubes 1 foot 9 ins ; Diameter of copper condensing tubes 1 inch.

Criticisms of apparatus : (1) The chief disadvantage of a metal (iron) condenser is the discolouration of the camphor by iron rust. If the condenser were entirely of copper there would be little or no colouration.

(2) Since practically all the camphor condenses in the condenser tubes and only the oil and water pass into the receiver, a tube condenser has the disadvantage that the tubes would soon get blocked. Apart form this the layer of camphor on the tube would form a non-conducting medium and lessen the effeciency of the condenser.

(3) It is difficult to clean out a tube condenser, and easily remove the camphor, though this could easily be done by a special scraper fitting the condenser tubes.

(4) The chief disadvantage of the particular still described is the time wasted in discharging and recharging.

The discharging could be hastened by having a lateral opening above the perforated plate, and made air-tight by an asbestos sheet.

(5) In a large still the weight of the leaves or wood, especially when wet, would tend to create

pressure inside, by blocking the passage of steam. This could be remedied by using a series of perforated plates, a definite quantity of material (wood or leaves) resting on each.

A better plan and one which would simplify discharging and charging would perhaps be a metal cage which could be lifted bodily out of the still by means of a crane or other mechanical device and easily emptied by inversion and replaced when discharged. This would also allow steam to enter the material from all sides.

YIELDS.

In the first experiment with this apparatus, a whole tree, including roots, was received from the Batu Tiga Experimental Plantations and consisted of :—

Leaves weighing 12½ lb. equal 7·5 per cent.
Twigs less than ½ inch diameter weighing 30 lb. equal 18·2 per cent.
Twigs and wood over ½ inch diameter 93 lb. equal 56·3 per cent.
Roots 29·5 lb. equal 18·0.

Separate distillations were made of the leaves, twigs under ½ inch diameter, wood, and root with the following results :—

12½ lb of leaves yielded 2 oz. of camphor and oil equal 1·0 per cent
3 lb. of small twigs yielded 1·07 oz. of camphor = 0·22 per cent.
93 lb. of large twigs and wood yielded 9·8 oz. of camphor = 0·66 per cent.
29½ lb. of Roots yielded 5·7 oz. of camphor and oil = 1·2 per cent.

The camphor in these experiments was of a brownish colour, due to contamination with iron oxide or rust from the condenser. Most of the camphor scraped from the copper tubes of the condenser was almost white, which leads to the conclusion that a copper condenser would not discolour the product. The discoloured camphor can readily be rendered white by redistillation through a glass condenser or by sublimation.

PERIOD OF DISTILLATION.

In the small preliminary experiments it was found that all the camphor and oil distilled over within three hours or rather less, in fact the greater portion of the camphor distilled over within half an hour after steam commenced to pass through the material. In the later experiments the distillation was carried on for a longer period than three hours in order to ascertain whether in the large plant, similar results would be obtained. In each case the camphor and oil from three hour distillations were collected separately. The results obtained are described.

CONCLUSIONS:—These experiments indicate that it would probably not be advisable to carry on the distillation for a longer period than three hours in the case of camphor prunings.

COMPARISON WITH CEYLON INVESTIGATIONS, &c.

The results compare favourably with the investigations of Messrs Willis and Bamber on the cultivation and preparation of camphor in Ceylon (Vide Circular Series I, No. 4 Royal Botanic Gardens, Ceylon 1901). Hooper (Vide Parmaceutical Journal (56) Vol. ii P. 21) also obtained a yield of 1 per cent of oil from leaves of plants grown in India. In one instance the oil is stated to contain only 10-15 per cent of camphor, while another specimen yielded 75 per cent of camphor. Schimmel & Co. in Germany, one of the largest manufacturers of essential oils, also obtained an oil from the roots, which was stated to consist chiefly of camphor. The amount of camphor isolated from the oil will depend on temperature, etc., more camphor can be separated from the oil by cooling, and also by redistilling the oil alone, preferably under reduced pressure, or with steam. The camphor is a much more valuable commercial article than the oil, but the oil is also used to a considerable extent now for the preparation of safrol, as well as for solvent purposes, in cheap perfumery, soaps, etc.

FUTURE EXPERIMENTS.

The experiments already initiated will be carried on as time permits with further material and with younger trees. The trees in the Experimental Plantation, Kuala Lumpur, are only two years old, and experiments will be made with these at intervals, to ascertain the yields at different stages of the plant's growth. Experiments are also being made to find the most suitable planting distances and in addition the most suitable form of cultivation, methods of pruning and their effects are being investigated. Analyses of the soils on which these trees are being cultivated will also be made, and the manurial value of the prunings estimated before and after extraction.

BORNEO CAMPHOR.

