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AND

Magazine of the Ceylon Agricultural Society.

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THE

TROPICAL AGRICULTURIST

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CEYLON AGRICULTURAL SOCIETY.

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Rice Cultivation in Ceylon.

In view of the facts that we import more rice than we grow, that few local cultivators will sell any rice, and that local rice is not usually prepared in such a way as to appeal to the imported coolie, no more important subject can be brought up.

Large areas of new and good land are now available under irrigation in the dry zones of Ceylon, where larger crops can be obtained than in the poorer soils of the wet zones; yet no one offers to take up these lands, other than the local villagers, whose object would seem to be as much to keep out outsiders as to use the land for cultivation for themselves. The Kandyan villager of the North-Central Province will not grow rice for sale, to any appreciable extent, though the Batticaloa Tamil or Moorman will do so. It is difficult to see what remedy can be applied other than increasing the population, *e.g.*, by the importation of Tamils, perhaps even from South India. The Kandyan villager at present grows only what he himself requires, and frequently allows his fields to lie fallow for one or two or even more crop seasons. Perhaps a larger charge for the unused water would tend to make him grow a little more rice. One cannot blame him for this attitude, but it is a great difficulty in the way of agricultural improvement.

It is doubtful, having regard to the increase of population, whether the area under rice cultivation in Ceylon is really increasing; the figures are too unreliable to base any calculations upon, but at least they show that if any, the increase is but small.

We shall welcome contributions, of moderate length, upon this subject from any one with special knowledge of it or of any side of it.

GUMS, RESINS, SAPS, AND EXUDATIONS.

Consular Reports on Rubber.

REPORT ON THE VENEZUELAN RUBBER INDUSTRY.

The Venezuelan Rubber Industry, although rich in possibilities, cannot be regarded as of any present importance; nor does it appear probable that it will assume any very considerable dimensions in the near future. The following facts will serve to illustrate this opinion.

ACTUAL CONDITIONS.—All the rubber shipped from Venezuela passes through the port of Ciudad Bolivar, on the Orinoco, and amounts, according to the latest returns, to some 200 tons a year; the source of this supply is on the upper waters of the River Orinoco, not far from the Brazil boundary line. This may be said to constitute the actual extent of the rubber industry in this country, as apart from experiments and schemes for its cultivation in other districts of the Republic. The plant from which the above supply is extracted is known as the *Hevea brasiliensis*, which grows wild in the district mentioned and is found in great abundance. The inaccessible nature of the region, however, and the political conditions, combined with difficulties of labour and transport, have hitherto restricted the annual output to its present meagre limits. It may perhaps be a question as to whether some rubber of Venezuelan origin, be not shipped, with that from Brazil, through the port of Para, but this does not probably amount to anything very considerable.

YIELD PER TREE.—With respect to the average yield per tree, an official publication on Venezuela, compiled in 1904, states that "in the Orinoco region the rubber tree found produces from 40 to 50 grammes of sap. In December and January, two hundred plants will produce from 12 to 14 kilos, which is equivalent to some seven kilos* of rubber. In April the sap contains more water and only yields about four to five kilos of rubber."

PRICE.—As regards the price, that publication places it between 40 and 50 pesos (equal to about £6 10s. to £8) to the hundred pounds, although the finest qualities are more expensive.

METHOD OF EXTRACTION.—The method of extraction is primitive, but, I believe, effective. Incisions are made at different levels in the trunk of the tree, and the sap is allowed to drop into a vessel provided for the purpose. A photograph illustrating this process is enclosed.

EXTENT OF VENEZUELAN RUBBER RESOURCES.—It is, unfortunately, not possible to convey any just estimate as to the actual extent of the rubber-bearing districts in this country, for the region of the Upper Orinoco is practically a *terra incognita*. In the official publication referred to above, its extent is estimated at some thirty million 'hectares.' It is known to possess unbounded resources and to be capable, were the district opened up, of producing an almost unlimited supply of rubber for a large number of years; the absence of population, however, and the difficulties of every kind hitherto encountered, have disappointed all the hopes of the Venezuelan enterprise, and of the fairly numerous group of American and European capitalists who have, from time to time, interested themselves in this branch of the national wealth.

PROSPECTS.—To turn from the actual to the prospective state of the industry in Venezuela, I should mention that efforts are being made by Messrs Sprick, Luis & Co., as well as by other firms on the Orinoco, to develope the dis-

* About 14 lbs.

tricts watered by the Rivers Caura and Paragua, lying at a distance of some two hundred miles to the South and West of Ciudad Bolivar. The region is reported to possess large resources of rubber, but, so far, small quantities only have been exported as samples.

EXPERIMENTAL CULTIVATION.—Some important experimental rubber cultivation is now being carried out by a Senor Raimundo Fonseca on his cocoa plantations, situated upon the North Coast between La Guayra and Puerto Cabello. The work was commenced in the expectation of favourable results, and his initial efforts were carried out upon a somewhat large scale, about 100,000 trees of the description known as *Castilloa Ribrens* being planted. Senor Fonseca's idea appears to have been to combine the two products of cocoa and rubber upon his property; he accordingly substituted the usual shade-trees—the two varieties are known here as 'guamo' (*Inga*) and 'Bucare' or 'bois immortel' (*Erythrina umbrosa*)—and planted the castilloa trees in their place, hoping to secure shade for the cocoa and a profitable crop of rubber into the bargain. The 'guamo' and 'bucare,' however, draw apparently little substance from the soil, whereas the rubber trees possess unusually exhaustive properties; and this is also a well-known attribute of the cocoa plant. The result was shown in the fact that the natural development of both plants was retarded, for whilst the cocoa crop was seriously diminished, the rubber plantation has been reduced to no more than some 4,000 bearing castilloa trees, and I am not aware that any exportations have been made, save as samples of the rubber produced.

With the above exceptions, rubber cannot be said to be cultivated in Venezuela.

I may conclude these remarks by mentioning that the experience gained in the various cases mentioned has led to the opinion, which is one shared by the large majority of persons interested in the subject here, that the rubber-tree,—as also similar plants, such as that producing the 'Tonga Bean' and Balata Gum is only seen at its highest yield under entirely natural, and therefore wild, conditions. All attempts to transplant, cultivate, improve, or otherwise modify the circumstances under which it is originally found would appear to be attended with disappointing results. This fact, should experience elsewhere confirm it, would apparently have to be reckoned with, by the Government of Ceylon,—and I may add that the hopes at one time entertained of producing rubber in the Island of Trinidad have also been disappointed, it is thought owing to similar causes.

SUMMARY.—To sum up, I would ask that the industry in Venezuela, being still scarcely beyond the experimental stages, and labouring, as it does, under unfavourable conditions, can have no appreciable effect on the volume of the world's supply; on the other hand, the unbounded resources latent in the interior constitute a store of hidden wealth which, in the progress of time and enterprise, may one day raise Venezuela to a leading position amongst the countries exporting rubber to the European market.

BALATA.—I have omitted any reference to the important staple trade in Balata, which is, I believe, not strictly rubber. Some thousand tons are annually shipped through Ciudad Bolivar, and a small supply comes from Maturin in the East of the Republic.

I am indebted mainly to Senor J. F. Padron, Secretary of the Chamber of Commerce, for the foregoing information.

Caracas, June 20, 1906.

ARGENTINE.—I.

British Consulate, Rosario, May 29, 1906.

SIR,—I have the honour to acknowledge the receipt of your Circular, Commercial (13423) of April 28th, 1906, respecting the cultivation of rubber, and in reply I have to report that in this district this industry is of no importance whatever.

I have, &c.,

His Majesty's (Signed) H. M. MALLET.
Principal Secretary of State
For Foreign Affairs.

HONDURAS.—II.

British Consulate, Puerto Cortes, June 5, 1906.

MY LORD,—I have the honour to acknowledge the receipt of your Circular, Commercial, of 28th April last, instructing me to forward full information with regard to the rubber industry in this Republic.

At least nine-tenths of the rubber exported from this port is of the wild quality and is of a very superior grade. Scarcely any rubber has been cultivated, although there are plenty of lands available and suitable.

In consequence of the high price ruling for the gum a large number of trees have been ruined from continual tapping, and unless these trees are replaced, the export must decrease.

The quantity of rubber exported from Puerto Cortes from July, 1904, to July, 1905 was 48,039 lbs.

I have, &c.,

His Majesty's (Signed) W. J. BAIN.
Principal Secretary of State,
For Foreign Affairs.

British Consulate, Truxilo, June 9, 1906.

SIR,—With reference to your Circular, Commercial, No. 13423, in which it is requested that Consular Officers should send information respecting the position of the rubber industry in their districts, I have now to inform you, that rubber is not cultivated in my district, but about twenty thousand pounds of wild rubber are yearly exported from this Port.

The prospects for a continual supply are about the same.

I have, &c.,

(Signed) A. E. MELHADO.

His Britannic Majesty's
Secretary of State for Foreign Affairs,
Foreign Office, London.

Rubber Cultivation in Malaya.

AREA UNDER CULTIVATION.

Although statistics show that tropical America contributes about 63 per cent. of the world's total rubber supply, tropical Africa 34 per cent., and Asia the remaining 3 per cent., British-grown rubber is steadily asserting its claim to priority with the consumer at home. The small output contributed from Asia includes products of the Federated Malay States, Ceylon, South India, and British North Borneo, which invariably fetch the best prices in European markets; but without considering the wide field open for capital and judicious enterprise in

each of these countries, where the development of the planting industry has been placed on a par with a rapid expansion of the tea industry in India and Ceylon, observations may be confined to what is being accomplished in the Federated States of Malaya, where for the most part the trees are maturing and have scarcely yet begun to yield. At the end of 1905, there were about 40,000 acres planted with rubber, and by the close of the year following this had increased to more than 85,000 acres, with between six and seven million trees. On January 1st last there were nearly 86,000 acres, half of which had been opened during 1906 on 242 different estates. The output of dry rubber was about 130 tons in 1905 and 385 tons in 1906. The reason, that, while the average has more than doubled, the number of trees has not proportionately increased is that the number of trees planted per acre during 1906 was not so great as previously. With the present yearly increase of about 10 per cent. in the consumption of rubber—a rate which is likely to be exceeded as soon as prices become easier—it must be many years before the supply can become equal to the demand. If the whole of the rubber now planted in these States should grow vigorously, without the loss of a single tree, until the end of 1912 (when all the trees ought to be in bearing and yielding throughout the high average of 1½ lb. per tree), the Federated Malaya States will then be supplying only about one-seventeenth of the world's estimated requirements at that date. This figure—which, by the way, is given by Mr. J. B. Carruthers, the Director of Agriculture and Government Botanist of the Federated Malaya States—is calculated at the present 10 per cent. rate of increase in consumption, and makes no allowance for a probable higher rate. But meanwhile casualties amongst the trees must occur, for drought, excessive moisture, insect, fungoid, and bacterial pests with other accidental causes, such as sudden winds and fire, have all to be taken into account in reducing output.

AVERAGE YIELD PER TREE.

In going carefully through the figures compiled from the annual reports of the numerous rubber plantation companies of Malaya issued during the past six months, it is found that in the great majority of cases the yield of rubber obtained exceeded the estimate. The average yield per tree in the Federated Malaya States appears to be just over one lb. of dry rubber per annum. In the case of estates having older trees this quantity is exceeded, and if labour were always available to tap the trees to a limit, no doubt considerably higher average would be obtained. On the Consolidated Malaya Rubber Estates, where 32,693 lbs. of rubber was harvested from 11,348 trees, the average was 2·88 lbs. per tree.

In the case of the Highlands and Lowlands Estate an average over 38,639 trees of nearly 2½ lbs. per tree is reported, while a yield of over 7 lbs. per tree was obtained from 807 trees widely planted to occupy 16 acres. The result of three tappings of these 807 trees was: First tapping, 2,500 lbs.; second 1,469; and third tapping 1,773 lbs.; a total of 5,742 lbs. But such results must be regarded as quite exceptional; although the returns indicate the immense superiority in the growth and yield of trees which are given plenty of space. This fact is being slowly realised by planters in the States, who nevertheless require considerable convincing, as, naturally, they desire to get their rubber into the market as early as possible in order to benefit by high prices. They realise that they have a sure market now, and perhaps feel a little uncertain respecting the future, so that one appreciates their motive in having close-planted trees during the first few years of bearing. Their view is that by the time the close-planting begins injuriously to affect the yield they will have made their money. But it is always possible, of course, for estates with a large acreage to combine the two systems, thus keeping a reserve of open-planted trees which would doubtless, by their increased yield in future years, make for the deficiencies of the close-planted. In this connection, however,

it is found that there are large areas quite as well, or even better, suited for rubber cultivation than the land already taken up. During 1906, for instance, a large area was planted in Perak than in any of the other States, an entirely new district having been opened in Lower Perak, where rubber is now growing as well as in more popular districts. Selangor has now nearly 45,000 acres under rubber cultivation, Perak about 30,000, Negri Sembilan 11,000, and Pahang close upon 485. Working on the various estates are 39,000 coolies, of whom nearly 30,000 are Tamils, 4,000 Javanese, 1,500 Malays, and 3,400 Chinese. When, however, the 13,000,000 trees already planted in Peninsula are all in bearing (say five years hence) about 50,000 coolies will be needed for tapping operations, apart from opening, planting, weeding and other work. Thus it will be seen that the labour question is of paramount importance, and now that Government recognises the importance of studying the coolies' health and comfort, the outlook is by no means unpromising.

PRICES REALISED.

Turning, in conclusion, to the prices realised during the past year's working of the various rubber companies of Malaya, it is found that a considerable decrease on the previous twelve months' results has to be recorded. The price of best cultivated Para, which in January stood at 6s. 1¾d., after a gradual rise of 1½d. up to the end of March, began to recede in an evenly descending scale, until in December it stood at 5s. 5½d., recovering a little before the end of the year and at the time of writing is approaching 5s. 10d. The price of Brazilian Para took practically the same course, beginning at 5s. 5d. and reaching to 5s. 1d., being as a rule about 10 per cent. to 12 per cent. below the cultivated rubber. The factors which affect the price of rubber, and which must be considered in trying to foresee the future market price of this product, are many and various. How much the demand for rubber will increase is not easy to foretell, but rubber at the present high prices continues to find fresh markets and new uses.—*Indian Trade Journal*, Vol. VII., No. 87.

Calcutta, 28th November, 1907.

LONDON RUBBER MARKET.

LONDON, November 22nd, 1907.—The market continues in a very uncertain condition, Fine Plantation, in sympathy with other kinds, being about 7d. per lb. lower where sales were effected, compared with last sale quotations. The highest price of the sale, viz., 3s. 10d., was realised for two small lots of biscuits from Hattangalla and Warriapolla. 3s. 9d. was the highest price obtained in the room for Crepe, the finest parcels of this and Block being held for about 4s. 1d. per lb. It is worthy of note that no such prices as these have been seen for Plantation Rubber since 1902, while the price of Hard Fine Para is lower than it has been since February, 1903. Scrap, unlike the finer grades, did not show such a depressed market, although here also sales were only effected with difficulty at comparatively low prices, and the darker grades of Crepe and Block were mostly withdrawn for want of support. Average price of Ceylon and Malaya Plantation rubber.—To-day 90 pkgs. at 3s. 1⅜d., corresponding sale last year 301 pkgs. 5s. 2¾d. Hard Fine Para to-day 3s. 4½d., corresponding sale last year 5s. 2d. Particulars and prices as follows :—

CEYLON.

Mark.	Pkgs.	Description.	Price. s. d.
B.N.S. (in diamond)	1	R'gh sheet etc.	1 6
K.P.G.	6	Dark pressed crepe	0 6
Elston	1	Rejections	1 10
Ellakande	2	Brown crepe	3 0
Culloden	23	Brownish to dark crepe 2s 9d to	3 0½
Heatherley	4	Good darkish to black crepe pt. sold, 2s 11½d to	2 11¾
Hattangalla	2	Fine biscuits	3 10
Warriapolla	4	do do 3s 9½d to	3 10

Mark.	Pkgs.	Description.	Price. s.	d.
Doranakande	3	Good biscuits	3	6
Tallagalla	4	Fine biscuits	3	8
M.A.K. (in diamond)	1	Fine sheet	3	8½
	9	Good scrap and rejections pt. sold	1	10
Taldua	2	Fine scrap	2	8½
	2	Dark scrap and rejections pt. sold	2	0
Ambatenne	1	Good scrap	2	6½
Northumberland	2	Ball scrap and rejections pt. sold	2	2

MALAYA.

Mark.	Pkgs.	Description.	Price. s.	d.
P.S.E.	5	Fine sheet	3	8½
R.S. (in diamond) R.	15	Fine sheet 3s 8½d to	3	9
E.B. & Co.	2	Fine pale and palish sheet	3	8½
A.G. & Co.	3	Fine pale and palish crepe 3s 8½d to	3	9
A.G. & Co.	1	Scrap	2	2
	6	Fine sheet pt. sold	3	8
B.M. & Co	3	Good scrap	2	7½
	3	Wound scrap &c	1	9
	1	Fine sheet	3	6
Beverlac	1	Good scrap	2	7½

LONDON, December 6th, 1907.—This was about the largest auction of Plantation Rubber that has yet been held, and the stronger tone of the market was well evidenced by the good competition that was forthcoming for all grades. About one-half of the offerings were disposed of in the room at prices generally showing an advance of from about 4d. to 6d. per lb. on last sale quotations. This is more satisfactory in view of the fact that the Bank Rate remains unchanged, and that the position in America as yet hardly admits of active business in that market. Sheet and Biscuits were in good demand and sold readily at from about 3s. 11d. to 4s. 4¼d. per lb., the latter price being realised for some very fine dark Sheet from Highlands Estate, while the highest price for Biscuits, viz., 4s. 3d, was paid for some from Arapolakande and Glencorse Estates. Crepe was rather more plentiful than other descriptions, and the quotation suffered to some extent in consequence. Some of the palest offered, viz., that from Jebong was withdrawn for higher limits, and the highest price for this grade was 4s. 2¾d. paid for a small lot from Arapolakande. Block continues to be less sought after than other kinds, and 66 cases of fine clear amber block from Lanadron Estate were bought in for want of competition. Average price of Ceylon and Malaya Plantation rubber.—To-day 481 pkgs. at 3s. 7⅞d., corresponding sale last year 217 pkgs. 5s. 2¾d. Hard Fine Para to-day 3s. 8½d., corresponding sale last year 5s. 2d. Particulars and prices as follows :—

CEYLON.