Investigations are also being carried on with *Dryobalanops Camphora* of the Natural Order *Dipterocarpeae*, commonly known as the Borneo or Sumatra camphor tree, from which the valuable so-called Borneo Camphor is obtained. This tree does not yield the true "camphor" known in commerce but a closely related compound known as Borneol. The oil and "camphor" has not hitherto been an article of commerce at home but is chiefly used by various Eastern nations for ritualistic purposes and for embalming. No very detailed chemical examination of the oil has so far been carried out, owing to the scarcity of the oil. The oil has been obtained previously by distillation of the wood (age?) and by tapping the trunks. The crystals of "camphor" can often be seen in cavities in the wood. According to Watt's "Commercial Products of India," 1908, this camphor is valued by the Chinese at 40 to 80 times that of ordinary camphor. An average tree (age?) is said to yield 11 lb. the older trees being the most valuable, while only some 10 per cent of the trees destroyed are really remunerative. Experiments are being carried on at present with the prunings from trees nine years old cultivated in the Experimental Plantation, Kuala Lumpur.—J. W. CAMPBELL, Supt., Exp. Plantation, F.M.S.; B. J. EATON, Government Chemist, F.M.S.

COCONUT IN THE F. M. S.

Mr. J. B. Carruthers' Report.

The "Consols of the East" have again had a prosperous year. No serious outbreak of disease occurred, and the crops from mature palms were equal to the average of recent years. The relatively poor quality of the copra prepared in the Native States is a question which is receiving attention. The constant rainfall of Malaya makes it often impossible to properly dry the copra without artificial heat and renders it very liable to attacks of moulds and bacteria which damage its marketable value. It is possible to improve the quality by putting up light roofs which can be quickly placed over the copra being dried when rain is coming. Arrangements will be made for the Coconut Preservation Staff to instruct small-holders as to the advantages of such methods in preparing their product for the market. Another factor which in some cases reduces the profits which should be obtained by the coconut grower is the practice of taking the nuts from the tree before they fall. It is not easy to see the advantage of this method, and it has always seemed to me curious that the Malay, with whom dislike to unnecessary work is no less a trait than in other races, should so frequently adopt it. If a nut is plucked unripe the amount of copra it contains is less than if it is left on the tree ; we have no data to show that any decrease in the amount of copra or the oil it contains takes place if the nut is kept a little time after it is ripe. When the nut is fully ripe it falls from the tree and can be collected from the ground with considerably less trouble than if it has to be picked from the top of the tree, and with the additional advantage that it contains its maximum amount of copra.

Further observation seems to point to the fact that the thorough drying of copra is more easily effected in the case of ripe nuts which have fallen from the tree than with those picked, many of which are not fully ripe. The arguments I have heard adduced in favour of the practice of climbing the trees and plucking the nuts are that the copra is darkened in colour, that the other nuts still unripe on the bunch are improved by the excision of the ripe ones before they fall, and that the prevention of theft is more difficult. None of these reasons seem to me to weigh seriously against the probable increase in the crop of copra and the saving in labour which gathering the nuts from the ground ensures. The coconut planter, like other tropical cultivators, is conservative in his methods, but such an easy method of improving his cultivation should at least be the subject of careful experiment before its adoption is refused. Coconut cultivation, while not offering the possibilities of profit which the growing of rubber shows, is an extremely safe and profitable industry, and many areas of accessible land, especially on the Coast, are much better suited to the coconut palm than the Para Rubber tree. The acreage under coconuts in the Native States at the end of 1908 was 118,697, an increase of over 6,000, or five per cent., since the same date in 1907, when there were 112,550 acres. The value of the coconut land planted in the Federated Malay States cannot be less than some $23,000,000.—*Report of Mr. J. B. Carruthers, Director of Agriculture and Government Botanist, F. M. S,*

MR. PETCH ON "RUBBER PADS."

Mr. Petch's note on the pads sent to him for examination, published in last *Tropical Agriculturist*, must have gratified the supporters of the Northway tapping system, which it appeared very largely to vindicate and relieve of responsibility for causing the unhealthy sub-cortaceous formations. Mr. Williamson, however, has some very penetrating criticism to offer elsewhere in our columns today, on the conclusions drawn; and some still more searching questions to ask. No doubt Mr. Petch is in a difficult position, asked point-blank to approve or condemn the Northway system ; seeing that the Peradeniya Director, Dr. Willis, gave it general approval before its birth into the world of public notice. But the problems Mr. Williamson submits can be answered independently of this, and we await the Mycologist's reply at the earliest possible date as being of high importance to rubber planters.

More Information Wanted.

Sunnycroft, Ruanwella, Aug. 25th.