Mark.	Pkgs.	Description.	Price. s.	d.
Kumaradola	2	Good biscuits	4	0¾
G.M.	10	Lump scrap 2s 5d to	2	6
Vicarton	2	Good palish biscuits (77 lbs.) 3s 7½d to	4	0
	1	Barky scrap	2	0
Matang	23	Good palish to darkish crepe 3s 2¼d to	3	8
	12	Good sheet	4	2½
	3	Wet pressed crepe and scrap pt. sold	3	0
Sorana	6	Good biscuits	4	2¼
Gonakelle	1	Good biscuits	4	2½
Gonakella	2	Fine scrap and cuttings 2s 7½d to	2	11
V.S.	7	Good biscuits and sheet 4s to	4	0¾
K.M. (in d'mond)	4	Darkish and dark crepe 2s 4d to	3	4½
	3	Biscuits, scrap and rejections 2s 6d to	2	10
Waharaka	2	Block and scrap 2s 7d to	4	0
Ambatenne	1	Good biscuits	4	2½
	1	Scrap	1	6
Densworth	2	Good biscuits	4	2¾
Sunnycroft	1	Good sheet	4	0
Doranakande	4	Block scrap	2	7
Tallagalla	2	do do	2	7

Mark.	Pkgs.	Description.	Price. s.	d.
M.A.K. (in diamond)	9	Good biscuits 3s 4d to	4	0
	7	Crepe, scrap and rejections pt. sold 2s 7d to	3	0
Taldua	2	Good biscuits	4	2½
	1	Scrap	2	6
Northumberland	1	Block scrap	2	6
Clara	1	do do	2	9
K.M. (in diamond)	3	Good & medium biscuits	3	9
Culloden	13	Very fine pale crepe	4	1
	5	Fine palish and brownish 3s 7¼d to	4	0
	11	Good dark	3	5
	2	Dark block	3	3
Arapolakande	1	Very fine pale crepe	4	2¾
	7	Fine biscuits	4	3
	1	Good mottled crepe	3	7½
Arapolakande	3	Brownish to darkish	3	6
	1	Good scrap	3	0
Glencorse	1	Fine biscuits	4	3
	3	Good scrap and cuttings 2s 5½d to	2	10½
Neboda	9	Good brownish to dark crepe 3s 1½d to	3	7½
Aberdeen	5	Very fine sheet	4	2
	1	Good pressed scrap	2	10
	1	Good rejections	2	6
Glanrhos	14	Good sheet and biscuits pt. sold 3s 10¼d to	4	0
Marakona	1	Fine sheet	4	1¼
Gikiyanakande	7	Brownish to darkish crepe 3s 2¼ to	3	8
Kepitagalla	12	Fine sheet	4	1
Suduganga	2	Fine sheet	4	0

MALAYA.

Mark.	Pkgs.	Description.	Price. s.	d.
Golconda	7	Good sheet	4	0½
	1	Dark block	3	0
F.D.P. (in Estate mark)	10	Good sheet 4s to	4	2
	1	Rejections	2	10
B. & D.	11	Fine pale to darkish crepe 3s 5d to	4	1
	6	Good darkish to dark crepe 3s to	3	6
	2	Fine pale sheet 4s to	4	1
	1	Good biscuits	3	11
	1	Good sheet	4	1
	1	Scrap	3	6
Damansara	17	Fine sheet	4	1¾
	2	Good dark block pt. sold	2	3
	9	Good to medium dark block pt. sold 2s 9d to	3	0
S.K.R. Co. Ld.	17	Good palish crepe pt. sold 3s 6d to	3	10
A.G. & Co.	1	Fine pale sheet	4	1
Mc.I. (in diamond)	4	Dull biscuits	3	8
S.P.S. (in circle)	7	Biscuits scrap etc. pt. sold 2s 5d to	2	10
Jugra	1	Darkish pressed crepe	2	9
V.R. Co. Ld. Klang F.M.S. (in triangle)	46	Good palish and mottled crepe pt. sold 3s 7¼d to	3	7½
	10	Dark ,, pt. 3s 1¾d to	3	4¼
E.A.C.	15	Very fine pale crepe	4	0¾
	11	Good brownish & dark crepe 3s 5d to	3	7
R.S. (in d'mond)	R. 4	Good scrap 2s		8
K.M. (in triangle)	2	Good sheet pt. sold	4	1¾
P.S.E.	8	Fine sheet	4	2¼
B.S.	18	Fine sheet	4	2
Bila	19	Good scrap and rejections 2s 7½d to	3	0¾
Linggi Plants.	15	Dark pressed crepe & block	2	8
Sungei Krudda	4	Palish scrap 2s 10d to	2	10¼
	11	Dark pressed crepe and scrap pt. sold	2	4
	1	Mottled crepe	3	7½
Highlands	20	Fine sheet 4s 3¾d to	4	4¼
	36	Good palish to darkish crepe 3s 3d to	3	8½
	1	Fine block	3	8
	1	Good dark block	3	3½
Glenmarie	7	Good sheet and biscuits 4s to	4	1
	1	Dark pressed crepe	2	11
A.R.P. Co. (in estate mark)	2	Darkish to dark crepe pt. sold	3	2½
Shelford	6	Fine & medium block 3s 3¾d to	3	4¼

OILS AND FATS.

SYNTHETIC CAMPHOR.

FUTURE OF THE NATURAL PRODUCT.

Synthetic camphor is at last an accomplished fact, and a product which is said to respond to all chemical tests of natural camphor, and to answer all its industrial requirements can now be obtained in England in commercial quantities at prices materially below the present cost of the natural article. Until a few months ago artificial camphor was a little more than scientific curiosity, but within the last two or three weeks it has been placed on the market in serious competition with the product of the camphor tree of Formosa. This event marks a new era in certain industries in which the use of camphor is essential, and will possibly be the starting-point of new commercial enterprises.

In 1899, four years after the forests of Formosa became the property of Japan, the camphor industry was placed under Government monopoly, and the world became practically dependent on Japan for its supplies. In due course, the price of camphor began to advance, and eventually reached such a figure that not only were industries dependent upon camphor crippled, but great encouragement was given to scientific research in the direction of finding a chemical substitute for the natural product which was so difficult and so costly to obtain. This price, which was at one time 50s. per cwt. for the raw product, advanced to 400s., and remained there long enough to do considerable damage to industry. In fairness to Japan it must be said that certain difficulties rose in Formosa, which rendered the cost of camphor collection much higher; but as these difficulties were gradually overcome the monopoly showed no disposition to make equivalent concessions to purchasers. It is believed that the Japanese contemplated the manufacture of celluloid, and, in fact, it is stated that this industry is already carried on to some extent in Japan. Had it not been for the recent triumph of science there is a possibility that in course of time not only would Japan have held the monopoly of camphor production, but would have secured a predominant share in all those industries in which the use of camphor is required, including such important branches of commerce such as the manufacture of celluloid, smokeless gunpowder, a certain class of disinfectants, and a number of popular medicines.

FREE FROM CHLORINE.

The synthesis of camphor has been promised for some time, and in fact an impure product has been obtainable on a small scale for more than a year. The difficulty hitherto has been to produce synthetic camphor free from chlorine at a reasonable cost, and these difficulties have just been overcome. Apparently until a few months ago the Japanese Government felt assured that both these obstacles were insurmountable, for it was not until the end of March this year that it introduced an important change in camphor distribution, and within the last four months the price of the refined natural product has dropped to the extent of 45 per cent., the last reduction, equivalent to £28 per ton, having taken place a few days ago. The price of natural camphor, however, is still substantially higher than that at which the synthetic product can be produced, and there seems to be little doubt that in course of time the competition of the synthetic article will bring the price of the Japanese product very considerably below its present reduced value. It is estimated that at least two-thirds of the world's supply of camphor is absorbed in the manufacture of celluloid, and the new source of supply will therefore prove an enormous stimulus to this industry. The demand for celluloid goods

is steadily increasing, and as a result of the excessive prices that have been ruling in the camphor market, the increased demand has to some extent been met by cheap imitations of celluloid largely composed of shellac to which a very small percentage of camphor has been added.

EFFECT ON TURPENTINE MARKET.

Patents for the production of synthetic camphor are being worked in Germany, France, Switzerland, America and England, and most of the processes are based on the production of pinene hydrochloride from turpentine, the pinene hydrochloride being changed into isoborneol, which is oxidised to camphor. As turpentine is the most important raw material on which the synthesis relies, it is clear that the future of the camphor market depends very largely indeed on the cost of turpentine. If turpentine were to remain somewhere about its present price it is possible that in due course the value of camphor might recede to nearly one-half figure now quoted for the refined product. Turpentine has been dearer than it is at present, and it has been very substantially cheaper, but an increased demand occasioned by the manufacture of camphor would doubtless have a hardening influence on the market, and if this were aided by an increased demand for the purpose of paint and varnish manufacture the cost of synthesising camphor might be considerably higher than at present. These are possibilities which must be taken into account, but unless some quite unforeseen circumstance should arise to enhance the value of turpentine more considerably than the influences just mentioned synthetic camphor could still be produced at very much less than the present selling price of refined natural camphor. There is also the possibility that cheaper methods of synthesis will be devised, and then Japan may stand in the same position with regard to synthetic camphor as does India to synthetic indigo. In appearance the new camphor is identical with natural camphor, and chemically they are the same. There is this distinction, however, between the two products—that the natural camphor rotates the plane of polarisation to the right, synthetic camphor, like other synthetic substances, has no action on polarised left. This it merely a technical difference which has no bearing on the use of the new product in the industries.—*Indian Trade Journal*, Vol. VII., No. 87, Calcutta, 28th September 1907.

[With the drop in price that has lately gone on, it will be more difficult to start manufacturing camphor to profit.—ED.]

THE SOURCES OF GARJAN OIL IN BURMA.

Only six of the fifty species of Dipterocarpus that are known to occur in the tropical forests of the south and east of the Asiatic continent are said to be indigenous to India proper. The others are more or less specific forms of the Malayan type of forest vegetation and are distributed over Ceylon, Burma, the Malay Peninsula, Siam, and the island of the Indian archipelago. But, whenever they are met with, the Dipterocarpus are characterized by at least two marked and constant features—(1) they are among the most lofty trees of their habitat, (2) the fibro-vascular bundles of their wood secrete and hold large quantities of fragrant, balsamic. oleo-resins. Of the eight species of the genus that are distributed over the moist or dry forests of Burma, the *Dipterocarpus alatus*, Roxb. (Kanyin pyu or white Kanyin), the *D. laevis*, Ham. (Kanyin ni or red Kanyin), and the *D. turbinatus* Gaertn. f (Kanyin) yield the so-called 'Kanyin oils'; while the *D. Griffithii*, Miq., the *D. incanus*, Roxb., the *D. obtusifolius*, Teysm (In bo), the *D. pilosus*, Roxb. and the *D. tuberculatus*, Roxb. (Eng., In, In ma or female In) are the accredited sources of the 'In Oils' of Burma. Of these again, the *Dipterocarpus turbinatus* and the *D. tuberculatus* are the most abundantly distributed species of their respective

groups, and consequently furnish the bulk of the products referred to the groups to which they belong. The term "oils" as applied to these remarkable products is not only a misnomer but distinctly a misleader; for, so far from being merely oils, these products are organic compounds consisting of mixtures of both fixed and volatile oils and balsamic resins resembling copaiba. The groups themselves differ much in physical as well as chemical constitution,—the Kanyins being more nearly oils than resins while the Ins are more nearly resins than oils. Again, the method of the extraction of the product, in each case, furnishes a difference between them of some practical importance and goes far towards helping us to gain some insight into their varying compositions,—the oils of the kanyins are extracted with the aid of fire, the resins of the Ins. without such aid. For the rest, the former are thin, brown to greenish black products; the latter are thick grey-to-greyish-white exudations. Although they are frequently promiscuously distributed and sometimes even occur beside each other, the species yielding the Kanyin oils evince a marked preference for the moist seclusion of the dense, damp, evergreen forests of the hills and valleys of the interior of Burma; whereas, those furnishing the In oils show a no less conspicuous predilection for the outer, open, dry forests of the lower foot hills and plains of the country. Indeed, while the former are sparsely and sporadically intermixed with the dominant trees of the cool forest that instal themselves on deep, rich soils and alluvial deposits, the latter are so eminently gregarious as to frequently form pure forests on beds of laterite, gravel, and clay. To the assemblage of varied oleo-resinous products that are obtained from species of varying characteristics such as these the one commercial name of "Garjan Oil" has been applied. No separate trade names exist for the different products that are really referred to under the name of garjan oil. No endeavours appear to have yet been put forth to separately obtain, examine, or determine the oils and resins of the species met with, nor has any serious or systematic attempt been made to investigate their technical value. At present they are almost universally accepts to be 'oils' from the great tiger haunted forests of Burma; while, even the chemical examination of the oil by Messrs. Fluckiger and Aunbury, as reported in their Pharmacographia, itself appears to have been conducted upon the sample of a product of dubious origin obtained by them from the port of Moulmein.

The method of extraction of the Kanyin oils is simple, crude, and needlessly wasteful. Between the months of November and May, varying with the size of the tree, one or more "deep pyramidal hollows, the apices of which point towards the interior of the stem" are cut near the foot of the tree, and fire applied by means of bamboo torches to the upper surfaces of the cuts. The oil which readily trickles out at the cut ends of the vessels of the wood accumulates at the bases of the hollows and is ladled out thence once or twice a week. Soon after and as often as the oil is collected by the operator, fire is applied to the cuts, the charred surfaces of which are also occasionally chipped with a narrow bladen adze. These operations are said to be necessary to stimulate the flow of oil and to keep the pores of the wood open. A tree six feet in girth, with but a single cut, yields on an average about 20 pounds of the oil in the year. This quantity is valued at about Rs. 2 locally. The oil, as such, is however sold only when a good demand exists for it; usually it is mixed with chips of rotten wood which, on becoming quite saturated, are neatly rolled between the leaves of the screw-pine (Pandanus, spp.) or saluhicuala peltata (Roxb.), and made into torches of which from 10 to 15 lakhs are annually exported from the Tenasserim ports of Mergue, Tavoy, and Moulmein alone. These torches are worth from Rs. 2·8 to Rs. 3·0 per 100 at the port of shipment. The extraction of the In oils proceeds upon similar lines to those adopted with that of the Kanyin oils. The tapping season in their cases, however, begins in August and ends in the February or March following. No fire is applied to the cuts, but

their surfaces are frequently chipped clean to remove the congealed resin that clogs the pores of the wood. The yield and value of In oil are about the same locally as those of Kanyin oil. Unlike the latter, it is seldom utilized in the manufacture of torches, but is chiefly employed, either alone or in combination with the oleo-resin of the *Melanorrhœa usitata*, Wall, for varnishing, water-proofing, lacquering, in medicine, etc. Besides these known uses of the products Garjan oil has been suggested for utilization in the manufacture of lithographic and printing ink, as a substitute for the Brazalian balsam of Copaiba (copaiva), in the painting or varnishing of wood work exposed to damp or insects, and as a solvent of the hydrocarbon, caoutchouc. For the last-mentioned purpose it would appear to be eminently suited because of the large quantities of essential oil it contains—almost every known essential oil being an effective solvent of caoutchouc.

The wasteful and primitive methods of extracting the Garjan oils in Burma coupled with the annual destruction of hundreds of valuable trees from overtapping or being burnt down in the fires that travel through the forests in the hot weather are matters that deserve the attention of those responsible for the Forest administration of the provinces of Burma. Systematic tapping under scientific treatment following the due conservation of at last those forests in which the *Dipterocarpus terminatus* and the *D. tuberculatus* at present occur spontaneously in Burma is likely to do much in the direction of assuring purity of quality and sustained quantitative yield in two of the most valuable products of the country. Such action cannot fail to revive and enlist commercial and technical interest and sympathy in the elimination and utilization of these products. It might even lead to the discovery of new uses and to the erection of new industries for their adequate and efficient utilization ; for, it is the product that seeks and finds its utilization more frequently than the industry that determines its use.—*Indian Agriculturist*, Vol. XXXII, No. 10, October 1907, p. 308.

[Several species of Dipterocarpus occur in Ceylon. *D. glandulosus*, Thw., which is comparatively rare, yields dorana-tel, used instead of Garjan oil in the Colombo Lepers' Hospital.—ED.]

Coconut Water.

(Quelques recherches sur la composition de l'eau et sur les diastases du fruit de Cocos nucifera. de Kruyff in Bull. Jard. Colon. 7, 1907, p. 339).

This author finds that

1. The coconut water contains saccharose, which is inverted during maturation.

2. This inversion is carried out by the action of the diastase sucrase, which is dissolved in the water.

3. This diastase is secreted by the cells of the endosperm (flesh of nut).

4. The water also contains oxydase and catalase.

5. The water of a very young fruit only contains the two latter.

6. The haustorium (organ with which the young plant feeds on the nut) contains in its cells lipase, proteolytic diastase, amylase, catalase, and feroxydase).

These researches were carried out with the object of finding a use for the water in the young coconut, but none was discovered.

FIBRES.

COTTON SEED SELECTION, 1906-7.

The great importance of seed selection, in the cultivation of Sea Island cotton has, for a long time been recognized, and even in the cultivation of the ordinary qualities of cotton, seed-selection is assuming a very prominent position. It has long been known that wherever a large number of plants of the same variety are grown together, slight variations are always to be found, and that is particularly noticeable in a cotton field. Usually the variations are not of a very pronounced nature, but when each year those plants are selected which show a desirable variation, however slight it may be, the ultimate result will be an improvement in the produce as a whole. Such has been the case with the Sea Island cotton seed selection experiments that have been carried on from year to year in the Sea-Island cotton-growing districts of America. The cause of the variations which take place in the plants of the same species grown together cannot definitely be stated, but probably a number of different factors are responsible for them. The tendency to produce variation, as shown by Sea Island cotton, however, demands attention for two reasons: First, since it is of great service in affording material for develcping special varieties of plants and desirable qualities of cotton; and secondly, because—owing to this varying character of the individual plants—unless seed for planting purposes is specially selected from individual plants, the cotton will become less uniform in quality in each year, and so of less value. The method adopted in these experiments has been frequently referred to in the pages of the Agricultural News; and in the West Indian Bulletin (Vol. VII. p. 153) this method has been described at some length. Briefly, it is as follows: Each plant in the field is carefully examined as regards its general growth, freedom from disease, prolificness, and quality of cotton produced, and those plants which are most satisfactory in these characters are carefully marked. The seed-cotton from these plants is then picked separately, and subjected to a very critical examination; the best samples are determined, and from these the seed is obtained. The next season, this seed is planted in a nursery in order to produce enough for general planting purposes. All the remaining samples are discarded. When these experiments are conducted on any estate for the first time, each field must be very carefully examined for specially good plants; but when the experiments have been carried on during the previous season, the plants in the nursery only are examined. The number of plants which are examined on an estate where the experiments are being carried on for the first time is naturally very large. Since about 4,000 plants is the number usually grown per acre, this means that if 20 acres of cotton are gone over, it will necessitate the consideration of many as 80,000 plants. The Imperial Department of Agriculture has been very active in taking this work in hand, for, from the first it was realised that if the industry was to be successful, it would be necessary to start experiments, and to supply seed of the highest possible quality. In the season of 1905-6, seed-selection experiments were commenced in Barbados; and during that year they were conducted on seven estates. In the season 1906-7 the work was extended to ten estates in this island. During this season experiments were also started on five estates in St. Vincent, and a few plants have been selected at the experiment stations in Antigua, St. Kitt's, and Montserrat. In Barbados during the season of 1905-6, the number of plants selected in the field were 264, but as a result of the final examination, seed was selected from only fourteen of these. In 1906-7, 224 plants were selected in the field, and from these, twenty-six were finally selected for seed purposes. During this same season in St. Vincent, 102 plants were selected in the field, seed being obtained

from twelve of these after the final examination. The seed from the finally selected plants is very carefully dealt with in each case. On each of the estates where the experiments are being conducted, a special plot of land is set apart as a nursery, and in this nursery the seed is carefully sown, care being taken to have the nursery in such a position that the plants are not likely to be cross-fertilized by those in the general field. Another important factor in selecting the nursery is that the soil and situation shall be nearly as possible typical of the general conditions of the estate.

The principal measurable qualities of the cotton produced by these selected plants in Barbados, during the seasons 1905-6 and 1906-7, and in St. Vincent during the season 1906-7, are clearly shown in the following table :—

		Average length of staple.	Average percentage proportion of weak fibre.	Average diameter of fibre.
Barbados	...	1905-6 50·7 mm.	27·21	0·0156 mm.
Barbados	...	1906-7 47·7 mm.	24·1	0·0155 mm.
St. Vincent	...	1906-7 47·7 mm.	2·22	1·0159 mm.

A comparison of these figures is interesting, since they indicate the measurable qualities of the cotton. As regards the length of Barbados cotton, it will be seen that this reason, the staple from the selected plants is shorter than that of last year. The reason for that is that, as a result of statements made by Mr. E. Lomas Oliver during his visit to the West Indies during the early part of this year, greater importance has been attached to the strength of the cotton than to its length. In describing the relative values of the various qualities, Mr. Oliver stated that strength was of greatest importance; then came fineness, and next length. This being the case, those responsible for the selection experiments have been willing to make certain sacrifice as regard length in order to obtain strength. It will be noticed that the selected plants of this year contained much less weak fibre than those of the previous season, some of the individual plants this year containing as low as 17 per cent. weak fibre, while last year none produced less than 24 per cent.

The above table does not show clearly the extent to which St. Vincent cotton scores over Barbados cotton, and it should be stated that only a very few samples of cotton produced in the latter island contained a low proportion of weak fibres, whereas this low portion of weak fibre was a very marked factor in nearly all the samples from St. Vincent.

This year the experiments will again be continued, and we hope by these carefully and thorough means to maintain the high qualities of West Indian cotton, and thus to place the cotton industry on a more substantial footing.—*Agricultural News of the Imperial Department of Agriculture for the West Indies*, Vol. VII, No. 143.

Barbados, 19th October, 1907.

SISAL FIBRE CULTIVATION.

Beginners of sisal planting, if not well posted in the subject by practical object lessons, must be often at a loss as to which of the many writers on the subject to follow.

"N" in "Capital" for instance would lead us to think we had tumbled upon a veritable Tom Tiddler's ground in fibre cultivation. A sanguine temperament is a pleasing and essential trait in the successful establishing of a profitabie planting industry, but, if not to a certain extent combined with business discretion is apt to lead to disaster.

"N" in the Article in "Capital" refers frequently to this cultivation in Assam. But judging from his remarks he very evidently has had no practical experience of Sisal Cultivation. When Sisal planting was started, one of its principal virtues was its supposed indifference to the kind of soil in which it was planted. It was believed to grow best and produce a paying crop upon a soil too poor to support a paying crop of anything else. It was even believed that a worn out tea garden would be rejuvenated into a flourishing concern by simply planting it with Sisal. "N" says that Sisal although growing upon rich cultivated land, grows best and produces best fibre upon poor arid land. Now every Sisal planter knows—and in some instances the knowledge is likely to be dearly bought—that although Sisal will exist on poor land it will not produce leaves giving either quality or quantity of fibre to pay for the cutting and decorticating.

According to "N" the Sisal is a long-lived plant if *judiciously cultivated.* If by *judicious* cultivation he means that cultivation, which will insure a fair crop of good quality fibre, according to all practical experience of the cultivation of the plant it will shorten its life. But during its shorter life it will produce more fibre and of better quality than it does when grown on poor land, although it may live three or four times the number of years. Contrary to being a long-lived plant it is essentially a short liver, as, like all mono-carpic perennials it dies when it flowers.

"N" again says that when the plant gets old, in about fifteen years the fibre deteriorates and the plant may be thrown out and replaced. This statement is so ridiculous to those who know anything about the cultivation of Sisal that it is hardly worth while commenting upon it if it were not that beginners might take it seriously. If "N" puts out a plantation of Sisal and gives it that *judicious* cultivation already alluded to, in fifteen years he will not have one single plant left, as before that time they will all have poled and consequently died. But taking it for granted that the plantation has been properly looked after, the new plants which have replaced the dead ones will be in full bearing, and some of those even will be poling and dying.

Whether the leaves are cut or not makes no material difference in the time of the plants poling. It used to be thought that if the plants were cut too hard it induced early poling. This has not yet, to the writer's knowledge, been proved, but cutting too hard certainly weakens the plant and shortens the after coming leaves. As to "N's" remarks upon wet soil, the plant will not grow upon water-logged soil, but will grow luxuriantly upon a soil in which tea will not exist,—a soil, the surface of which is continually only 18 inches above water level. It is not a deep rooter and has no tap root.

Its roots have not even a spreading habit, and if the soil in which Sisal is planted be not of fair average, to good quality, feeding the plant must be resorted to and is absolutely essential if a profitable quantity and quality of fibre is to be obtained.

A low-lying damp situation is not a desirable one for this plant owing to its restricted transpiratory system.

Most Indian plants growing in such situations are provided with free canals which run along the substance of the leaf converging at the tip. This is, supplementary to the ordinary transpiratory pores of the leaves and in certain conditions of the atmosphere which retards the usual transpiration, the canals come into use, and the water drips from the tip of the leaf. The Sisal plant is exceedingly deficient in transpiratory pores, and is not provided with such canals, and during a cold damp spell the transpiration is often so checked as to cause a rupture in the tissues of the leaf from pressure within, and causes an unsightly black blotch which discolours the fibre and reduces its value if the attack is severe.

"N" appears to have as vague ideas about the decorticating machinery as he has about the Sisal plant itself. He alludes to the Lornella machine as being used by the Assam Planters. The writer is only aware of one Lornella machine in India, and will not be surprised if that one is relegated to that limbo of impractibles and failures, the factory scrap heap, in the near future.

Engineers are very busy trying to bring out a perfect machine for decorticating fibre leaves. One is badly wanted as there is not such a thing as a perfect machine of this kind yet. The Lornella makes over 30 per cent. waste more than the small Raspador type. That is, the same weight of green leaves from which a small machine will take three pounds of dry fibre the large Lornella will only take two pounds. The Lornella will not clean the Mauritius leaf at all, but cuts it all to bits. The principal drawback to the Raspador type of machine is its comparatively small outturn. But a battery of twelve of these small machines fitted with Barr and Thrusoris Automatic feed arrangement will more than equal the outturn of the large expensive "Tornella."

More labour is required to handle these small machines, but this is by far and away overbalanced by their producing 30 % more fibre than the larger machine.

When a "Lornella" gets out of order, and when it does so, it gets very much out of order,—it means that the whole factory is stopped. There is no fear of this happening with the smaller machines.

It will be well for intending Sisal planters to remember that Mr. Joseph Chamberlain over twenty years ago was persuaded into planting large tracts of Sisal in the Bahama Islands under the impression that it would grow upon poor land. The collapse of the undertaking is now ancient history, perhaps not known to Sisal planters generally.

Sisal planting will be found to require more systematic cultivation and keeping the land in "heart" than ever tea has had. If a tea garden is planted in a fairly good soil it may not *perceptably* require much attention in the shape of fertilisers during the first dozen years or so. But, if a Sisal garden is treated in the same way, it may be confidently asserted that the leaves of the second planting will hardly be worth cutting.

EXPERIENTIA DOCET.

PLANT SANITATION.

Entomological Notes.

BY E. E. GREEN, *Government Entomologist.*

A correspondent from Polgahawela gives me some useful particulars concerning the life history of the red coconut weevil (*Rhynchophorus signaticollis*) He writes:—"On the 19th July last a tree which was felled to reduce the dense shade over some coconut plants, fell on a two-year-old coconut plant and seriously damaged it, pushing it out of the perpendicular and snapping it below ground level."

"Within four hours there were red beetles on the tree, and on the 5th of November last the tree was still green, but evidently falling to pieces, and rotten at the base. The tree was removed and carefully taken to pieces by hand. There were eleven empty cocoons with beetles near them—thirteen cocoons containing perfect beetles which began to move about when the cocoons were opened. Of these twenty-four perfect insects eighteen were males. There were some partially made cocoons with grubs in them, and some perfect cocoons within which were insects in various stages of mutation. There was but one grub which was active and had only just begun to make a cocoon. There were no cocoons in excess of the number of insects found, so I take it that none of the beetles had yet left the tree. The whole life-history of this beetle (or weevil) seems therefore to occupy sixteen weeks from the date of the eggs being laid to the full development of the insect. There would hence be three broods a year—approximately."

My correspondent's estimate of three broods per annum does not necessarily follow from the observed facts. There is sometimes a considerable interval between the emergence of the adult insect, and the deposition of eggs. Moreover, it is not certain that the period of development of the insect is at the same rate in different seasons. It may be delayed by cold wet weather.

The red coconut weevil having come into considerable prominence lately as a coconut pest, it will be advisable to give it its correct scientific name. This has recently been determined by Mr. H. M. Lefroy (Government Entomologist for India), to whom I sent some of our specimens, as *Rhynochophorus signaticollis*. He writes me that *R. signaticollis* was orginally described from Ceylon [Ann. Soc. Ent. Fr. 6, ii, p. 562 (1882)]. *Rhynchophorus ferrugineus* is said to be larger, duller and more uniformly coloured—a description that tallies with another (less common) palm weevil that occurs in Ceylon.

A correspondent writes, asking for advice *re* "shot hole borer" (*Xyleborus*). It appears that he has recently obtained tea seed from an estate infested by this pest, and has been warned by a friend that he runs the risk of introducing the borer by so doing, and that he should take the precaution of washing the seed and burning the bags in which it arrived. My correspondent asks if he should go still further and destroy the seed itself.

I have replied that there is no appreciable risk in employing tea seed from a district infested by "shot hole borer." That insect has never been known to inhabit the seed of the tea plant. With regard to the bags, though there may be an off chance of a wandering insect being entangled in the sacking, this chance is a very remote one, and the risk from this source is no greater than from the clothing of any person who might visit the estate after travelling through an infected district. Under the terms of the Pests' Ordinance, I have recommended the prohibition of the removal of tea *plants* from districts in which the pest occur but I have specially exempted tea *seed* from this prohibition, as being unlikely to carry the infection.

I have received specimens of the caterpillars of the Tussar silk moth (*Antheraea paphia*), said to have been found feeding upon the leaves of a Para rubber (*Hevea*) plant. The caterpillar is a large and voracious one, and would soon defoliate a small plant; but its appetite would quickly draw attention to its ravages, and being a large and conspicuous insect, it can be readily seen and destroyed.

The caterpillar is of a brilliant apple green colour, with vivid orange spots on the prominent tubercles.

Plant-feeding caterpillars are usually unmitigated pests. But I have received specimens of the caterpillars of a common moth (*Plusia oxygramma*, Hubn.) with the report that they are doing excellent service in destroying a troublesome weed (*Conyza* sp.). My correspondent writes:—"I have a plot (of tea) of several acres under very heavy weeds, this weed (Conyza), Ageratum, and a weed like groundsel. The caterpillars are leaving the other weeds but making an absolute clean sweep of this particular weed, eating all the leaves and the top—except the ribs. I think all these weeds will die. What I want to know is, is the poochie harmless, and ought it to be encouraged; or should it be exterminated as a pest of tea, rubber &c.?"

I was able to assure my correspondent that these caterpillars are very unlikely to attack the tea or any other estate produce. They are, however, sometimes troublesome in a kitchen garden, where I have known them to play havoc with a bed of tomato plants.

Outbreaks of 'Red slug' (*Heterusia*) have been reported from several districts. This caterpillar confines its attentions to the older leaves of the tea plant and does not appear to relish the young flush. Extensive defoliation of the mature foliage will, however, weaken the bush. If the tea is nearly ready for pruning, this work should be taken in hand at once. The prunings should be burnt in situ, together with all fallen leaves and rubbish from below the bushes. But if the pruning of the tea is inadvisable at the time, little can be done beyond collecting the caterpillars by hand. At the same time, the rubbish and fallen leaves should be swept up and burnt, as many of the caterpillars will have formed their cocoons amongst the dead leaves.

This caterpillar is fortunately very much parasitized by a species of fly (*Exorista heterusiæ*) which very materially aids in checking the pest.

If the earlier attacks are detected, and the caterpillars collected and destroyed while the insect is confined to a few bushes, further and more extensive trouble will be avoided.

I have received specimens of *Cajanus indicus*—the 'Pigeon Pea' or 'Dhal' of India—with the leaves thickly covered with a 'mealy bug' (*Oudablis* sp.) to such an extent that the whole plant appears snowy white, I am not aware that this plant is cultivated to any extent in Ceylon, but the pest might be a serious one if introduced into India.

Specimens of plantain fruits have been submitted to me with their skins badly infested by a 'scale-bug' (*Aspidiotus destructor*). The quality of the fruit does not appear to be affected in any way, though the presence of the bug is a distinct blemish to the appearance of the fruit.

The aquatic larvæ of Dragon flies form a considerable portion of the food of imported trout in Ceylon. I have had the opportunity of examining the contents of the stomach of a medium-sized fish, which contained little else than the remains of these larvæ. But they take their revenge in the stew pond where the large species take heavy toll from the young fry. In fact, in two cases that have come under my notice, they appear to have been responsible for the extermination of practically the whole stock of young fish.

A Coconut Palm Root Disease.

The following is a report on a root disease of coconut palms reported from Trinidad, West Indies :—

ROOT DISEASE.—An attack of this disease is generally first shown by the leaves. They show a slightly wilted appearance, they turn yellow, first at the tips and then gradually all over the leaflets. These dry up, blacken, hang down from the 'cabbage,' and often remain for a considerable time before they are shed,—a badly attacked palm often being entirely enclosed in numbers of leaves around its trunk. Frequently, however, it is noticed that the leaves do not hang down around the trunk but the petioles break across, leaving the sheathing portion on the trunk, while the foliage portions of the leaves have fallen to the ground. Sometimes the petiole does not completely break and the foliage portion of the leaves hangs vertically downwards, attached to the portion of the petiole that is left attached to the stem.

The outer leaves are sometimes those that show signs of wilting and yellowing first, but this is not always so, for frequently palms may be noticed in which a 'middle' ring of leaves becomes wilted and yellow, while rings of green leaves remain above and below.

After the yellowing of the leaves, trees bearing a good crop of nuts as a rule gradually shed most if not all of them, irrespective of their size and state of development, and the flowers subsequently produced do not set. In fact, it is possible for a person to pick out with certainty trees that are diseased before any yellowing of the leaves is noticed, by carefully looking at the condition of the leavees and at the latest flowers that are being put forward. Any trees that are diseased can at once be singled out. The local conditions of the soil must be considered before a tree is definitely stated to be diseased, as the whole appearance of the diseased trees suggests a lack of water, and therefore may be confused with trees that are suffering from this cause alone in drought-affected areas.

An increased supply of water, either natural or artificial, will improve the condition of drought-affected trees, but the wilted appearance of diseased trees, although it may be slightly less noticeable, is more permanent, and the symptoms do not disappear.

After a number of the leaves have yellowed and died, it is only a question of time before the terminal bud falls over and becomes a putrid mass,* and the palm eventually dies, as it has no power of branching or of producing a new growing point.

Trees which only present external signs of disease to the experienced observer show that apparently the roots are probably the parts which become first affected. After a considerable number of these have been rendered useless in contributing to the life of the plant, changes take place which result in a sour-smelling red discolouration in the stem that probably commences at the level of the ground and extends upwards.

The position of this red discolouration would appear to vary in the stem directly with the roots that are affected, and it has been repeatedly noticed that when a 'middle' ring of leaves shows signs of yellowing, the discolouration is found towards the centre, while if the lowest leaves become wilted, the stem presents a ring of discolouration towards the outside of the stem. The petioles also show that

* When a coconut palm is affected by any disease or pest, the terminal bud, in the advanced stages, becomes involved in a rot. This must not be confused with 'bud-rot' which appears to be a specific disease, as the roots, stem and leaves are sound, while the bud is in a diseased condition.

they are infested with the mycelium of a fungus, for when the leaves become dry and hang down the fructifications push through the epidermis and form pustules of varying size and shape. Eventually, when the vitality of the tree has been reduced, the terminal bud as already noticed becomes infested with a 'rot' which causes the whole cabbage to fall over, resulting in the death of the tree.

Specimens of leaves, roots, stems, petioles, &c., were taken from a considerable number of diseased trees for examination and for cultural and infection experiments. Although it has been impossible to establish with certainty the whole of the life history of the fungus in the short time that has been given to the study of this disease, yet some interesting points have been established.

Microscopic examination of diseased roots was made in longitudinal and transverse sections. At once it was noticed that the cortex of the roots was abnormal.

In a diseased root, the walls of the cortex cells appear to be shrunken and the cells are turgid no longer. Between the walls of consecutive cells can be seen large dark-coloured septate threads of a fungus mycelium, while many of the cells themselves have become invaded by the same. When a cortex cell is threatened by the approach of a fungal thread, its cell contents appear to be altered, for large yellowish globules make their appearance. Whether these have been produced by the cell itself as a means of protection against the fungus, or whether they are the result of decomposition could not be determined, but after the mycelium has gained an entrance into the cell, these globules as well as all the other cell contents are destroyed and absorbed.

The mycelium of the fungus spreads from one cell to another by piercing through the cell walls, and soon obtains an entrance into the thin-walled cells of the central cylinder and eventually into the vessels themselves.

The red discolouration of the stem was carefully examined microscopically, but except in the case of trees that were very badly diseased, few mycelial threads could be detected. These in the advanced cases were similar to those noted in the roots, but I am of opinion that the red discolouration is primarily due to the disorganization of normal changes in the stem through the stoppage of supplies from the roots, rather than to any effect of the small amount of fungal mycelium found in diseased stems.