SIR,—With reference to Mr Petch's article on rubber pads copied into your paper of 20th inst., I would like to make the following remarks as, evidently, the pads, which he writes about, are the ones originally forwarded from this estate. Mr Petch gives as a reason for saying that the rubber pads were formed on the trees before the bark was pricked ; that the pads had, on the outside and inside, teeth marks of the pricker. This is true, but does not prove that the pads were there when the bark was pricked for the following reasons :—

1st. It is impossible for any one to force a small Northway blunt pricker through nearly ½-an-inch of bark and also through a pad of rubber adhering to it and into the wood as well; both because the force required is more than any man could exert, and also because the pricks on the small Northway pricker are not long enough to penetrate right through.

2nd. When a pricker is driven into the bark and wood of a tree deeply and a pad is formed afterwards, it will have marks on the inside as well as the outside, due to the hollows in the wood filling up with latex and coagulating in that shape in the former, and in the latter, of course, the pushed-in bark will show on the close fitting pad, and will correspond with the inside marks,

Mr Petch, in summing up, arrives at the following conclusions to account for the rubber pads:—

1st. Scraping kills the bark in patches when sunlight comes in contact with it.

2nd. After death of the bark, rubber pads are formed before pricking, due to inflow of latex from surrounding parts.

If these conclusions are correct, will Mr Petch inform me and my brother planters through the medium of your paper, why it is, although we scraped thousands of trees on this property, not a single pad was found on any unpricked tree, only on some of those which had been pricked the most, and these trees were growing in a heavily shaded spot where much sunlight could not penetrate ? It is a pity that Mr Petch did not finish his article by approving of the Northway System or condemning it, for thousands of rupees have been spent on it, and many planters would like to know from such a high authority, whether to go on with it or stop it. Destructive criticism is all very well in its way, and Mr Petch seems very fond of it (*vide* his burial of prunings articles); but what the common or garden planter wants is the right road pointed out to him, with sign-posts along it telling him what to do as well as what not to do.—Yours faithfully,

D. B. WILLIAMSON.

MR. PETCH ON RUBBER-PADS AND THE NORTHWAY SYSTEM.

We direct attention to the Government Mycologist's elaborate and in many respects convincing reply to Mr D B Williamson's criticism of his recent report on specimens of bark, with subcortaceous rubber-pads, submitted from an estate in the above named planter's charge. The dangers of the use of the pricker are once again made plain—at any rate of the earlier styles of pricker; and it is for the using of this instrument that Mr Petch views with this disfavour the Northway System—the renewed bark showing non-laticiferous tissue under the pricker cuts, and a tendency to produce burrs having been noticed. Have our Uva rubber-growing friends experimented with the Northway system?—and what has been their experience? We should be glad to hear their views and some of their practical results.

RUBBER PADS AND THE NORTHWAY TAPPING SYSTEM.

Mr. Petch in reply to Mr. D. B. Williamson.

Peradeniya, Aug. 28th.

SIR,—My specimens of rubber pads were accompanied by a label marked "I.G. 31.5. 09."

It is curious that in Ceylon scientific questions immediately become personal questions, and are discussed as though they were political. The object in discussing a scientific question should be merely to ascertain the truth, and all the evidence for or against must be stated fairly if the participants have any claim to scientific reputation; but in a political discussion, the chief object is to gain an advantage for one's own side, and the evidence, according to custom, may be "modified" to fit the occasion. Mr Williamson is inclined to adopt political methods. He states:—

"1st. It is impossible for any one to force a small Northway blunt pricker through nearly half-an-inch of bark and also through a pad of rubber adhering to it and into the wood as well, both because the force required is more than any man could exert, and also because the pricks on the small Northway pricker are not long enough to penetrate right through."

If he will read my article again, he will see that the bark was only three to four millimetres thick. It might have been five millimetres thick when fresh, that is one-fifth-of-an-inch. The total thickness of bark and pad in specimen A was nine millimetres, i.e. about one-third of an inch; in specimen B it was 14 millimetres, i.e. just over half-an-inch, and I expressly state that *owing to the thickness of the pad, the pricker cuts did not penetrate through B.* Therefore, Mr Williamson's remarks about nearly half-an-inch of bark and also a pad of rubber are quite irrelevant, and I am at a loss to know why they were introduced, except to score an entirely unjustified point. Moreover, it is not correct to suggest that because the teeth of the blunt pricker are only 8 millimetres in length, therefore it can only penetrate to a depth of 8 millimetres. The body of the wheel is pushed into the bark for a depth of about two millimetres, forming a continuous cut connecting the pricker marks. Users of improved prickers will kindly observe that these specimens were developed in May last.