PETIOLES.—It was observed that almost without exception, the petioles of the leaves of badly diseased trees showed a large number of minute ruptures of the epidermis, after they had died and had fallen to the ground. The petioles in varying stages of disease were therefore submitted to a careful microscopic examination, and it was observed that a mycelium of a fungus was found in all diseased petioles.

The point of the first attack could not be determined, but it would appear that the petiole, just where it expands to ensheath the stem of the tree, is the part where the effect of the fungus is first noticed. The whole petiole gradually assumes a blackish colour, the leaflets become brown, and eventually on the dead petioles minute ruptures take place in the epidermis of the petiole just where it begins to expand before joining the stem. These give off a black powdery dust, which consists of spores of two kinds—one, single-celled and colourless, and the other two-celled and brown.

The two-celled spores suggested that the fungus belonged to the genus *Botryodiplodia*, and therefore specimens were forwarded to Dr. N Patouillard, who has recently described several new specimens of fungi on coconuts from French Polynesia for identification and he reports as follows :—

"I have examined the specimens of parasitic fungi on petioles of coconut.

The epidermis is raised and split up but covers the fungus. Out of the slit a black powder which is formed of brown uniseptate spores protrudes. If a section is made through the wart-like pustules, there is found under the skin a black cellular stroma, filled with several lockets. These spaces are filled with colourless nonseptate spores. If these are placed in a damp chamber, in about 24-36 hours germination takes place. The colourless spores are therefore adult and mature. If we consider the fungus in respect to its hyaline spores it must be considered a *Cystospora* (a large genus) or better a *Fusicoccum*.

If the brown septate spores really belong to it and are the final end of the development, the fungus will be a *Botryodiplodia*. It remains then to establish that these last belong to the fungus. It is very probable but not proved."

In working out the life history of the fungus, it has frequently been noticed that the colourless spores become brownish in colour and afterwards become septate. Considering that no difference can be noted in the mycelia produced by the two fungi, that the wart-like pustules bear both kinds of spores, and that the colourless cells have been observed to be divided by a single septum, I am of opinion that there is sufficient evidence to conclude that the septate brown spores are the final results (the colourless unicellular cells being the forerunners), and that therefore the fungus must be considered as a species of *Botryodiplodia*.

The damage caused by the fungus in the roots of the disorganisation of the cortex cells has been observed, and therefore the effect this has on the cocount plant may clearly be understood. The roots of a healthy plant conduct the water and food in solution from the soil to the leaves, and therefore, when the fungus has destroyed a large number of roots, a reduction in the water-absorbing power of the root system takes place. There are, however, few economic plants that so quickly repair damage to roots as the Palmæ, and, therefore, the seat of the injury must extend through a large number of roots before it is of any consequence.

When a large number of roots are diseased, the water, etc., is absorbed in gradually decreasing quantities, and consequently less food substances are elaborated.

Young trees do not appear to suffer o any considerable extent, for numerous instances have been noticed of young plants having quite a healthy appearance, while a number of the roots were in a diseased condition.

When, however, the fruiting period comes on, a large drain is made upon the tree. It is taxed very highly and, if the roots are diseased, wilting or yellowing of the leaves is noticed. It was observed that trees that were just coming into bearing were the most liable to succumb, although many old trees were in a diseased condition.

When the root system, reduced in extent by the action of the fungus, is incapable of supplying the needs of the plant, the leaves commence to roll up so as to reduce evaporation. Subsequently the leaves do not obtain sufficient water to keep their tissues alive, and then they gradually begin to turn yellow and to dry up, the leaves are, therefore, unable to carry on their functions, and the whole mechanism is thrown out of action. The general appearance of the plant is that of one suffering from 'drought.'

The petioles of the leaves are also filled with fungus mycelium. This may be noticed in all dying leaves, for their petioles are blackish in colour. No instance has been found of the mycelium passing from the petioles into the stems of the trees, and if a section be cut through a terminal bud of a freshly diseased tree, a sharp

line of demarcation will be noticed between the diseased petioles and the healthy bud. This mycelium cuts off much food to and from the leaf, and therefore assists in the general disorganization of the functions of several parts of the plant.

The general opinion of the planters of coconuts was that this disease is due to the weakness of the plants produced by the setting of immature nuts. In some districts histories of weather-beaten cargoes of green nuts been driven on the shores and the nuts used for planting purposes were held out as the cause of the trouble. This disease, however, is not limited to a few scattered trees, and evidence distinctly points to its being infectious. A tree that has become attacked by the disease is sooner or later surrounded by a large number of others showing signs of the disease. In one portion of the Cedros district, the disease has been noticed making its way gradually into other fields of coconut further South. It is, therefore, impossible to believe that the large areas of coconuts in Cocorite, Laventille, Guapo, Cedros, and the interlands of Mayaro were planted with immature nuts.

Moreover, the fungus found in the roots and in the petioles of diseased trees is capable of attacking vigorous trees; but anything which tended to reduce their vitality would considerably help along the fungus. Circumstances which retard growth, both of the root and shoot system, give the root fungus a much better chance. This was conspicuously brought to my notice on a portion of an estate in the Cedros district. A low-lying hollow showed that a large quantity of water was present in the soil. Such a condition was unfavourable to good development of the trees; they were stunted in growth and showed that root development was not very large. The clayey impervious nature of the soil suggested that an elaborate system of drainage was needed in order to procure the æration necessary for vigorous plant growth. In this hollow most of the trees had died out very rapidly, and the disease had soon spread from this portion of the estate to other parts where the soil conditions were very much more favourable. Trees on sandy soil on higher ridges were often noticed to be attacked, but it is generally in low-lying undrained hollows that the disease is the worst. This is also seen in the Guapo and Mayaro districts.

These examples should suffice to show how natural peculiarities of an estate and other physical features affect the disease, but these alone cannot be sufficient to cause the death of the trees, as is often urged. The characters of the soil affect the growth of the plant, and they may also affect the fungus, and therefore it is necessary to keep the condition of the soil as good as possible, in order that it may be favourable to the growth of the plant.

It is also commonly stated that lack of cultivation and manuring is the cause of the trouble, and it should not be forgotten that every effort to improve the condition of the soil and render it better adapted to the healthy and vigorous growth of the root system may be a blow at the fungus, for some of the new roots would certainly go to replace those destroyed by the parasite.

The presence of a parasitic fungus in the roots and in the petioles must, therefore, be held to be the cause of the disease, and improvements in cultivation, drainage, manuring, etc., should be practised as they possibly may affect the disease indirectly by rendering the coconut plants more capable of withstanding its attacks.

The distribution of this disease apears to be fairly general throughout the coconut districts, and considerable loss has been experienced in the southern end of the island.

The aggregate injury throughout the colony must be very considerable, but it is only in a few localities that serious loss has been experienced.

Numerous instances have been seen where diseased trees just coming into bearing have succumbed, and signs of old stumps surrounding them have been noticed. These examples would bear out the opinion of Mr. Hart that the disease has been present in the colony for a considerable time.

It is only recently that it has assumed dangerous proportions. On one estate alone in the Cedros district, out of a total of 25,000 trees, 3,000 have been cut down within the last twelve months, and many more are either dead or in a diseased condition, and in many other places the disease is already a serious annoyance.

There is undoubtedly danger of further spread. This danger is emphasized by the recent rapid spread through some estates in the Cedros district, and if conditions favour its development and proper remedial measures are not taken to check it, the coconut industry of Trinidad will materially suffer.

Already some of the smaller proprietors are beginning to feel the loss of returns, and this loss will be felt the more severely if the present prices for coconut and their products do not hold.

Samples of soil from around the roots of diseased trees have been investigated microscopically, and sterile mycelium, which appeared to agree with that found inside diseased roots, was present in them. This would suggest that the mycelium is capable of spreading through the soil. This mycelium may be capable of attacking and killing the younger rootlets and then entering into the larger ones. The entry of the mycelium into the roots is still an unsolved problem, but evidence tends to show that the larger roots first show signs of infection where the small rootlets join them. In no case has the mycelium been noticed on the exterior of the roots, and it would seem that it has to depend upon the rot of the smaller roots for its distribution.

The roots of several young supplies that were planted upon or near to the place where diseased trees have been removed, showed on examination, the presence of a mycelium within them but not in sufficient quantities to cause their death. This indicates that infection can take place through mycelium.

It would appear to be probable that the disease may spread :—

(1) By mycelium through the soil from root to root.

(2) By spores blown from tree to tree.

(3) By germinating tubes of spores from petioles attacking either the roots of the same tree or the roots of another.

(4) By germinating "chlamydospores" from decaying petioles.

The best conditions for the germination of the spores depend upon the presence of suitable quantities of air and moisture, and the spread of the disease would be expected to be most rapid when the conditions are the most favourable. The distribution of fungus spores by wind and rain will be dealt with more fully under the leaf disease and, therefore, will not be discussed here.

The spread of mycelium in the soil depends a good deal upon the cultivation. Any condition of the soil that is unfavourable to the coconut may favour the root disease by hindering free root development. Excessive moisture and excessive drought may be favouring conditions for the disease. The latter cannot be remedied except by irrigation, and does not appear to be a factor of any importance in this disease. The former, excessive moisture, is noticeable in many of the low-lying portions of the States. In these hollows, the soil is often of a clayey nature—impervious to water—and, therefore, many of the air spaces between the soil particles are replaced by water. The normal working and growth of the root is interfered with, and the destruction of such roots by fungal mycelium may speedily follow. The effects of excessive moisture can be lessened by careful attention to drainage and to the mechanical condition of the soil.

The present system of cultivation of coconuts in Trinidad could be improved, and the attention of all growers of coconuts should be drawn to the progressive German colonists and to the Americans in the Philippines, where modern orchard methods are being successfully practised in the treatment of coconut estates, as improved cultivation would tend to retard the spread of disease.

Although the complete life-history of the fungus and its method of spread is not yet known with certainty, it would appear that owing to its habit in penetrating and spreading in the living tissues of the root of the host plant, cure is practically outside the question where a large majority of the roots are permeated with mycelium, and therefore it is probable that only the most drastic measures are likely to provide pemanent relief.

It cannot be expected that the disease can be entirely eradicated, but, by a method of what is known as "stamping out," the amount of disease may materially be reduced and the fungus kept in check.

There are six principal ways in which we may hope to attack this disease. They are:—

(1) Destruction of all diseased material.

(2) Isolation of diseased areas.

(3) Resting of infected land before planting 'supplies.'

(4) Spraying and application of chemicals.

(5) Improved cultivation and drainage.

(6) Searching for and propagating disease-resistant varieties.—*Bulletin of the Department of Agriculture, Jamaica*, pp. 114/22, June and July, 1907.

TREATMENT OF FUNGUS DISEASES.

In previous numbers of the Agricultural News, and in other publications of the Imperial Department of Agriculture, the attention of planters in the West Indies has repeatedly been drawn to the principal fungus diseases that affect their crops. It is here proposed to give a brief account of the methods that are commonly adopted for the prevention of the occurrence and spread of fungus parasites.

Improved methods of investigation have resulted in a vastly increased knowledge of the nature and causes of disease, and there has also been a corresponding advance in the treatments adopted for its prevention. In the control of many fungus parasites remarkable success has been obtained. Some of the methods have received a wide application, and should by this time have secured the confidence of the planter.

The chief points to be continually kept in mind when discussing the general treatment of fungus diseases may be classed under six heads: (1) care in cultural operations and in the destruction of all diseased plant tissues; (2) spraying and soaking in disinfectants for destruction of parasites; (3) rotation of crops; (4) raising and propagating disease resistant varieties; (5) avoiding the introduction of new plants from disease-affected localities; (6) use of good, healthy seed.

(1) Probably the most common source of plant infection arises through not promptly destroying all portions of plants that have become diseased. Such serve as centres of infection, and if they are allowed to remain, the fungi produce large quantities of spores that may infect healthy areas. The best method for the destruction of such diseased material is, of course, by burning; and this should be adopted whenever possible. Those plants or portions of plants that will not satisfactorily burn should be buried with lime—on no account should they be left lying about. It has always been recommended that all diseased cacao pods, as

well as the husks or shells of healthy pods, should be buried, and it has further been advised that all dead fruits from the cacao tree, whether diseased or not, should be systematically collected, and included in the general burial (Agricultural News, Vol. VI, p. 174). Where such methods have been adopted, considerable prevention of "pod disease" has undoubtedly resulted.

Investigation into the disease affecting the coconut palm in Trinidad has also emphasized the necessity of keeping plantations as free as possible from dead or diseased trees, and it would appear that wherever careful sanitary methods have been adopted, the spread of the diseases has been considerably checked. Many other diseases might be instanced under this heading, but it is only necessary to direct the attention of planters to "canker," "die back," and "thread" disease of cacao; "anthracose" of cotton; and "root disease" of sugar-cane, as instances of diseases that can be controlled with fair success by care in cultural operations. Canker of cacao is caused by a wound parasite, and makes itself the more noticeable on such estates where pruning is not carefully carried out. As much "canker," "die back," and "thread blight" as possible should be cut out during pruning operations, and portions of estates that are at all badly affected should receive special attention. "Anthracnose" of cotton may be induced somewhat by too close planting, whereas the "root disease" of sugar-cane can be prevented, to a certain extent, by care in cultivation, and in the treatment of cane cuttings as recommended by the Imperial Department of Agriculture.

(2) For the destruction of fungus parasites without injuring the host-plant, the disinfection of cotton seed in corrosive sublimate may be taken as an example. Spores of "anthracnose" have frequently been observed in the lint that remains attached to the seeds after ginning. These, if allowed to remain, might cause loss amongst the cotton in the seedling stage, but as recommended by the Imperial Department of Agriculture, they can be efficiently destroyed without damaging the germinating power of the seed, by soaking in a one-part-per-thousand solution of corrosive sublimate for twenty minutes. It might also be suggested that similar disinfection might be successfully adopted in respect to other seeds of economic value, at the time they are being shipped from one country to another. For the destruction of superficial vegetative portions of parasites or their productive spores, spraying with fungicides is of value. This, however, should rather be used as a preventive. The spread of much of the disease to be found in cacao estates might probably be prevented if spraying with fungicides—such as Bordeaux mixture—were adopted as an estate duty.

(3) Rotation of crops is to be recommended for the purpose of checking disease, especially when the disease is present in the form of mycelium or resting spores in the soil. The fungus that causes the root disease may frequently be successfully starved out by a rotation of crops. With permanent crops such as cacao, rotation cannot be practised; but in such cases root diseases may be prevented from spreading if the infested area is isolated by digging trenches. The disease is thereby confined in extent. Such areas should be cleared, the affected trees dug up and destroyed, and the soil treated with quantities of lime in order to kill out some, if not all, of the mycelium of the fungus. After the ground has been allowed to rest for some time, and has been carefully cultivated, fresh supplies may be planted with little fear of their being attacked.

(4) The raising of the disease-resisting varieties of plants has recently become recognized as a matter of considerable importance. Many of the seedling sugar-canes that have been raised by this department are capable of withstanding certain fungus diseases much better than the older varieties, and the wilt disease of cotton and cowpea has been successfully overcome in the United States by

selecting immune varieties. Workers in the breeding of improved varieties have long been endeavouring to obtain definite information in respect to disease resistance, and it would now appear that evidence has been obtained by the experimentalists of Cambridge University, which should make it possible to breed with certain varieties of cereals immune to certain diseases. Experiments have this year been laid out in Barbadoes in respect to the breeding of sugar-canes, with the view of ascertaining whether similar methods may be adopted for the production of disease-resistant varieties of sugar-cane.

(5) Plants from disease-affected localities should be as far as possible avoided for planting purposes, as it has often resulted in the introduction of new fungoid diseases. Most of the West India Islands now have laws preventing the importation of plants from countries known to be affected by disease, and most plants are disinfected at the port of entry.

(6) Good seed for planting purposes should always be chosen, and it need only be mentioned that much disease of sugar-cane has in the past been due to the choice of bad plants, to impress upon planters the necessity of using only carefully chosen seed.—*Agricultural News of the Imperial Department of Agriculture for the West Indies*, Vol. VI. No. 143, October 19th, 1907.

SCIENTIFIC AGRICULTURE.

Some Factors Influencing Soil Fertility.

By C. Drieberg.

This is the title of a recent Bulletin issued by the United States Department of Agriculture.

The Excretory Theory of de Candolle is one which every student of Agriculture is familiar with, and its temporary acceptance and final rejection by the scientific and practical agriculturists of the day is a matter of history. At intervals, since that time, attempts have been made to revive de Candolle's theory, and those who remember the time when coffee-leaf disease spread devastation in the planting districts, and the efforts made to fight the fungus, will recall how the excretory theory was conjured up to explain the failure of the then staple industry of the Island.

It is somewhat astounding, therefore, in this twentieth century to find that the conclusions of scientific workers is tending to confirm the findings of an old-time scientist whose theory was supposed to be as dead as Queen Anne! But such is the case, and the researches of Messrs. Schreiner and Reed have shown a definite tendency in that direction. There is, however, this to be said, viz., that de Candolle and his followers failed to recognise the agencies responsible for the destruction of such organic substances as corresponded with the "Excreta" of the theory, and inclined to the belief that once a crop had made the soil noxious through its excretions, it would always remain so as regards that particular crop.

The infertility of soils is, according to our experimenters, mainly attributable to *toxic* substances, organic in their nature, in the soil, transmitted to it—partly if not wholly—by growing plants. It is a common experience to find that the continual growth of a particular crop on the same land results in a diminished yield. The results of research now goes to prove that the diminished yields are not due primarily to the exhaustion of plant food, but to the toxic substances given off by the plants. This has been demonstrated even in the case of highly-enriched garden soils that failed to grow crops which at one time flourished on them.

It has also been found that not only is there a deleterious influence exerted by a growing plant upon its own kind, but, in certain cases, upon a totally different kind of plant. (This would point to the necessity of avoiding such successions in a rotation). To put it another way, some forms of vegetation are antagonistic to others—a condition directly opposed to the symbiotic relation characteristic of certain forms of vegetation. Such conditions are calculated to well nigh bewilder the practical agriculturist and impress him with the complexity of the study of the plant and the soil which are his care. One instance may be given in illustration of this antagonism in vegetable life. In the Woburn Experimental Fruit Farm it was found that young apple trees suffered seriously when grass was allowed to grow about them. After ruling out that such injury was due to removal of plant food, loss of moisture, exclusion of oxygen from the soil, &c., it was proved to satisfaction, as the result of seven years' research, that there was no evidence of root parasitism, but that the deleterious action of the grass was of an actually malignant character akin to that of direct poisoning. We are here reminded of the late Mr. William Jardine's contention, viz., that coconuts, especially young coconuts, did twice as well on bare land as on sward. Instances of converse deleterious action, viz., of tree roots on herbaceous plants are also cited, and go to confirm our own gardening experience in similar conditions.

In the experiments carried out in the continuous growth of one kind of crop, it was discovered that it was possible to maintain the yield by the application of, materials not primarily valuable on account of the plant-food they contained. Lime and green manure, for instance, were found more efficient in maintaining the yield than special fertilizers providing easily available nitrogen, phosphoric acid and potash. (In the laboratory experiments pyrogallol, ferric carbonate, carbon black and calcium carbonate neutralised the toxic properties in soil—either by rendering the deleterious substance insoluble or by producing more abstruse chemical changes.) Further, it was found that when the organic excretions in a soil are subjected to the action of air or micro-organisms, the soil conditions were considerably improved. Oxidation brought about by proper cultivation, the encouragement of soil bacteria, and the oxidising power of the roots themselves, are all important factors in this connection.

In average soils which are kept in what is ordinarily known as "good tilth" and subjected to a proper system of rotation, there is thus much less tendency for toxic excretions to accumulate to an extent that would be harmful. Where, however, soils are of poor physical condition—unusually wet or dry and poor also in organic matter—the continuous growth of one crop is most liable to failure by the accumulation of deleterious substances. Another fact brought out by experiments is that stable manure exerts a beneficial action in overcoming the toxic action of our unproductive soil.

In a word then, according to the present state of knowledge, we must regard the excreta of growing plants as among the main causes of the low yields obtained in imperfect cultivation and rotation (*e.g.*, in Ceylon Rice fields). On the other hand, it must be admitted that certain soils, influenced perhaps by climatic environments, are able to overcome the action of toxic excretions and produce undiminished yields of the same crop year after year.

The practical conclusions to be drawn from these researches are too obvious to need pointing out, while it is equally clear that on the intelligent and methodical work of the cultivator will depend to a very great extent the fertility of his soil.

THE AGRICULTURAL USES OF SALT.

Agriculture, as well as other industries, to be successful should be pursued upon scientific principles; otherwise, no matter how much care and skill a farmer may have exercised upon his land if the conditions which tend to fertility have not been observed, he can only be rewarded inadequately for his efforts.

The most important and necessary conditions of fertility are not always secured by using ordinary manures. This is especially the case when the seasons are irregular, at which time other fertilising agents are certainly requisite.

Salt is quite as essential to healthy condition of vegetable as of animal life, and that it serves the purpose of a fertiliser admirably has been proved by the experience of thousands of agriculturists.

The use of salt for agricultural purposes is by no means recent, as is evidenced by the fact that the Romans and Chinese used it as a fertiliser for centuries before the Christian era. Why its use has been so much neglected and undervalued in the nineteenth century is a mystery to many scientific men.

The probable explanation is that the use of salt was interrupted by the prohibitive tax which was formerly placed upon it. Now that it can be obtained so easily and cheaply, the value of its great properties may be expected to become more generally appreciated. Another reason for the limited use of salt for fertilisation probably is, that its action in the soil is not fully understood. Below is given briefly

some information on the subject, and it is confidently believed that, where a fair and patient trial is given, the results cannot fail to prove satisfactory.

A PROVIDER OF PLANT FOOD.

It has been proved by experiments that the solvent powers of salt in solution are twenty times greater than those of rainwater for breaking up the soil and setting its constituents free and available. Salt may therefore be described as a powerful chemical agent for providing and preparing soluble food for plants from the materials present in the soil. This is a most important consideration when we remember that in all soils there are about two-thirds lying dormant, and only one-third in an active condition. Being a disintegrator, salt makes stubborn soils easier to work if applied just before the land is broken up. In all cases salt hastens weathering, and keeps the soils soft in frosty weather.

AN ABSORBENT.

Salt not only absorbs moisture from the atmosphere, but retains such moisture in the soils, thus compensating for a deficiency of rain.

In accordance with well-known action of the fixed alkalies, it is also believed that soils which contain a sufficiency of salt absorb a certain amount of ammonia from the atmosphere, by which the nitrogenous plant food is increased; in other words azotised manures are rendered more effectual.

Reports have come to hand from many quarters that the best crops were found where salt was applied early in 1896 before the drought.

A PURIFIER AND CLEANSER.

Salt purifies and cleanses the land by decomposing all inert matter, neutralising sourness, and assisting in the circulation of stagnant water.

A DESTROYER OF WEEDS AND INSECTS.

A heavy dressing of salt is the most effectual means of exterminating weeds and insects. Autumn applications are strongly recommended for this purpose. In some cases 7 cwt., but in the majority of cases 10 cwt., per acre, is necessary to destroy wireworms and deeply rooted weeds.

SALT IMPROVES GRASS LAND AND RENOVATES OLD PASTURES.

From 5 to 10 cwt. of salt per acre, according to soil, and in average cases 10 cwt. per acre, sown broadcast, either in Autumn or early Spring, has an excellent effect, making sour grasses sweet and palatable for cattle and sheep. Old "foggy" pastures, where there are quantities of rough grass and coarse herbage, are wonderfully improved by liberal applications of salt. Owing to their fondness for salt, the animals crop the grass closely, with the result that a finer and sweeter herbage springs up. Ground rocksalt is often used for this purpose.

SUCCESSFUL EXPERIMENTS WITH SALT IN CULTIVATION OF GRAIN CROPS.

The results of experiments conducted by the Bath and West of England Society upon twenty-five farms in nine countries are summed up in the Society's journal as follows:—

"As a general rule the salt plots produced a better sample of corn, with decidedly stiffer and stronger straw. In some instances, the crop on the plots without salt (though not heavier) was much laid, while that on the salt plots stood up well. Mr. Ashcroft, a careful observer and one of our most valued experimenters, says: The corn on the unmanured plots was the most uneven of the three samples, and the salt plots have an advantage over the unsalted, in colour, evenness and size of grain, by, I should say, quite 2s. per quarter. The salt makes the grain and straw perceptibly whiter. I am convinced, from four years' experience, that it is the right thing to add."

FLAX.

In the cultivation of flax salt has proved to be very useful and necessary, the effect of salt being noticeable both in seed and fibre. The general rule is to apply from 2 to 4 cwt. per acre.

TURNIPS, MANGOLDS, AND BEETROOT.

These root crops are all benefited by the application of salt, in quality as well as in quantity. It is considered to be the surest preventive of turnip fly and mildew. Mangolds keep better, and are in other respects superior when salt is used. Beets thrive in a marked degree when they get sufficient salt in the early stages of their growth. Mixing salt with farmyard manure is a good plan, but top dressings when the plants are fairly up, are often beneficial.

SALT FOR GARDENS AND ORCHARDS.

When applied early in Spring to gardens and orchards, at the rate of 2 ounces per square yard or 6 cwt. per acre, salt has been found beneficial to all vegetables and fruit trees, especially Peach, Cherry, and Apple trees, as well as to flowers. Many practical gardeners recommend salt for the stock, Hyacinth, Amaryllis, Iris, Anemone, Colchicum, Narcissus, and Ranunculus, &c. A heavier dressing of salt is required for Seakale and Asparagus, both sea side plants. One per cent. solutions are generally recommended for fruits and flowers.

AMERICAN TESTIMONY AS TO THE FERTILISING VALUE OF SALT.

(Reprinted by permission from the " Cultivator and Country Gentleman." Albany, N.Y., U.S.A.)

We will accept Professor S. W. Johnson as one who is familiar with Agricultural Chemistry, and here is what he gives us on this point :—

The Ash of—	Per cent. Soda	Chlorine.
Hay contains	7·0	8·0
Oats	4·4	4·4
Barley	1·7	5·6
Wheat	1·9	5·3
Rye	1 5	4·3
Clover	1·5	5·4
White Clover	7·8	3·2
Beets	14·7	6·6
Beet Leaves	21·0	11·3
Sugar Beets	9·6	2·0
Turnips	11·4	4·1
Carrots	22·0	7·1
Rape	10·3	12·4

These are specimen figures of common crops, and there is not one in the full category that might not be given if it were needed, to show that these two substances are indispensable to the growth of all plants, as must be the case, or there would be no animals living ; for salt is essential to animal life and animals feed on vegetables directly or indirectly.

Then it follows that as a plant will not grow unless every element in it is supplied, and as it is the case that ages of washing of the soil by rains and floods

have carried into the ocean most of the salt that was in it at the first, it is indispensable that some be given occasionally to supply the needs of the crops.

Experience has shown that salt is useful to almost every crop. Some will not yield much at all without it. I have always given my root crops as much as 600 lb. per acre, and I have doubled the yield of grass and clover by the use of 200 lb. of it, and oats and barley are both improved by the same quantity.

H. STEWART.

We are indebted to the same paper for the following extracts concerning

SALT AS A POTATO MANURE.

On my shore, in the water, there is an annual rank growth of what is known as sea ore, that in summer grows so thick as to make it no easy job to get a boat through it. For years I watched the effect of this, spread on the gardens and potato patches of oystermen, who collect it, and with a wheelbarrow take it to their gardens, a mile off, and spread the ore, wringing wet with salt water, and really the effect is wonderful; and it is the chief manure that many use to raise potatoes. I doubted the value of it, but seeing is convincing, and every man, woman, and boy of the neighbourhood knew full well its virtue.

Since writing the above, I have spoken with a number of practical and successful farmers from the potato region of the Eastern Shore, and they more than confirm the story of the great results from the use of salt on their potatoes, and surprise me by stating how much is used—not by the carload, but by the hundred carloads, sent to two small countries on the shore.—Mr. A. P. SHARP, in "Albany Cultivator and Country Gentleman."

POTATOES, CABBAGE, AND CARROTS.

Potato disease may generally be checked or prevented by a judicious use of salt which also acts as a solvent of potash compounds, and keeps off the grubs, Cabbages and carrots require 3 to 7 cwt. salt per acre in proportion to the lightness of the soil. Kohl rabi requires similar quantities.

SAVE THE AMMONIA BY SALTING MANURE HEAPS.

In moderate quantities, salt promotes decomposition of vegetable matter but still more important is its power of checking rapid fermentation and preventing the escape of ammonia. At the same time salt destroys immense numbers of insects which propagate in the manure heap.

SALT AND NIGHTSOIL.

Where nightsoil or house refuse is used as manure, it should always be mixed with salt, which destroys any organic life therein, and by chemical action makes the manure more valuable.

THE APPLICATION OF SALT.

As to the application of salt, it is difficult to lay down hard and fast rules, as so much depends upon the condition of the soil and the season. Several applications in moderate quantities give better results in most cases than a heavy application at one time. Many experienced agriculturists apply 5 cwt. per acre in Autumn, and the same quantity in Spring.

The quantities given below, however, may be useful as a general guide, and in all special cases we shall have much pleasure in advising.

TABLE OF QUANTITIES OF SALT WHICH MAY BE APPLIED TO AVERAGE LIGHT, MEDIUM AND HEAVY SOILS.

Crops.	Cwts. per Statute Acre.						Suitable Time and Mode of Application.
	Light Soil.		Medium Soil.		Heavy Soil.		
Wheat	5	to 6	4	to 5	3	to 4	Autumn or Spring before seed-time. Top-dressing in Spring.
Oats	6	7	5	6	4	5	
Barley	6	7	5	6	4	5	
Rye	7	8	6	7	5	6	
Peas and Beans ...	8	9	7	8	6	7	Soon after sowing.
Hops	6	7	5	6	4	5	November or December. Mix with other manure.
Flax	3	4	2	3	1	2	Month before seed-time.
Potatoes	7	8	6	7	5	6	Broadcast, two or three weeks before planting.
Turnips	9	10	7	8	4	5	Month before sowing. Top-dressings recommended.
Mangolds and Beets ...	10	12	8	10	6	8	
Carrots and Cabbages	7	8	5	6	3	4	Early in Spring.
Grasses and Pastures	10	12	8	10	6	8	Autumn and Top-dressings in May and June.
Fallows	12	14	10	12	8	10	Just before ploughing.

GENERAL OBSERVATIONS.

1. Salt should not, as a rule, be applied with the seed. A little salt is sometimes mixed with carrot seed, an exception to the above rule.

2. It is not advisable to apply salt to very cold, wet clay land. Salt nevertheless assists in the disintegration of clays, if applied before ploughing.

3. One of the principal reasons given by scientific authorities for the application of salt more or less to all soils is based upon the fact that Chloride of Sodium, like other soluble salt is constantly being carried off the land into the rivers and seas. If the soil is to be kept fertile, this unavoidable loss must be replaced. Bearing in mind the above-mentioned fact, it will be seen that those who think the land near sea coasts does not require salt are in error, as the small amount of salt carried a short distance by sea breezes bears no comparison with the quantity carried away.

4. As a guide to those who wish to make experiments, we may say that a fair average quantity is two ounces of salt per square yard. A rough calculation is one handful to each square yard.

5. Salt has for a long time been a stock ingredient of many high priced fertilisers, and in this way farmers have paid double and treble the market price for it. Salt undoubtedly assists other manures, and some of them cannot act without it; but as a matter of economy it is best to buy the salt separately, at market price, and mix it afterwards, if desired.

6. Two cwts. of salt to 1 cwt. of nitrate of soda, 1 cwt. salt to 2 cwts. lime, equal quantities of salt with basic slag, guano, and superphosphates, are usual proportions. Kainit generally contains about one-third common salt, and in a report of recent experiments at Reading it is stated that "An equivalent amount of salt to that contained in the Kainit dressing has been equally effective."

7. Salt encourages the growth of mushrooms, and is largely used in some districts for that purpose. The liberal use of salt in old pastures where horses are kept produces so large a crop of mushrooms that a new and most profitable agricultural industry is opened up.

SALT THE BEST OF CONDIMENTS.

Do you give your livestock sufficient salt? It is surprising that although salt cellars are placed regularly upon our tables, our domestic animals are in this respect neglected. Animals require their salt quite as much as we do, and it is a refinement of cruelty to deprive them of it. Every meadow, every farmyard, every stable, every shippen, should be provided with the equivalent of our salt cellar in the shape of lumps of rocksalt. Horses, cattle, and sheep are equally fond of salt, and suffer if it is not supplied them. Wild animals travel immense distances in search of salt. Salt marshes are the favourite pastures. The desire for this natural condiment is therefore instinctive. Salt is admittedly the surest preventive of rot in sheep and other diseases. By improving the appetite, salt hastens fattening. A properly salted diet has a marked effect upon the condition and appearances of horses, giving a finer and smoother coat. An excellent preventive of gall is to bathe the horse's shoulders each evening with salt water. Wash the shoulders with clear water first. It cools and reduces inflammation.

The following reasons why salt should be regularly supplied to farm stock are given in an able and comprehensive article entitled "The Importance of salt as an article of Diet," by Professor A. P. Aitken, D.Sc., in the *Veterinarian*.

1. Because in the blood of animals there is six or seven times more sodium than potassium, and that the composition of the blood is constant.

2. To keep animals in good health a definite amount of common salt must be assimilated.

3. The excess of potassium salts in vegetable foods causes by chemical exchange an abnormal loss of common salt. This is proved by the fact that the craving of an animal for common salt is most noticeable when the food contains a large proportion of potassium salts, such as wheat, barley, oats, potatoes, beans, and peas.

4. The addition of salt to animal food increases the appetite, promotes the repair of tissue by its searching diffusion through the body, and stimulates the rapid using up of its waste products.

5. Boussingault's experiments showed that salt increases muscular vigour and activity, and improves their general appearance and condition.

MILK PRODUCTION AND SALT.

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"Free access to salt is advantageous to livestock, a fact which has not been so widely accepted as could have been expected. It is regarded generally as important from a health point of view, but it is doubtful whether many are aware of the influence which salt may have on the production of milk. If a cow is in good and sturdy health, it may be expected to produce more and better milk than an animal in poor condition. Experiments have recently been made to ascertain whether the giving of salt to dairy cows has any direct bearing on the supply of milk, and the results have been of a character which will be surprising to many who attach little importance to providing salt for their cattle. Salt they must have in some form or other, and if it is supplied to them in suitable quantities and ways, they will take sufficient and no more for their own benefit. For about a month, from June 20th to July 18th, three cows were kept without salt, and the milk from each weighed twice daily from the 4th to 18th July, when they gave 454 lb. From July 18th to August 1st the same cows received 4 oz. of salt each, and during that time the milk showed an increase of 110 lb.; the weight being 564 lb. From this experiment it appears that there was a considerable gain, which would pay admirably anyone to keep his stock well supplied with salt; and it may also be added as another good custom to

follow, to keep plenty of fresh water where it can be always accessible. Whilst the salt costs less than ½d., the increase of milk was worth from 6s. to 7s., a very large profit on an insignificant outlay. It may be that nobody who begins to place salt regularly before his stock may find such a large profit result from it as in this case, but it is more than likely that he may improve their condition to such an extent that the milk secretion will increase, and he will gain some profit from it, even if not to the large extent which is shown by this experiment."

SWEETENING FODDER.

For sweetening and preserving fodder, and to prevent hay from fermenting and becoming mouldy when stacked, the antiseptic properties of salt make it a most valuable remedy. Sprinkle salt over every layer of 2 ft. in the central part of the stack. Coarse salt is the best for this purpose.

SALT FOR DAIRY PURPOSES.

Too much care and judgement cannot be exercised in choosing salt for dairy purposes, as upon this depends, to a large extent, the saleable appearance and keeping quality of the products. A suitable quality of salt dissolves quickly without leaving behind a particle of "grit," and the butter or cheese will have a uniform taste and flavour. The "Ashton," "Eureka," "Yeoman," "Falcon," and "Black Horse," brands of dairy salt are undoubtedly the most approved.—*Indian Agriculturist*, Vol. XXXII, No. 10, October, 1907.

PRINCIPLES OF TILLAGE AND ROTATION.

BY WM. H. DAY, B.A., *Lecturer in Physics.*

It is the chief purpose of tillage to improve the condition of the soil in order that it may the better minister to the plant, which needs moisture, air, warmth food, and proper sanitary environment.

Perhaps the most important factor in crop production is the proper supply of moisture, for on this depend all the others. If the water is excessive, the soil is cold and germination and growth slow, air cannot reach the roots, and the plant suffocates, grows sickly, and refuses to assimilate the food. If, on the other hand, the water is insufficient, no amount of air, warmth or food can avail to produce a crop. Hence we shall notice first, tillage in relation to soil moisture.