"2nd. When a pricker is driven into the bark and wood of a tree deeply and a pad is formed afterwards, it will have marks on the inside as well as the outside due to the hollows in the wood filling up with latex and coagulating in that shape in the former, while in the latter, of course, the pushed-in bark will show on the close-fitting pad, and will correspond with the inside marks."

The pushed in bark is in small fragments, and, if pushed in by the pricker before the formation of the pad, it would be pushed into the hollows in the wood: the fragments are not united to the main bark. If the pad were caused by the inflow of latex after pricking, it would bear projecting teeth of rubber corresponding to the marks in the wood, and also similar projecting teeth on the outer surface corresponding to the holes in the bark. Mr Williamson will admit that latex would issue through the pricker holes? But the actual examples have projecting teeth on the inner side and incisions on the outer! Again, on Mr Williamson's theory, the particles of bark would be on the ends of the inner projecting teeth, whereas they are actually, as I have stated, "within the pad," at the base of the incised pricker marks, nearer the outer than the inner surface of the pad. It is impossible that they should get into such a position, and that the pad should bear actual incisions, except by pricking after the formation of the pad. A further point against Mr Williamson's theory is that there are no projecting teeth on the inner surface of the thicker pad; the pricker for some reason did not reach the wood there, though it did everywhere round it. The reason, of course, is that the pad was already in existence and too thick for the pricker to penetrate.

"Scraping kills the bark in patches when sunlight comes in contact with it" is what I might have written—if I had not preferred to be less positive on the matter. My statement was that the bark died in patches in consequence of the scraping. It would have been better to have written "after" the scraping. There is no doubt that trees have been scraped, if not done too deeply, without subsequent injury in many cases. We have yet to discover why the patches die in other cases. Sunlight was offered as a possible cause; "there seems to be no explanation, other than exposure to sunlight, etc." Mr. Williamson's experience does not negative the possibility. It may possibly occur, not when the whole stem is exposed to sunlight, but when a narrow beam strikes a small area. That could be obtained through the foliage in a heavily-shaded spot,

I have seen many rubber pads on trees which have not been pricked, or tapped in any way; but I have not yet found any evidence to alter my conclusion that the bark must separate from the wood before the pad can be formed. My views on the Northway system should be well-known, whatever their value may be; I have never claimed that they were based on the formation of pads, or black marks on the wood. My objection is to the character of the renewed bark after pricking, *i.e.* the non-laticiferous tissue beneath the pricker cuts and the greater tendency to produce burrs. Mr. Williamson and others must recognise that if I had made this a personal question, I should have been tempted to join him in adducing the formation of rubber pads as another argument against the use of the pricker.

Mr. Williamson closes with a personal note. It would be easy to follow his example with equally irrelevant sneers. I would point out that I am in Ceylon as a plant pathologist; hence my criticism must be in a great measure destructive, dealing with possible errors in methods, and also in ideas, which tend to swell the number of pathological phenomena, though in some cases, *e.g.* planting distances, the destructive carries the constructive with it. I regret the limitation, but under the circumstances it is obligatory.

T. PETCH.

RUBBER ON THE NILGIRIS.

The annual report of the *Scientific Department* of the *Imperial Institute* in London, on the specimens of Nilgiri rubber submitted to it for examination and valuation is very encouraging. The specimens were of "Para (Hevea brasiliensis"), prepared at the Government experimental gardens at Kullar and Burliar, and the opinion was expressed that from both sources the chemical composition was very good, and compared favourably with similar

SPECIMENS FROM CEYLON,

except in the matter of strength. The Burliar rubber was much lighter in colour than that from Kullar and was, for that reason, valued at a higher figure than that from Kullar, the quotations being 5s 4d to 5s 5d per pound; and 5s to 5s 2d per pound respectively, with plantation biscuits at 5s 3d to 5s 9d per pound. Beside Para rubber specimens, "Castilloa" rubber specimens ("Castilloa Elastica') were also received for examination by the same authority, from the two localities above mentioned. The "Castilloa" from Kullar was of inferior quality on account of the large amount (32·5 per cent.) of resin present. Perhaps as the specimens were taken from young trees, not more than six years old, which is the age of all the experiments with rubber planting on the Nilgiris, the quality may improve as the trees become older. The specimens from Burliar were superior in physical properties to that from Kullar and contained no more than 13 per cent. of resin. Their values were from 3s. 6d. to 3s. 8d. per pound, compared with fine, hard, Para selling at 5s. 1d. per pound. The Kullar Castilloa was valued at 3s. 2d. to 3s. 4d. per pound. The "Ceara" (Manihot Glaziovii) was biscuit rubber from Kullar and was found of good quality, containing 82·5 per cent. of caoutchouc and exhibiting very satisfactory physical properties. It was quoted at 5s. 6d. per pound, Para biscuits being quoted at 5s. 3d. to 5s. 9d. per pound, thus showing that this rubber is of the best and promises well for the planter.

THE EXPERIMENTAL GARDENS

from which the specimens were sent are wayside stations on the Coonoor Ghaut road, Kullar, having an elevation of little more than 1,200 feet, and Burliar of 2,400 feet. The latter was regarded by Mr. E B Thomas, a former Collector of the Coimbatore District, of which the Nilgiris once formed a taluq, as a suitable place for growing and acclimatising sub-tropical fruits and spices, such as the mangosteen, the clove, nutmeg, cocoa and the vanilla, introduced from the Moluccas and where they are thriving luxuriantly. Government sanctioned the opening of this experimental garden in the latter fifties, and continue to maintain it to the present day, no better soil and climate on the Nilgiris being found for the purpose contemplated. Kullar and Burliar are extremely feverish, but as the Nilgiri Railway has stations at both places, a stay under their malarial influences at night can be avoided. Formerly, relays of bearers were kept at Kullar and Burliar for the visitor for whom tongas and muncheels were the only means of conveyance up to the sanitaria on the plateau.

At one time Government was not disposed to continue experimental rubber cultivation as part of the duties of the curator of Nilgiri Parks and gardens, intending, as then reported, to make rubber a forest product and entrust the cultivation to the Conservator of Forests and his Assistants. Little, however, has since been heard of this official rumour. And the South Indian planter has, therefore, the whole industry in his hands, and is pursuing it, both in Government and native territory with commendable enthusiasm and energy.

RUBBER AT BEAUFORT, BORNEO.

All the rubber estates here are doing very well, the younger trees growing with marvellous rapidity. I have visited all the estates and found everything satisfactory as regards the treatment of coolies, the fact that there are so few absconders where there are so many coolies on merely monthly contracts proves that they have little to complain of. Mr, Watson has imported a large number of Klings from Singapore, under no contract. They were recruited by the Mandores who came in charge of gangs and, in not a few cases I believe, were got into the country under false pretences. A good number had never worked on an estate before but were merely sampan and dock coolies who state that they were told they were going to similar work in Sarawak. This, of course, in the absence of a contract—which I am told the Singapore authorities refuse to register for Klings coming to this country—is hard to prove, and the men came at their own risk. However, the bulk of these men have made no complaints and appear contented. Javanese coolies have also been imported to several of the Estates and come almost as cheaply as local labour, besides being bound for a longer contract. The Protector, Mr. Penney stayed four days in Beaufort at the beginning of the month but paid official visits only to Woodford and Klias Estates. During the month the Planters' Association held a meeting in Beaufort.—*British North Borneo Herald*, Aug. 16.

BUBBLES IN RUBBER BISCUITS.

We should advise "Learner"—who enquires elsewhere about bubbles in his Rubber biscuits—to be sure that the coagulating pans are clean, and the latex should be gently stirred when the acetic acid is poured in. The bubble marks are, as a rule, the result of froth; and this apparently rises, or forms, in the pans after coagulation has partly taken place. The coagulating pans should be watched and it should be noted if any froth forms a few hours after the acetic acid has been added. "Learner" might try a few pans with latex mixed with clean water before coagulation. Perhaps, some practical planter, who has overcome this trouble, will assist our correspondent?

Wattegama, Aug. 31st.

SIR,—We are tapping trees from 7—10 years old, growing at an elevation of about 2,000 ft. above sea level. The milk is brought in at about 10 a.m., strained, &c., and then turned into soup plates. A few drops of acetic acid are put into each plate and all froth is carefully taken off. The rubber is not ready for further treatment until 9 or 10 o clock next morning, when each biscuit is taken in turn, washed in hot water, rolled and left to dry. Before rolling it is seen that the under surface is covered with bubbles and, when pressure is applied, the bubbles burst and a mark, like a pock mark, is eft, the biscuit looking as if it had had a bad attack of small-pox. I should be much obliged if any reader can advise me how to get rid of these bubblos.

LEARNER.

PREPARATION AND PACKING OF VANILLA.

Nellacotta Estate, Daver Shola, S. E. Wynaad, Aug. 27th.

DEAR SIR,—We have a very large number of vanilla vines on our Beenachee estate, Sultan's Battery, South Wynaad. Those vines have been there for number of years. Only last year they were fertilised and, we are glad to say, we will be able to gather 400 to 500 pods. We shall feel greatly obliged if you or any of your numerous readers will enlighten us as to the preparation and packing of the pods as also the marketable place and some idea about the price.—We are, dear Sir, yours faithfully,

A. R. HAJEE FAKEER MOHOMED SAIB.

[Will some vanilla-grower kindly reply, as to the most up-to-date methods?—ED.]