It may be well at this juncture to inquire, "Whence do crops draw their supply of moisture? Do they draw it mainly from the rains that fall throughout the growing season, or do they draw it rather from the store of water in the soil beneath, accumulated there from the April showers, the snows of winter, and the rains of autumn?" This is a vital point, on it hangs the whole question of cultivation. If the supply is drawn mainly from the summer rains, then our cultivation must be such that the soil will absorb quickly the water of those summer rains, and rid itself quickly of the surplus; if it is drawn mainly from the spring, winter and autumn precipitation, then our cultivation must be varied accordingly. Whether they draw from the summer or winter precipitation, depends to a certain extent upon the season. During a very wet season plants feed largely upon current rains; but during a moderate or dry season they have to draw from the store below, because the evaporation from the soil and the transpiration by the plant exceed the amount of rainfall while the plants are growing. Let me give you here the result of a little test we have made on this point. Last year was a rather dry season. We sowed wheat, peas, barley, and oats in four-gallon crocks, and set them outside where they received all the rain that fell during their period of growth, but this was found insufficient, and the crocks were watered at

intervals as necessary. The results were as follows :—

TABLE SHOWING RAINFALL AND DEPTH OF WATER IN INCHES USED BY CROPS DURING A DRY SEASON.

Crop.	Depth of rain while crop was growing.	Depth of water added.	Total depth of water used by crops.	Total depth compared with rainfall.
Wheat ...	10·51	12·09	22·60	2·15
Peas ...	12·50	14·88	27·38	2·19
Barley ...	7·91	10·61	18·52	2·25
Oats ...	7·91	13·24	21·15	2·57

That is, these crops, during their period of growth, used approximately two-and-one-quarter times as much water as fell in rain. Since the plants did not grow as large or strong as those in actual field conditions, we are safe in assuming that field crops used as much as or even more than those in the crocks. Last season was about an average one. Thus we see that under ordinary conditions, if the crops are to be supplied with all the water they need, there must be a great store of it in the soil from which they may draw. Hence, in anticipation of an average or dry season, our treatment of the soil must put it in such a condition that it will retain a great deal of the spring, winter, and autumn precipitation. The crocks in 1905 were set on the root of the annex to our building during the early part of the season ; but it was thought that possibly the loss there was very much in excess of what it would be at the ground. So about the middle of the season half the crocks were removed to the garden, part being set on the ground and part in the ground about level with it. Between the losses from the former and the latter, the scales showed no difference, though the loss from those on the roof was slightly greater than from those in the garden. But the first tests in any experiment are seldom made in just the same way as subsequent ones. This season (1906) all crocks were set in the ground in a field of barley, a path leading into the grain, and the crocks being set back in it on either side of the path.

The crocks had a capacity of four gallons, were 10 inches in diameter, and about 12 or 13 inches deep, and caught all the rain that fell. The day they were set outside a very heavy rain fell, and having weighed them just before the rain, we weighed them again just after, and compared the result with our rain-gauge. It was found that the crocks had absorbed the whole shower. None of the rain was lost by drainage. We had a drainage tube in the bottom of each crock, but not once during the whole season was the rain sufficient to saturate the soil and cause percolation. The quantity of rain required to saturate the soil depends on the amount of moisture in the soil when the rain comes. We tested that point once during the season. We let the soil dry out until the grain began to wilt. The amount of water in the soil at wilting point varies in different soils. This was a loam, and by actual test was found to contain 7·3 per cent. water when the plants wilted. Water was added to the crocks until it began to run out of the drainage tube. When percolation had just ceased, they were weighed again, and it was found that to saturate the soil whichwas nine inches deep, it required two-and-one-half inches of water. That is, in time of drought when your crops begin to wilt it would require a rain of two-and-a-half inches to saturate the soil nine inches deep. That explains why it takes so much rain to "break the drought." In all our records here we have no such rain in 24 hours. Only two or three times have we had as much as two inches. A rain of one-and-one-quarter inches would *saturate* the soil four one-half inches deep, but gravity and capillarity would carry part of the

water farther down, so that such a rain, which would still be a heavy one, would *moisten* the soil probably eight or ten inches. Since the soil is seldom so dry as to be at the wilting point, but generally contains from 15 to 20 per cent. of water and sometimes more, a rain of about one inch is often sufficient to cause percolation. A saturated loam contains about 30 to 35 per cent. water by weight.

The season of 1906 was a very wet one during the growing time, and the same test resulted as follows :—

TABLE SHOWING RAINFALL AND DEPTH OF WATER USED BY CROPS DURING A WET SEASON.

Crop.	Depth of rain while crop was growing.	Depth lost by drainage.	Depth of water added.	Net depth of water used by crops.	Total depth compared with rainfall.
Wheat...	12·62	1·00	5·00	17·32	1·38
Peas ...	12·62	1·00	6·00	18·32	1·45
Barley...	12·62	1·00	6·50	18·82	1·49
Oats ...	12·62	1·00	6·25	18·47	1·47

Thus we see that during a wet season the crops do not use as much water as during a dry one, only about 18 or 19 inches in 1906, as compared with 23 or 24 inches in 1905, although the supply was much more abundant. Still they usep about one-half more than the rainfall ; but any soil, whatever its condition, retains enough of the spring and winter precipitation to supply this deficiency. The table also shows that part of the rain was carried away in drainage. In actual field conditions the amount to be thus removed would be much greater. Moreover, it is a matter of common observation that excessive water standing in the soil for 48 hours or more is very injurious to plant life. Hence, during a wet season it is our chief concern to remove the surplus water before its presence becomes dangerous to the crop.

Now it is a curious coincidence, or shall I say a provision of nature, that in most soils the conditions which, in a dry season, make for the retention of great stores of the winter and spring precipitation, and the subsequent conservation thereof, are the very conditions that in a wet season rid the soil most quickly of the surplus water. It behoves us, then, to inquire what these conditions are. First and foremost a proper soil texture, a grandular condition not too fine nor too coarse, neither too compact nor too loose. Let me illustrate this by a simple experiment. Here are two brass tubes with sieve bottoms. Equal weights of loam were placed in them. In tube No. I the soil was packed to field conditions ; in tube No. 2 it was left as loose and open as possible. Water was poured carefully into each and allowed to soak through. When both soils were just filled with water, the loose one *contained* 34 per cent. more than the compact. In soil six inches deep this is equivalent to one inch of rain, *i.e.*, if a loam is loosened up for a depth of six inches it will absorb one inch more than the compact soil before any of the water is lost by surface run off. The tubes were then let drain, and when all drainage had ceased it was found that the loose had *retained* 28 per cent. more water than the compact, which amounts to four-fifths of an inch in six inches of soil. This is equivalent to a very heavy rain. A further test was made with these two samples. We measured the rate of drainage, and it was found that the loose soil allowed water to pass through it more than twice as fast as the compact did.

This illustration demonstrates one of the chief objects in fall-plowing, viz., the absorption and retention of water; it also teaches that deep ploughing will achieve this object better than shallow plowing, and further that subsoiling may

be beneficial, provided, of course, that the subsoil is left in the bottom of the furrow, as demanded by other conditions. It should be said here, however, that there are some soils, *e.g.*, light sandy loam, which do not admit of loosening up to any great extent, for being of coarse texture they dry out very rapidly when loosened up. We may infer also that lands with open subsoils (not too open, of course,) will have greater reserve of water for the plants in time of drought than will those with close subsoils. And we might hence inquire if there is any means of improving the texture of subsoils of the latter class. In this connection we recall that it is a matter of common experience that well-drained soils will withstand a drought better than similar soils not so well drained, although the crops on both might look equally well at the commencement of the drought. This result, which, at first thought might not be expected, finds its explanation in the fact that the drainage always improves the texture of all the soil affected, subsoil as well as surface soil, and with improved texture the water-retaining capacity is increased. Thus, when the soil is in best condition for supplying water to the crops in a dry season, it is likewise most capable of protecting them during a wet one.

But there is another aspect of soil moisture that during seasons of average or scant rainfall is equally as important as that already considered, viz., the conservation of the water after it has been stored in the soil. The one great source of loss is evaporation. Few, I believe, have any conception of how much water may be lost in this way. We have had the good fortune to devise a reliable apparatus for measuring the amount of evaporation from water surfaces, and have been making continuous tests since the middle of May, and I must confess that we have been surprised at the results. The College reservoir, which you have all seen, is approximately 100 feet by 60 feet and 12 feet deep. How much water do you suppose evaporates from that reservoir per day, on an average, from May to October? Most people guess in gallons, and when we suggest barrels they look incredulous; yet it is a fact that on an average during that whole period twenty barrels a day were lost by evaporation, a depth of one-fifth of an inch. The greatest loss on any one day was fifty barrels, which occurred between 6 o'clock on the evening of August 24th and 6 o'clock on the evening of August 25th. The three days preceding had been excessively warm, but about 4 o'clock on the 24th the temperature dropped suddenly, and a very strong wind rose which continued throughout the night and the following day.

In measuring the evaporation we use a graduated glass standpipe of water which feeds automatically into an evaporating cup, so arranged that the wind cannot blow the water out, although the evaporating surface is level with the top of the cup. The amount that has passed out of the standpipe gives the *depth of water evaporated* since last observation, and from this we can calculate the amount in barrels. When we have another season's work on this and on evaporation from soils, we hope to publish a detailed report of our methods and our results.

An evaporation of twenty barrels a day from an area 100 feet by 60 feet is equal to about 140 barrels per acre. The amount will, of course, vary with the situation, exposure, temperature, etc. What the exact loss from soils would be during that period we are not yet in a position to say, that problem lies all before us; but, from preliminary tests, we have reason to believe that so long as the soil is *bare* and *looks moist on the surface*, evaporation is robbing it of its moisture about as fast as it takes water from the reservoir. But as soon as the soil looks dry, or is hidden by a crop, the rate of evaporation falls off very rapidly.

These latter conditions are best brought about by cultivating and seeding as soon as the land is dry enough. If there are two plots of soil side by side, and one is cultivated and the other is not, the evaporation from the cultivated one is much

greater for a day or so than from the other, but *this evaporation takes place chiefly from the loosened portion*, and hence in a very short time, provided no rain falls, this layer becomes dry and acts as a blanket to protect the soil below, diminishing, the evaporation in one test we made by 62·5 per cent. Hence it is a matter of vital importance that the soil should be cultivated at the *earliest possible moment.* A delay of one week in this operation after the soil is fit will rob the soil of from one to two inches of water, an amount sufficient to tide the crop over the critical period of a drought. Deep cultivation is not advisable, for all of the loosened layer dries out in time of dry weather, and since the deep blanket is little, if any, more effective than the thinner one, the extra loss from the thicker blanket itself is not atoned for by greater saving of water in lower layers, and is therefore a net loss to the plant.

With cereals the conservation of moisture by cultivation may be continued until the grain is nicely up. If a rain has come, packing down the soil and destroying the loose blanket and thus setting up rapid evaporation again, it is good practice to run over the crop with a light harrow and restore the blanket. The saving in moisture will more than atone for any injury the harrow may do the young plants. With roots and other hoe-crops conservation of moisture may be continued throughout the whole season. Theoretically, they should be scuffled or cultivated after every heavy rain. This frequent working may not be always possible, but it should be followed as closely as practicable.

In humid sections, where the autumn rain is usually sufficient to saturate the soil, after-harvest conservation of moisture is not essential, and the customary ganging serves to sprout the weed seeds, and also, together with the fall plowing, to put the soil in condition to retain enough water for the ensuing crop. But in sub-humid or semi-arid regions the tillage right after harvest is essential for the purpose of conserving moisture, as well as for the reasons already given.

Before leaving the question of soil moisture, I should like to refer briefly to the work in drainage that is being done by the department of Physics. Throughout the Province there are thousands of acres non-productive, or under-productive, at least, which, if drained, would be the very best of land. People are realizing this more and more, and drainage operations are being more generally undertaken than heretofore. But in many cases men are hesitating because they are not sure as to the best methods of going about it, whether they have fall enough, the best course for the drains, etc. The department of Physics is endeavouring to help these men. Anyone having such difficulties may have the assistance of a man from our department to take the levels of his land, determine the falls, locate the drains, give him a working plan of his farm or field, and advise him generally as to the best methods of operation. The condition upon which this service is rendered is that those wishing work done pay the railway fare, etc., of the person sent by us. When the applicant lives a considerable distance from Guelph, he sometimes clubs together with one or two of his neighbours who have work to be done, each paying a share of the expenses.

We have done a great deal of this work during the past season, and the men for whom we have done it express themselves very strongly on the benefits derived. I mention it here because of its connection with the subject in hand, and also in the hope of making the scheme more widely known. For the initiation of the plan, I wish to give due credit to Professor Reynolds, my predecessor, in the department.

Another important soil factor is proper temperature. There is a certain temperature at which each kind of seed germinates best. Of the more common cereals, wheat has the lowest germinating temperature at about 70°, barely, oats and peas probably in the order named, at about 80°. This may throw some light

upon a result obtained by the Experimental Department. By several years' tests they have shown that the order in which these grains should be sowed is, first wheat, second barley, third oats, and lastly peas. And in testing six different dates of seeding at intervals of one week, they have shown that for wheat and barley the first sowing is the best, but for oats and peas the second. Temperature is undoubtedly one of the factors producing this result. This question and that of soil moisture are very intimately related. A wet soil is a cold soil, but a dry one is a warm one. The seed bed of a well-drained, well-tilled soil will be from 5° to 15° warmer than that of a poorly drained, poorly tilled one. The reason for this is found in two facts: (1) The behaviour of different substances toward heat. It is more difficult to raise one pound of water one degree in temperature than one pound of any other substance in the soil. The same heat would warm dry sand 10°, dry clay 7°, dry loam 7°, dry muck or humus 5°, would warm the same weight of water only 1°. This may easily be proven. Take a pound of water and a pound of sand at the same temperature. Heat the sand 11° and put it in the water. The temperature of the water will rise 1°, the temperature of the sand fall 10°. Again, take two samples of the same soil, one saturated, that is, holding all the water it can, the other half saturated. The heat that will raise saturated loam 3° will raise half saturated loam 4·5°; and, by the way, a half saturated soil is in about the best condition for tillage, for germination, and for plant growth. Hence, from a temperature standpoint, you can see how essential it is that the soil should not be too wet. (2) Evaporation cools the soil. That this is so I can prove to you in this simple way. Here are two thermometers. They both read 67°. Here is a wet linen sack that just fits the bulb. One would think it should be the same temperature as the thermometers, for all have been lying here side by side. I slip the wet sack on one thermometer and watch the result. The wet bulb reads 50°, *i.e.*, 8° lower than the dry bulb. These readings would vary for different conditions. The only possible cause for this phenomenon is the evaporation from the gauze. The heat from the thermometer is going into the gauze and into the water and evaporating the water. You may take a certain amount of water and heat it from freezing point to boiling point. You cannot make the water any hotter, yet the flame is sending more heat into it all the time. What is becoming of that heat? It is being used to turn the water into vapour, or steam, as we say. It takes 5·35 times as much heat to turn the water into vapour as it does to heat it from freezing to boiling. In evaporation the same thing is true, only, since there is no fire to supply the heat, it must come rom the water itself, and hence the water is colder than the surrounding air. The very same phenomenon occurs wherever evaporation takes place. Hence, the sooner you get that dry blanket of soil on the surface and check the evaporation, the sooner will that soil become warm and suitable for seed-germination and plant growth.

A third soil factor in crop production is the proper supply of air. Whether the roots actually breathe this air as the leaves do has never been decided, but the fact remains that they can no more do without it than the leaves can. But absolute exclusion of fresh air occurs only when the soil is filled with water. Soils in a good state of cultivation permit sufficient change of air for all our crops but the legumes. We have been testing this point both last year and this year, and that is the conclusion we have arrived at. Peas, beans, clover, cow-peas, vetches, etc., would all be benefited by more air than reaches the roots under ordinary conditions. This may explain why peas do so well on sod; the soil is open in texture and allows much interchange of air.

Perhaps it may be interesting to note some of the agencies that promote aeration. First, there is change of temperature of the soil. The air in the soil

expands as it is heated, and thus some of it is driven into the atmosphere. If the rise in temperature amounts to 10° when the temperature of the soil stands at 45°, then one-fifth of the air in the heated zone is expelled ; and if it amounts to 20°, then one-twenty-fifth is expelled, and so on. The change of atmospheric pressure also aids. If the pressure fall half an inch, the air expands and about one-sixtieth of it escapes ; if the pressure falls one inch, one-thirtieth escapes. Rain is a very potent factor. As the water sinks into the ground, an equal volume of air must be displaced. As it passes away, by drainage, by evaporation, or by absorption into the plant, the air is drawn into the soil again. Drainage aids very materially. When rain falls on undrained land, the imprisoned air must escape upward through the water as the water sinks down ; the two actions thus opposing one another, the air escapes very slowly, often so slowly that large quantities of water, being unable to make their way into the soil, run off the surface and are lost. But if the soil is well drained some of this run-off may be prevented, the imprisoned air escaping downward through the drains as the weight of water above increases, fresh air following the rain into the soil. This gives us another reason for the great superiority of the drained soil over the undrained. Proper tillage increases the efficiency of all these agencies of aeration.

Another factor, and one that is gaining some prominence at the present time, is a proper sanitary environment for the roots. The latest investigations of the Bureau of Agriculture at Washington arouse the suspicion that the apparent "exhaustion" of soils is not due so much to the depletion of the stock of plant food as to the lack of proper sanitary condition. Animals forced to exist in an atmosphere rendered foul by their own poisonous exhalations soon cease to thrive ; the plant above ground likewise gives up waste products, which if not removed, become a menace to its safety ; is it not therefore natural to expect that from the roots of the plant also there are excreta that, if allowed to accumulate, threaten its very existence ? As proper ventilation is necessary to insure the health of the animal, as diffusion, drafts and winds must bring fresh air to the leaves, so must tillage or other treatment purge the soil of the injurious substances cast off by the roots. In this purifying process it is believed that air, and therefore cultivation and drainage, plays an important part, certain fertilizer ingredients are effective under certain conditions, but more potent still is organic matter in the form of humus. There is another method, however, of eliminating the toxic or poisonous effects of these excreta. Whatever they may be, it appears that those cast off by one variety of plant are not, as a rule, injurious to another variety, hence the possibility of rotations of crops. By the time the first crop comes round again, the intervening cultivations having stirred up the soil, exposed it to the weathering processes, allowed the air to enter in and permitted the humus to do its work, all the excretions injurious to that crop have been removed or neutralized and we secure a yield equal to the last one. Hence it is that by proper rotation we may go on cropping our fields from year to year, cropping them indefinitely, without any apparent exhaustion, and indeed by wise rotation even increasing the yield.—*Ontario Department of Agriculture*, Bulletin 156, March, 1907.

EDIBLE PRODUCTS.

INNOCUOUS COFFEE.