August 31st.

DEAR SIR,—In reply to your correspondent, Mr A R Hajee F Mohomed Saib of the Wynaad, we have pleasure in giving the following brief directions as to the preparation and packing of vanilla beans.

For a month or six weeks the bean continues to grow and has then reached its full size; but ripening takes much longer. According to climatic and other conditions four to six months are required for the pods to reach the correct stage for gathering; this stage is when they begin to turn yellow, and produce a crackling sensation when lightly pressed by the fingers. The pods should be carefully gathered separately, by snapping off or cutting the stems. Indeed throughout treatment, from pollination of the flower to packing the cured bean, great care must be exercised to get the really good finished article. The pods must be gathered just at the right time, for if too ripe they split in curing, and if they are green and unripe they cure badly and have little perfume.

The beans are gathered when dry and conveyed in baskets to the curing house. There are various ways of curing, but we will only mention one common method here, for, no doubt, your space is valuable. The ripe beans are plunged for about 30 seconds to one minute in very hot, nearly boiling water. They are then taken out and laid on clean mats to drain and dry. When dry they should be spread on blankets and placed in the hot sun, but never allowed to be wetted by showers. When the sun is getting low, roll the drying beans inside the blankets and place them inside the building for preference in boxes. During the night they "sweat." This must be done daily; exposing them to the hottest sun and making them sweat in the hot blankets each night. This goes on for some days—10 days to a fortnight, or even more—until the pods become a fine brown or chocolate colour, and are soft and pliable to the touch when drawn between the fingers. The stage is now reached when the further drying is done in the shade (unless the weather is wet.) During this period the pods are squeezed between the fingers, drawing them through so as to distribute the seeds in the pods and make the essential oil of the vanilla even throughout the bean. The bean becomes smooth and oily to the touch, and any beans which split should be tied up with fine thread.

This second drying process takes some weeks, and gradually the beans dry and the finer, longer beans become coated with a fine "bloom" of white crystals These are the best and most valuable "frosted" vanilla beans; and will fetch fine prices on a good market.

The beans are then sorted according to length and size, and appearance generally. The long, thin, straight pods are the best. Short and misshapen pods, and splits, are kept separate The beans are then tied up in bundles of 25 or 50 pods, tied tightly at the ends. The finest beans are wrapped up in silvered paper, and the others sometimes in grease-proof paper. They are packed in wood boxes, or tins, according to sorted qualities; and are then ready to be shipped to the market.

Prices, of course, vary much according to the demand and the quality of the produce.

During July prices were as follows:—

Seychelles	...	8 to 8½ inch	13s 6d per lb
do	...	6 to 7 ,,	9s. to 9/9
do	...	2nds and 3rds	6s. to 7/6
Mauritius	...	8—9 inch	16s.
do.	...	6 ,,	10s.
do.	...	4 ,,	8s.
do.	foxy splits.	,,	8s. to 8/9

These prices are, of course, approximate only.

The best way to procure best prices is to sell in the London market or find a special outlet. Trusting this will be of use to your readers in Wynaad.—Yours, &c.

H.

INDIAN TEA IN 1908.

INTERESTING REPORT.

An interesting Note on the Production of Tea in India in the year 1908 has been issued from the office of the Director-General of Commercial Intelligence, India, a copy of which reached us yesterday and from which we take the following:

[NOTE.—The figures of area and production in these tables are for calendar years, and the figures for exports from India refer to the official years beginning on the 1st of April and ending on the 31st of March. The figures relating to exports from China and Ceylon are for calendar years. Statistics for Burma are included.]

AREA.

The area reported in each year since 1885 is given in Appendix I attached to this note.

The figures given in that statement are for the most part those reported by planters. In Eastern Bengal and Assam estimates are prepared by the local officers for those gardens for which returns are not supplied by the owners and managers (36 out of 931 in 1908). In Southern India also, similar estimates are prepared for certain non-reporting plantations. Including the estimated area, the total area under tea in 1907 and 1908 was divided between the different provinces as follows:—

Area in Acres.

		1907.	1908.
Eastern Bengal and Assam—			
Brahmaputra Valley	..	208,575	210,704
Surma Valley	..	133,757	134,938
Jalpaiguri (including Alipur Duars)		81,338	83,3[illegible]5
Chittagong	..	4,379	4,[illegible]83
Total Eastern Bengal and Assam		428,049	433,290
Bengal—			
Darjeeling	..	51,507	51,614
Chota Nagpur	..	2,292	2,291
Total Bengal	..	53,799	53,905
United Provinces	..	7,961	8,086
Punjab	..	9,411	9,393
Total Northern India	..	17,372	17,479
Madras .. Reported	..	10,974	11,436
Madras .. Estimated	..	2,684	3,190
Travancore	..	25,986	27,103
Total Southern India	..	39,644	41,729
Burma	..	1,[illegible]69	1,[illegible]24
Grand Total	..	540,533	548,127

Out of the total area of 544,937 acres for which either returns or complete estimates are received, 515,153 acres were reported to have been plucked during the year. On the remaining 29,784 acres the plants were too young to be plucked or were not plucked for other reasons.