Coffee can now be produced absolutely free from caffeine. The Coffee Trading Company in Bremen is reaping the benefit of this invention. This company owns a factory which is under the control of the chemical laboratory, "Trensenius," at Wiesbaden. There all the caffeine is extracted from the raw coffee berries. This system has already been patented in most of the civilised countries. Coffee freed from all caffeine hardly contains any substance which acts deleteriously on the nervous system. Experiments made in hospitals go to prove that it can safely be given to patients suffering from heart, nerve, or stomach complaints without injuring them in the slightest degree. The coffee retains all its original flavour after this treatment. Since October, 1907, coffee free from all caffeine is sold by all grocers in Germany at the same price as ordinary coffee. Since caffeine is sold for medical purposes, the expenses for extracting it from the coffee will easily be covered. The factory is capable of an output of 1,000 cwts. a day.—*The International, a Review of the World's Progress*, No. 1, Vol. 1, December.

EDIBLE OIL FROM SAFFLOWER SEED.

(*Carthamus Tinctorius*, Linn.)

The following memorandum drawn up by M. R. Ry. Rao Bahadur C. K. Subba Rau Avergal, B.A., Acting Government Botanist, Madras, and communicated to the Central Agricultural Committee by the Director of Agriculture, Madras, has been printed for general information :—

In the Tamil districts of Madura and Tinnevelly as well as in the Telugu districts of Cuddapah, Anantapur, Bellary, and Kurnool, safflower seed is cultivated on the margins of black cotton soil fields for preventing cattle trespassing into cholam and other crops.

While the ryots of the Telugu districts named above are accustomed to have the safflower seed crushed in an oil-mill after it is husked and winnowed, and thereby get an oil which is used for all purposes for which gingelly oil (*Sesamum indicum*) is used, the ryots of Madura and Tinnevelly only extract a lamp oil of no market value whatever, by the boiling process in the same way as they do castor-oil (*Ricinis communis*), and throw away the refuse. In the Telugu districts, the refuse of the oil-mill is used for feeding cattle or for manure.

In the Telugu districts safflower oil is sold in the bazaars at about 10 annas per Madras measure, and the oilcake at 3 to 3½ Madras maunds, of 26 lb. each per rupee, so that the price per candy is about Rs. 7.

In the Telugu as well as in the Tamil districts mentioned above, fried safflower seed is ground together with tamarind, salt and fried chillies and made into *chutney*. Roasted safflower seed mixed with fried rice-wafers, Bengal gram, etc., is sold in the bazaars in some of the Telugu districts named above, while in the Otapidaram Taluk, fried safflower seed is used by some people in making curry powder for fragrance sake.

On the 5th instant Mr. C. K. Subba Rau, the Acting Government Botanist, had the kernels obtained from forty Madras measures of safflower seed by grinding it in a stone mill of particular kind received from Tadpatri, crushed in an oil-mill at Pothimuttur, three miles from Otapidaram, in the presence of the Tahsildar, and a number of other people, and obtained 4⅝ Madras measures of sweet smelling oil.

He convened a meeting of ryots and other people at Otapidaram on the evening of the 6th instant, and distributed to them cakes called *Amavadai* fried exclusively in safflower oil. The people said that the cakes tasted as well as if they had been fried in ghee. At Pothimuttur the cake was greedily eaten by bullocks.

Eight measures of safflower seed generally give one measure of oil by the boiling process. The proportion of oil obtained by milling at Pothimuttur was slightly smaller. More oil could have been obtained by presenting a burning torch to the crushed mass of seed in the mill round and round while the pestle was turning. This was not done lest the oil should acquire a smoky flavour. The seed produced in the Tamil districts is small as compared with what is produced in the Telugu districts. If good seed obtained from the Telugu districts be sown in the Tamil districts, the safflower seed then produced would give a larger proportion of oil. —*The Central Agricultural Committee, Madras.* Circular No. 23.

REPORT ON THE RICE INDUSTRY IN THE UNITED STATES.

By Mr. E. Seymour Bell,

British Commercial Agent in the United States.

Area Cultivated and Yield.—Rice cultivation in the United States has become an important industry. During the fiscal year 1898-99, the production of rice in this country was 250,280,221 lb., the land under rice cultivation was 342,218 acres. This year it is calculated that the yield will be about 470,000,000 lb., the land planted with rice being 643,400 acres.

Imports.—Notwithstanding this large increase it is still insufficient to meet the home demand. The quantity of rice of all sorts imported during the last fiscal year amounted to 154,221,772 lb., chiefly through San Francisco and New York.

Exports.—The exportation of rice has increased considerably during the last two years. This is shown in the following figures:—

Exports of Whole Rice.

Fiscal Year.	Rate per Month. lb.
1901-02	51,000
1902-03	44,000
1903-04	197,000
1904-05 (three months)	419,665

Exports of Rice Bran, Meal and Polish.

Fiscal Year.	Rate per Month. lb.
1901-02	2,414,000
1902-03	1,601,000
1903-04	2,228,000
1904-05 (three months)	1,686,000

Cultivation.—Before 1860 the rice production in the United States was practically limited to the alluvial lands of the Carolinas, Georgia, Florida and Louisiana. When labour conditions were altered after the Civil War the production in the Eastern States decreased considerably. When machinery was adapted to rice production, and it was discovered that the prairie lands of South-western Louisiana and Southern Texas with their impervious subsoils would dry before the rice harvest sufficiently to support machinery, there was a revolution in the rice industry.

Fifteen years ago there was scarcely a barrel of commercial rice produced in what is now known as the prairie rice section of Texas, which extends 400 miles along the Gulf coast, and contains some of the most fertile lands on this continent.

These lands were valued at 25 cents to 1 dollar 50 cents per acre. To-day improved lands are worth on an average 12 dollars 50 cents per acre. Within the territory there are about thirty rice mills with a daily capacity of over 20,000 barrels of rice.

The rice belt of Louisiana and Texas comprises a section of prairie land bordering on the Gulf of Mexico and extending westward from the parish of St. Mary, along the coast of Louisiana, 140 miles to the Sabine River, and thence about 400 miles along the Texas coast to Brownsville on the Rio Grande, with an average width of 60 miles and a mean elevation of from 6 to 40 feet above the sea level.

By 1898 the canal and the deep-well system of irrigation had been satisfactorily tested, and the rice industry was rapidly extending along safe lines. At this date it was found that too large a percentage of the machine-handled rice was liable to breakage in milling. The attention of the United States Department of Agriculture was called to this fact, and measures were immediately taken to remedy the defect and to overcome the difficulty by the introduction of new varieties. The Department's work resulted in the introduction of a variety from Japan known as Kiushu, which has given very satisfactorily results.

The Kiushu variety is known for its short thick kernels and thin hull. It takes on but little polish, and the percentage of bran is small.

In the evolution of this industry further difficulties became apparent. While rice could be successfully planted during a period of nearly four months—March, April, May and June—it all ripened at nearly the same time, giving only about one month for harvest, against four months for planting; that is, it was demonstrated that the harvest could not be prolonged in proportion to the period of planting where only one variety of rice seed was used. The varieties planted developed this peculiar characteristic, that whether planted in March or June they would mature at about the same time, those planted later developing in every instance with increased rapidity. The harvest is the season of high wages, and the limited harvest period increased the expenses and prevented the use of the necessary care properly to cure, thresh and store the crop, thus greatly augmenting the cost and reducing the quality of the rice. If the period of the harvest could be materially lengthened, every grower could produce from 50 to 100 per cent. more rice. One farmer with a single helper and good teams can prepare the land and plant 200 to 300 acres of rice. It would be difficult to cut more than 100 to 150 acres with the same help, but if the harvest could be extended over three months' time, then the labourers who planted the crop could in the main harvest it. It became evident that this result could be obtained only by planting early, medium and late maturing varieties, and that these varieties must be rices of fixed characteristics and habits of growth. Such, with few exceptions, can be found only in Asiatic countries, where centuries of uniform conditions of climate and culture have established fixed habits of growth in certain varieties of rice. It has been found that American rice growers using imported Japanese seed have several points of superiority over the home-grown rice. It has generally been noted that the vitality and germinating power of the imported seed were nearly 40 per cent. greater than that of domestic seed. The imported seed averaged better colour and was freer from rust than much of the domestic. It was less liable to the chalky and break under the milling process.

SELECTION OF LAND.—In selecting land for the growing of rice the first choice is along some river or stream where the water rises and falls with the tide and yet is not brackish, where the land is low enough to be flooded at high tide, and at the same time high enough to be well drained at low tide. These lands permit of the best irrigation that are from 12 inches below high tide and 3 feet above low tide. On such fields water can be raised sufficiently high on all the grain, and

the drainage given by 3 feet is rapid and effective. Tidal deltas are largely given over to rice culture. In such localities land is selected far enough from the sea to get fresh water. Suitable lands, however, are found in many places where these conditions are not found, none of which can be regarded as absolutely essential. There are good rice lands that do not border on and are not near streams affected by the tide. There are rice lands above high tide and rice lands below low tide and rice lands so close to the ocean that the water of bordering streams is as brackish as the brine from the sea. A rice-producing soil, if above high tide or so near the ocean that the water from a bordering stream cannot be used, may be irrigated by water from wells, reservoirs or inland lakes; if below tide, it may be drained by pumps.

While low-lying areas easily irrigated and drained constitute the principal part of the acreage used for rice culture, there are fertile uplands, lands that cannot be irrigated in any way, that produce some varieties of rice. On such lands, however, the yield is small and the quality often inferior. Experiments have shown that there are large areas in the United States where upland rice can be grown at a profit. Marshes are found on the highlands of Georgia and the Carolinas that are easily irrigated and drained.

Medium loams, underlaid by a stiff subsoil, are well suited for growing rice. The substratum facilitates drainage and makes the land firm enough to allow the use of harvesting machinery. Among these are the lands formed by the decomposition of vegetation and deposits from the fresh water carried in the small streams from the interior which are distributed over the lands at high tide, and also the lands reclaimed from the marshes or swamps. Only such marshes as can be drained and irrigated from reservoirs, or by water pumped from fresh water streams can be utilised. Lands that are much elevated above the tide water are usually too poor for the profitable cultivation of rice. Soils containing a large percentage of gravel or sand are not suitable for this industry, from the fact that they dry too readily and will not hold sufficient moisture, A sandy soil, however, is sometimes found with a subsoil stiff enough to prevent the land from becoming too dry. On such lands one or two medium crops can be raised, seldom more.

Varieties of rice differ in shape, size and colour of grain in the proportion of food contained and in flavour.

In the Atlantic Coast States there are two principal varieties, the "gold seed" and the "white rice." The "gold seed" derives its name from the yellowish colour of the husk when ripe. This variety is extensively grown in the low lands of North and South Carolina, and is famous for its yield and quality. The "white rice" takes its name from the whitish colour of its husk and is valued for its early maturity. In the late plantings, which are in June, this variety is usually sown.

IRRIGATION.—The methods of irrigation are various and often crude, in fact the system of the colonial planter is still in use in many places. A common practice is the following :—

Suitable land being selected, a bank about 6 feet high, 35 feet wide at the bottom and 12 feet on the top, is thrown up along the river. A main canal is then cut, which reaches from the river through the plantation. On each side of this main canal, and running parallel with it, banks are thrown up, which join the bank along the river and follow the main canal throughout its entire length. Along these banks are fields or squares formed by check banks, some of which run at right angles, some parallel to the main canal. Within each of these squares, and about 20 feet from its bank, is a marginal canal or face ditch. Within this occurs the last and final division of the rice field. These divisions, called beds, are strips of land about 50 feet wide and of various lengths, formed by parallel ditches extending from the marginal canal on one side of the field to the marginal canal on the

opposite side. Face ditches usually measure about 3 feet in width and 3 or 4 feet in depth. The canals are smaller than formerly. Some of the old canals, however, measuring 6 feet deep and 40 feet wide are still extent.

The state of the land, the kind of soil and the nature of the subsoil determine the size of the field, which varies from 5 to 35 acres. Fields are laid off in such a way as to be well flooded and effectively drained. If the slope is considerable the field is small. If the slope is gentle the field is large. Effective drainage, however is not the only consideration in laying out the rice field. The land must be so graded that the water will stand at about equal depths in all places. Canals and ditches must be so constructed that each division may be independently flooded or drained.

The surface, to be properly irrigated, should have a uniform grade. An uneven surface requires more labour, produces smaller crops, and in the end damages the crop itself. Too much water in some places, and too little in others, soon show injurious effects on the soil. On each field the crop does not ripen uniformly; the field shows alternate patches of yellow and green, and the grain when harvested is found very inferior in quality. The planter whose crop is uniform in quality knows the value of applying water evenly over the entire surface. The rice lands of the Gulf and Atlantic State have a very gentle slope, and do not, as a rule, require much grading.

Drainage is very essential to rice culture. Planting, cultivating and harvesting all depend, to a considerable extent, on drainage. On grounds insufficiently drained planting is never well done, for the ground cannot be put in condition. Cultivation is greatly impeded, men cannot go on the fields to work, the ground cannot be stirred, and weeds and noxious grasses flourish.

Before the crop can be harvested it is necessary that the field be drained. When the land is wet the harvester works at a great disadvantage; the fields are dug up by the labourers; the surface becomes sodden and sour. On account of the insufficient drainage the grain is often taken from the fields to some high place where it is stacked and cured.

PREPARATION OF THE LAND.—In the Carolinas and Georgia the lands, as a rule, are prepared for planting in December and January. The ground is ploughed 3 or 4 inches deep, run over with a disc harrow, and then a roller, breaking up the clods and making the surface level and compact. In different sections the time for ploughing varies and the methods differ. In some instances the soil is so stiff that it is necessary to flood the fields before they can be ploughed.

Rice is a shallow feeder. Some planters are, therefore, of the opinion that deep ploughing is unnecessary. It might appear, however, that deep ploughing would give new land each year for the plant. In upland culture the ground is prepared as it is for corn, and in North Carolina the crop is raised in much the same way.

On lands that are flooded by river that carry a rich sediment, sufficient nutritive material may be deposited to insure its continued fertility. On lands not so favourably situated the soil becomes greatly impoverished if some fertiliser is not used. Many different kinds of fertilisers are in use in the rice belt. Among these are cotton seed meal, blood and bone, kainit and tankage. The last named is a special mixture for these lands. Most fertilisers contain a large percentage of potash, and are spread with very satisfactory results.

In North Carolina, where the upland rice is grown, fertilisers are little used. But where they are used the product is heavier and the yield per acre greater. On one plantation in this State, where acid phosphate was experimented with, the yield was 12 bushels more to the acre, and weighed 4 lb. more to the bushel. The amount spread per acre was 300 lb. As a rule the application of fertilisers has been followed by gains in the crops sufficient to make it a paying investment.

(To be continued.)

THE CENTRAL AGRICULTURAL COMMITTEE, MADRAS.

ADVANTAGES OF TRANSPLANTING PADDY.

The following article on "The Advantages of Transplanting Paddy," contributed to the August number of the Agricultural Gazette of Central Provinces for 1907, by Mr. D. Clouston, M.A.,B.Sc., Deputy Director of Agriculture, Central Provinces, is reprinted for general information in continuation of our Circular No. 14 on "Transplanting in Paddy Cultivation."

The five methods of sowing paddy practised in these Provinces are as (1) transplanting, (2) *biasi*, (3) broadcasting without *biasi*, (4) sowing in lines, and (5) *lehi*. Where transplanting is followed, the seed is first sown in a well-manured nursery bed, and when the seedlings are about 9 inches high, they are planted out in the plots where the crop is to be grown. In *biasi* the seed is first sown broadcast, and the plants are afterwards thinned out by working the country plough in the field, When this thinning process is omitted, the seed is sown broadcast without any subsequent *biasi*, and the method is known as broadcasting. In the process known as *lehi*, the seed is artificially germinated and then sown. By the fourth method, the seed is sown in lines by means of a light three drill. This latter method is but seldom practised in these Provinces, and has not, therefore, been included in the experiments of the Raipur Government Farm.

In an article which appeared in the November number of this Gazette in 1906, a detailed account was given of the method of transplanting; this article will deal with the results obtained from experiments conducted on the Raipur Farm in which this method is compared with the other three commonly practised. These experiments were carried out in Series "A" and "B"; "A" being irrigated and "B" unirrigated.

Both series of plots were uniformly manured with cattle-dung at the rate of 20 lb. of nitrogen per acre. The plots are each 1/10th of an acre in area. The results obtained from Series "A" are given in statement below:—

Plot.	Method of Sowing.	Outturn per acre in lb.						Average value of outturn, 1904-7	Cost of cultivation and manure.	Average profit obtained from different methods.
		1904—1905.		1905—1906.		1906—1907.				
		Grain.	Straw.	Grain.	Straw.	Grain.	Straw.			
								Rs. A.	Rs. A.	Rs. A.
1	Transplanting	1,940	1,440	1,630	1,050	1,840	1,340	46 11	8 14	+37 13
2	Biasi ..	1,450	1,0.0	430	340	1,600	1,240	29 0	10 2	+18 14
3	Broadcasting ..	750	640	740	580	1,240	690	23 5	6 14	+16 7
4	Lehi ..	930	1,010	470	410	790	570	19 0	10 7	+ 8 9

The transplanted plot has done best every year, and has yielded a net profit that is double that of the second best plot, *i.e.*, No. 11. It is often stated by cultivators who have never tried transplanting that it is suitable for irrigated paddy only, and that even then it is not profitable on account of the additional cost of labour involved. The results of this series of experiments prove that both these statements are doubtful, for the plots were not irrigated, and in calculating the profits derived from them, the cost of cultivation has been deducted in each case.

Transplanted rice grown under irrigation gives a still higher profit, despite the fact that the cost of cultivation in this case is increased by a water rate of Rs. 1·14 per acre. The results of the series are shown below:—

Plot.	Method of Sowing.	Outturn per acre in lb.						Average value of outturn, 1904-7.	Cost of cultivation including manure and irrigation.	Average profit.
		1904—1905.		1905—1906.		1906—1907.				
		Grain.	Straw.	Grain.	Straw.	Grain.	Straw.			
								Rs. A.	Rs. A.	Rs. A.
1	Transplanting	2,000	560	1,940	1,220	1,940	1,430	50 11	10 12	39 15
2	Biasi ..	1,630	1,040	1,610	1,660	1,240	1,150	39 11	12 0	27 11
3	Broadcasting ..	960	700	1,190	970	1,220	1,410	30 5	8 12	21 9
4	Lehi ..	770	1,270	1,120	840	730	690	24 11	12 5	12 6

With the exception of broadcasting, transplanting is the cheapest of all the methods experimented with, as it reduces the weeding charges very considerably. The weeds are so thoroughly eradicated by the ploughing given to the plot before transplanting that after-weeding is seldom necessary. The figures given above show the actual cost of cultivation by each method on the Raipur Farm, from which it will be seen that the extra cost of transplanting is much less than the extra cost of weeding entailed by other methods of cultivation. A most important factor in the cost of cultivation is pot, whilst *biasi* requires about 80 to 100 lb. of seed per acre, transplanting requires only 20 to 30 lb. of seed per acre,

In the Chattisgarh Division of these Provinces there are about 2,850,000 acres cropped annually with paddy, out of which only about 37,750 acres transplanted, so that this method is seldom practised. The annual monetary loss suffered by the cultivators in consequence must amount to crores of rupees. One of the most important lines of work now being taken up by the Agricultural Department in this tract is to demonstrate the advantages of this method on small Demonstration Farms. By presenting this method in all its details on a field scale, it is believed that it will recommend itself to the rice-growers of this tract, and that it will be the means of materially adding to the farming profits of this class. The rice cultivators of Chattisgarh should give a careful trial to the system of transplanting. The outturn is much larger than by the *biasi* system, and in ordinary years the crop will grow quite as well without irrigation, Transplanted rice requires more rainfall, but there seems at least to be no good reason why this method should not be followed in all rice land commanded by irrigation,

H. E. HOUGHTON,

P. RAJARATNA, Mudaliar,

Honorary Secretaries.