The total number of plantations was 5,839 in 1908 as against 5,811 in 1907—a net increase of 28 plantations. The increase is due for the most part to changes in the system of management, gardens formerly under combined management being separated and *vice versa*.

In Eastern Bengal and Assam 931 plantations are reported to have a total area of 433,290 acres under tea, an average of 466 acres. In Bengal 298 acres is the average of 181 plantations and in Travancore 411 acres of 66 plantations. In Madras and the United Provinces the average is much smaller, being about 130 acres in the former and 108 acres in the latter. In the Punjab where tea cultivation is conducted on a small scale, the average area is only 3 acres. In Burma the gardens are even smaller, approximately one acre each on the average. These figures relate only to tea-bearing areas and do not include the area in the occupation of planters, but not under tea cultivation.

The total production in 1908 is reported as 247,018,653 lb. divided between the different parts of India as follows:—

		1907.	1908.
Assam	..	167,545,751	166,569,433
Eastern Bengal	..	46,713,114	44,978,057
Bengal	..	13,5[illegible]3,444	14,993,590
Northern India	..	3,532,139	3,447,3[illegible]5
Southern India	..	16,219,906	17,0[illegible]0,208

The decrease in production reported for Assam and Eastern Bengal is not confirmed by the export returns. Every effort has been made to obtain correct returns from Planters, but the figures reported must be regarded as doubtful.

BURMA IS EXCLUDED FROM THESE calculations, as the produce of the Burma tea gardens is used almost entirely for the manufacture of wet pickled tea (*letpet*) which is eaten as a condiment. In 1908 453,644 lb. of *letpet* was manufactured and only 5,027 lb leaf tea (black).

The production per acre plucked of manufactured tea (green and black) reported for 1908 was as follows:—

		lb.			lb.
Cachar	..	533	Darjeeling	..	292
Sylhet	..	551	Hazaribagh	..	50
Goalpara	..	291	Ranchi	..	119
Kamrup	..	221	Almora	..	1[illegible]9
Darrang	...	489	Garwal	..	71
Nowgong	..	471	Dehra Dun	..	329
Sibsagar	..	429	Kangra	.	154
Lakhimpur	.	564	Nilgris	..	344
Jalpaiguri	..	558	Malabar	..	438
Chittagong	..	373	Coimbatore	...	347
Chittagong Hill Tracts		223	Travancoro	..	522

PRODUCTION OF GREEN TEA,

Reported Production.

	1907. lb.	1908. lb.
Surma Valley	1,276,589	96[illegible],166
Other parts of Assam and Bengal	[illegible]733,018	995,819
Total Assam and Bengal	2,[illegible]09,607	1,957,985
Northern India	1,120,[illegible]53	1,074,760
Southern India	399,000	101,720
Total reported production	3,529,260	3,134,465

Exports.

	1907-08. lb.	1908-09. lb.
From Calcutta and Chittagong	83[illegible],287	754,186*a*
By land and from Sind by sea	857,709	*a* [illegible]77,824
From Madras by sea	79,761	—
Total exports	1,770,757	1,432,010

Bounties have been paid on the following quantities:—

	1907-08. lb.	1908-09. lb.
Surma Valley	1,246,964	938,272
Other parts of Assam and Bengal	90,154	202,1[illegible]9
Total Assam and Bengal	1,337,118	11,401
Northern India	57,473	2,796
Southern India	—	—
Total	1,394,591	1,143,197

Almost all the bounty goes to green tea produced in the Surma Valley (Cachar and Sylhet) which is shipped from Calcutta and Chittagong. But a little green tea from these districts and from other districts in Assam and Bengal is sent across the North-Western Frontier. The greater part of the land trade in green tea, however, is supplied by the gardens of Northern India, particularly those of the Kangra Valley.

The figures of reported production particularly for past years are not accurate. It was discovered in 1907 after a special inquiry that in past years black tea was in certain cases erroneously returned by planters as green tea.

The chief foreign markets for green tea are the United Kingdom and Russia for exports by sea, and Afghanistan for exports by land.

EXPORTS.—Table No. 3 shows the quantity (in pounds) of Indian tea exported direct to each country during the last five years. The destinations given are those declared on export, and owing to the use of optional bills of lading it must be assumed that the true quantities differed in some cases from those stated. The result is that the figures of export from India do not agree with the figures of import into various countries, *e.g.*, the United Kingdom. But the discrepancies tend to balance one another in a series of years. The

MOST STRIKING FEATURES OF THIS YEAR'S TRADE are as follows:—Exports by sea increased by 6,795,572 lb. as compared with 1907-08. Direct shipments to the United Kingdom increased by nearly 7¾ million pounds. The proportion taken by the United Kingdom has also slightly increased (see Table 6—page 10). Direct exports to Russia have increased by over 3 million lb. or some 20 per cent, and those to Germany and Austria-Hungary by some 841,000 lb. (128 per cent) and 122,000 lb. (185 per cent) respectively. The exports to Denmark and Sweden also increased considerably, but most other countries in Europe took less, the largest decreases being in the case of Belgium and Roumania. Some 600,000 lb. more were exported to Egypt. Canada's imports increased by over 2 million lb., and the United States took some 52,000 lb. more. China decreased her imports by about 732,000 lb. and Ceylon by 4,600,000 lb. The shipments to Australia and New Zealand decreased by nearly 2 million lb.

FOREIGN TEA IN INDIA.

The imports of foreign tea into India in 1908-09 were nearly 7·6 million lb., just over a million lb. more than in 1907-08. About a sixth was re-exported as foreign tea chiefly from Bombay to Persia, Turkey in Asia, and Bahrein Island by sea, and by land to Afghanistan, leaving nearly 6 1-3 million lb. for consumption in India. Part of this, no doubt, was used for blending with Indian teas, and the blend when exported was perhaps treated as Indian produce in the Customs declarations.

CONSUMPTION OF TEA IN INDIA.

	Production.	Net exports to foreign countries.	Balance.
	Lb.	Lb.	Lb.
1904-05 ..	221,565,631	209,640,079	11,925,552
1905-06 ..	221,712,407	211,816,620	9,895,787
1906-07 ..	241,403,510	232,425,598	8,977,912
1907-08 ..	248,020,397	223,201,905	24,818,492
1908-09 ..	247,477,324	228,763,984	18,713,340

As already explained, the reported figures of production are far from accurate and consequently any estimate of the consumption *per capita* in India as a whole is vitiated at the outset. There are, however, reasons for thinking that internal consumption, especially in Southern India, is increasing.

In Burma, in addition to leaf tea, some 17 million pounds of pickled tea (*letpet*), mostly imported from the North Shan States, are consumed annually. The consumption per head of population is estimated to be about 2 pounds.

PERSONS EMPLOYED IN THE INDIAN TEA INDUSTRY.

The number of persons employed in the industry in 1908 is returned at 509,488 permanently employed and 74,719 temporarily employed, making a total of 584,207 persons or about one person to the acre. Compared with the return of the previous year there is an increase of 27,786 permanent emyloyes and a decrease of 3,933 in the number of temporary hands. In South India the work is sometimes done by contract, and in this case no record of the labour employed is available, and the figures are therefore not complete.

CAPITAL EMPLOYED.

According to the returns of the Registrars of Indian Joint Stock Companies and the accounts of the companies registered in London as reported by the Indian Tea Association, the capital of joint stock companies engaged in the production of tea amounts to nearly R24 crores or £16 millions, viz. :—

	R.
Companies registered in India ..	3,36,44,146
Do do London £13,487,383= ..	20,22,80,445

Particulars are available concerning the present position of 75 companies registered in India which have an aggregate paid-up capital of 244 lakhs. Of these companies 65 companies declared dividends for 1907 amounting to 10.3 per cent on their aggregate capital of 217 lakhs and 9 per cent on the total capital of 240 lakhs in 1907. Fifty-eight companies have up to now declared dividends for 1908 amounting to 8.8 per cent on their aggregate capital of 191 lakhs. The total dividends so far declared for 1908 on the average amount to 6·9 per cent on the total capital of 244 lakhs in 1908.

The value per R100 of joint stock capital as calculated on the prices of the shares of 68 companies quoted in the Calcutta market was R106 in March, 1908 and R100 in March, 1909.

Similarly particulars about the 67 companies registered in England with sterling capital of £10 millions (1,488 lakhs) are available and show that the total dividends declared in 1907 by 61 companies out of them with an aggregate capital of £8 millions (1,199 lakhs) amounted to 7.9 per cent, which means 6.1 per cent on the total capital of £10 millions (1,473 lakhs) in that year. This year the dividends declared up to now by the 32 companies come to 6.4 on their aggregate capital of £4 millions (or 604 lakhs).—FREDERICK NOËL-PATON, Director-General of Commercial Intelligence, India, Aug. 12th 1909.