LIVE STOCK.

Indian Bees.

(An Abstract of an Article entitled *Les Abeilles du sud de L'inde*, contributed by J. Castets, S.J., to the Revue des Questions Scientifiques, Bruxelles, October, 1893.)

The author, stationed at Trichinopoly, first pupil and subsequently professor in the Jesuits' College of that place, through the kindness of M. M. Oberthür, the well-known Entomologist, has been able to open a local museum as the result of observations made in the course of excursions to the hills from a villa on an arm of the Cauvery. One day, in May, 1889, at the height of the hot weather a terrible buzzing was heard, which proved to be from a huge swarm of bees that had invaded the single enormous hall of the ground floor of this villa; a swarm in comparison with which the biggest swarms of *Apis Mellifica* or even several such swarms joined together, would be insignificant. The swarm hung from a beam, forming a bunch about a metre in diameter and 20 centimetres thick. Scarcely two hours after a similar swarm settled on the next beam. This resulted in a deadly fight, and in the defeat and flight of the first swarm, which however left a comb as big as one's hand. From this started the author's interest in bees in spite of the aggressive character they had shown. The bees took no notice so long as no one disturbed them, and people could go and come into the room as if nothing were there. In two and a half months an enormous comb was built with large honey cells projecting on two sides. The author tried to have the bees kept there, but was obliged to see to their removal. His original intention was to obtain a comb entire with all its cells and specimens of the drones, queen and workers. A box was made 1½ metres long, almost as deep and about 30 centimetres broad, with two large openings at the bottom and several holes in the middle, the latter to receive the strong pegs which were to support the combs. By means of this the whole was successfully removed, but through the heat and jolting of the journey a part of the mass gave way and two-thirds of the bees were drowned in the honey. The author now determined not to wait for bees but to go and search for them. The result of expeditions proved that there are four kinds of bees in the district. *Apis indica*, *Apis dorsata* (the subject of the first experiment), *Apis florea* or *Socialis* and one small Trigonalid (parasitic bee) *Trigona iridipennis*. The author could learn nothing further from books except these names, a little about how bees work and a few details about *Apis indica*. It was possible, nevertheless, to make observations, as the swarms could be found everywhere, often in exposed places. *Apis indica* holds the first rank, not on account of its size but on account of its resemblance to the European bee. The author inclines to the opinion that the Indian bee is the parent stock from which *Apis mellifica* comes. In spite of this, hitherto (up to 1893) no one has taken any notice of this bee in spite of its universality in India and of its adaptability to every variety of climate to be found in this country. It varies with climatic conditions, which is its most interesting point. Thus a specimen of *Apis indica* sent from Ceylon and probably caught on the highlands near Kandy has been described as *Apis Peroni*, though it is evident on examination that it is only a local variety resembling the bees found at Timor, an island in Malay Archipelago. The author even thinks that the following bees are only variations of the same breed, *viz.*, *A. mellifica*, *indica*, *fasciata*, *Adansoni* and perhaps *rufescens*. The easiness of crossing the second and third varieties with *Apis mellifica* and the marked fusion of characteristics confirm this view. The bee of the plains may be described as follows :—Length of workers 11·5 millimetres. Abdomen banded alternately with light yellow ochre and brown ochre, darkening more and more towards the extremity, general tint a little

lighter than *Apis mellifica*. Males about the same length as the workers, but bigger, with a darkish abdomen without stripes, general colour blackish. It is difficult to distinguish the queen from the workers even in size.

CHARACTERISTICS OF THE VARIETY AT THE TOP OF THE GHAUTS.

Length of the workers 13 millimetres. Bands of the abdomen alternately yellow or whitish and black. General tint rather black. Body somewhat shorter than the type of the plains. Males are little shorter but thick, black and very hairy. In the plains *Apis indica* builds six workers' cells and five drone cells per inch; on the hills about five workers and four drone cells. These two are extreme varieties, the rest are intermediate between them. Plains type more prolific than the hills type, but the latter much more productive. The type in the plains resembles the native Indian in his carelessness and inclination for a rough life and bad lodging. Never stops up holes in trees or its nests with propolis (bee glue). Reasons for choosing sites for nests not discoverable. Except when in large numbers bees share the hollows of trees with spiders, cockroaches and lizards. The bee of the hills is much more active and more careful in choosing and guarding its abode. Both varieties are very tractable and just as suitable therefore for culture as any other variety. Attempts at cultivation has only recently (1893) been begun both in the plains and in the hills, but European bee-keepers are few though zealous, and the natives are likely to abide for a long time by their old system of chasing away and smoking out the bees without pity, a system which often gives them hardly more than a pint of honey to a nest. Attempt at keeping *Apis indica* very successful. In Calcutta one bee-keeper did so following the English system. Nevertheless it is more common to find hives of a breed crossed with *Apis ligustica* or even purely of that breed. In the plains the Indian bee works all the year round, and its activity entirely depends on the plentifulness of the flowers which he prefers. The giant of the bees is *Apis dorsata*. It is less common in the plains than in the hills. In Southern India its favourite habitat apparently between 300 and 2,000 metres above the sea-level. Swarms never found above 2,000 metres and rather rare in the plains, but seen everywhere at intermediate heights. However, their flight is strong enough to allow them to gather honey at more than 2,500 metres. Their deep buzz shows them to be industrious workers, as may be noticed in the hills where *Apis indica* and *Apis dorsata* are to be heard humming in deep and high notes respectively on trees of Australian *acacia* or Japanese *Ailantus*. The *Apis dorsata* in such cases furiously active in its work. These bees only build one comb; more than a metre in diameter, the cells for the workers and for the drones of the same size 5·5. millimetres long by 15 millimetres deep; the honey cells which are at the top of the comb but more one side rather larger, 6·5 millimetres long and up to 7 centimetres deep. This single comb always in the open on big branches of trees, jutting rocks, entrance gates of houses, of towns or temples, &c. Never troubled by the bats and other animals in the locality, with the exception of the wax moth of which the bees seem to have such a horror, that two or three moth grubs have been known to cause the desertion of a nest. The sting of these bees not more severe nor more dangerous than that of others, but their character apparently more irritable especially at certain times. On one occasion some amateurs disturbed a swarm of these bees, and were attacked by them and had to run many hundred yards away from the wood. Each received twenty or thirty stings; but for some reason or other, perhaps on account of the number of the stings, or on account of the rapidity with which they had to run, no swelling developed, and only one of the party felt a certain stiffness all over his body for some time. These same bees did not attack the author when he went to smoke them out next morning in order to examine their nest. Nevertheless, they have been known to attack Indians without any apparent cause, probably after there had been some domestic disturbances in the nest. The *Apis dorsata* differs from all other

varieties, as drones are smaller than the workers ; length of the drones 16 millimetres, workers 18 millimetres. On the other hand the drones have larger wings in proportion to their size, 13·5 millimetres as against 14 millimetres the length of workers' wings. A month's inspection from every side failed to discover the queen even with the aid of field glasses, probably, therefore, not very much different from the workers.

WORKERS AND THEIR CHARACTERISTICS.

Black body with reddish hairs, wings reddish especially in the middle with violet sheen, thorax yellow, abdomen covered above with down reddish on the first three sections, and often very brown or black on the others with brown lateral spots. In the male the body is brown with whitish hairs, abdomen more blunt, no lateral spots, abdomen covered below with rather long whitish down especially towards extremity. No variations in the varieties found in different latitudes. Certain authors say quite wrongly this bee could be reared in hives. As a fact attempt has never been made and could not succeed as it is accustomed to build only one comb, and is so fond of space and open air. The great difficulty will always be in modifying its instincts enough to make it build in hives and with many combs. Author suggests tentatively that a fertile queen-bee of this species might be given to Indian or other bees with pieces of comb of *Apis dorsata.* If the bees would consent to take care of this queen, its progeny might perhaps get accustomed for staying in hives and building combs that are parallel to each other. Perhaps an experienced bee keeper with seven or eight queens (so as to repeat his attempts) might end in succeeding. If one wanted merely to exploit a swarm which might come into the neighbourhood by chance, author has reasons to believe it would be enough to make all arrangements for the comb including five or six cross pieces. In this way the comb could be attached not only to the beam or to the branch, but also to the cross pieces which could be fixed in a perfectly open frame. It would then be possible to cut off the top of the comb once a quarter on the side where the honey was stored. One would thus have an abundant crop. Perhaps one might even go so far as to cut off from below the parts of the combs containing queens and drone cells, and fix them pretty far off on a tree or in a different room and thus obtain artificial swarms. As for the natural swarms one must not dream of collecting them. Every kind of hive would merely drive them away. This last method except as regards the artificial swarms might probably succeed, but the result would be precarious and only good enough to satisfy an amateur. There only remains therefore the first method which is much more difficult, seeing that it tends to change or modify the bees' instinct very considerably. Success of the experiment would be really a great advance in bee-keeping. The hives would have to be a cubic metre in size instead of a few cubic inches, and the cross pieces would have to be 9 or 10 centimetres broad. Natives very fond of honey. Have their own systems of collecting it. First way is to drive away the bees and carry off the comb. Another way (less paying and more dangerous for the operator) consists in sticking a long hollow bamboo into the honey side and using it to suck away the honey. This has been described to the author by several people, who have done it, or seen it done, and perhaps that was the way Jonathan used his staff when he took the honey during the pursuit of the Philistines. The habits of *Apis dorsata* closely resembled those of a much smaller and less useful bee *Apis florea* or *Socialis.* The plains seem to be the field of the latter's work. Never goes far for honey, and therefore never found above an elevation of 1,800 metres *A. dorsata* (?) only builds one comb which is hung from twigs, on bushes, on trees, often fixed flat on palm leaves, on panel of door or window. Prefers an open space for it comb, but surrounds with it any neighbouring branch or twig. Has a wonderful facility for adaptation. On one occasion author broke a piece of comb on moving it

and placed the broken piece horizontally, resting on a stick which supported the comb and on another cross-bar. It was discovered three days afterwards that the bees had raised this broken piece and fixed it perpendicularly above the first one by means of irregular cells. The workers' cells are nearly four to the centimetre and about 6 millimetres deep. Those of the males are much larger, about two to the centimetre with a depth of about 1½ millimetres. Those of the queens are 2·5 millimetres long and 12 millimetres thick. Honey cells are three to the centimetre and as much as 13 millimetres deep. The comb has always reached its complete growth about 20 to 25 centimetres in diameter before the drone cells are added to it as an appendage. Immediately below are attached as many as six or seven queen cells. The worker is black with transparent wings, with the first three sections of the abdomen pale ferruginous colour, the others having black and white bands, white down on the body and along margin of the segments of the abdomen; length 9 millimetres; general form somewhat long. Male entirely black with white down all over the body except on the upper part of the last segments of the abdomen; eyes blue; big and pot-bellied, length 12·5 millimetres. Queen black body, the first two segments of the abdomen ferruginous, the others with alternate bands of ferruginous colour and black; length 14 millimetres. These bees have a peculiarity; when flying or gathering honey they produce no perceptible sound. Quantity of honey insignificant; not more than half a pint for a numerous swarm. But these bees are excellent for observation; easy to obtain and build in the open. One can carry them on their branch from one place to another, or even put them in a box provided you leave large openings. In spite of their open situation they are never attacked by the wax moth, but after one year they seem to get tired of their comb and leave the lower part of it to rats and jackals. *Apis dorsata* seems to do the same, at least author has found complete combs abandoned without any trace of wax moth or foul brood. These species resemble each other in another particular. In the plains there is no winter and *Apis indica* gathers honey and pollen all the year round. *Apis florea* and *Apis dorsata* on the contrary stop work almost entirely from the beginning of November to the beginning of January. During this period they go our a little especially at noon; reason unknown. If they have no nest at the beginning of the season they do not begin one, and if they had begun one they do not continue it. Such at least is the author's experience. On one occasion a big swarm of *Apis dorsata* had been driven from a temple and had established itsel on a branch of *Acacia*. After one month this was cut and carried to the top of the College, but in vain. There was no trace of a comb, and as the bees had nothing to attach them to this branch they flew off two days afterwards. This inaction cannot be explained by cold, for the whole time the mean temperature is 29 degrees (84 degrees Fahrenheit) which is much higher than these same bees have in certain parts of hills even during the height of summer. Though these bees, and especially *Apis florea*, adapt themselves easily to every locality they seem to require a long time to make their choice. Swarms of the two varieties have been seen waiting on a branch near their hive as much as five or six days till the explorers whom they have sent out have found another which suits them. The care with which these explorers worked is shown by the following instance. For some time the College was visited almost every evening by a bee of the *Apis dorsata* breed. They passed and repassed on the terrace and along the corridors of the upper storeys as if they wished to make an inspection of the place. This was all the more puzzling, till then they had seldom been seen on the flowers in the gardens, and at the same time the College seemed to be too fully inhabited to afford hope of their taking up their residence in it. However, at 10 o'clock one morning the bees invaded the corridor of the second storey by hundreds, entering the rooms, examining every corner and collecting in larger and larger numbers on a beam at the eastern entrance

of the corridor. The inspection went on from 10 to towards noon. At this time the number of explorers diminished, and towards 2 o'clock not one remained. This seemed to indicate that the result of the inspection was favourable, and that the swarm would come; and it did so about thirty minutes later. The author could not watch the bees settling in their new quarters, but when he came back he found them practising flying under the arches without knocking against them. These long deliberations are difficult to explain. The author's own observations have hardly ended in anything more than proving the total absence of ideas or of the beginnings of reason. Among other facts the following may be compared with the observations on other *Hymenoptera* of M. H. Fabre. The author had been watching a swarm of *Apis florea* in order to take the comb when complete. Finally he smoked off the bees and shut up the swarm in a box. He then discovered that all the cells were closed except those of the queens, and not knowing what to do with the comb, it was left uncovered in a half-closed box, away from ants and rats. The wax moth would have attacked such a comb uncovered, and full of brood if it had been that of any other variety of bees. Three or four days afterwards the comb was found to be covered with young workers all busy in cleaning each other up, and especially busy over the drone cells. They rarely went out and then only round the box. After the males had come out, however, they seemed to be more active, and to all appearances might have succeeded in making a queen, but after ten or twelve days this fictitious life disappeared. The honey cells, although carefully closed, were entirely empty. The bees refused all offer of food and seemed determined to die, and this soon happened. When the comb was removed on a box it was found that the young bees had constructed five royal cells, two of which had been closed without anything in them. Evidently the poor creatures had behaved as if they were with their whole swarm and had never noticed the change of circumstances. At ordinary times they must have done the work of workers busying themselves with the cells already closed repairing the combs and building the queen's palace. They had evidently completely carried out their own functions. In order to go farther, the presence of a queen is necessary, and as she did not appear in time the bees could only allow themselves to die.

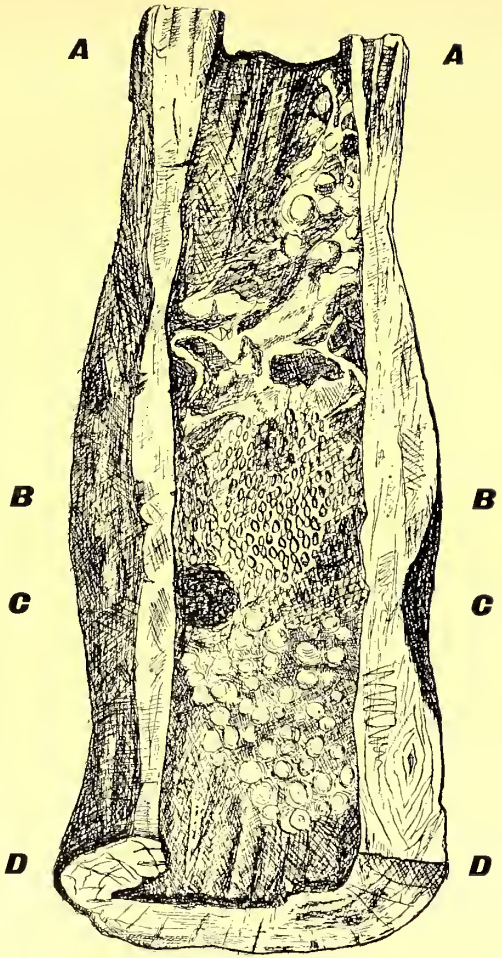
REMARKS ON TRIGONALIDS.

Principal habitat South America, many varieties, two principal groups *Melli ponæ* and *Trigonæ*. The former of the larger size and the latter very small, only two kinds (or perhaps two varieties) found hitherto in Southern India. *Trigona vidual.* de St.-F and *Trigona irridipennis*, Smith. M. de Saussure assured the author that the species he now describes was certainly *irridipennis*. Occupies the trunk of a tree, the crevice in a wall, a heap of stones or a white ant's nest, which it understands how to adapt or modify for its needs. The *Trigonæ* according to Darwin is a retrograde bee, but the author does not agree with his reasoning, which is based on the shape of their cells. These bees (the author finds) are remarkable for their courage and for their clever system of defence. Instead of the one system of furnishing found with other bees, you find with them an ordered variety. To begin with, the entry of the nest is a regular sentry box constantly guarded by a row of strong mandibles. Just behind these sentries the sentry-box chamber ends in a very narrow passage where the second defence can at once be organised against an invader. Even this is not enough. This sentry-box only communicates with the interior by a tube more or less long and always as winding as possible. Immediately at the exit of this passage are usually found the columns of pollen which have a pretty close resemblance to piles of shot heaped one against the other. Then comes the network of cells of irregular forms arranged in different manners. They contain the larvæ or else honey which has a special quality and very

delicate acidulated taste. Behind and attached along the walls of the nest are found the ordinary bags of honey in the shape of plums. Finally, at the top are oviform cells arranged in bunches and containing the workers' larvæ. The interior of the nest admirably clean and the partitions and revetments strongly built. The bees nevertheless have other resources. If you put them in a glass box with a cover which admits light, or which you open too often you will find one fine day that the buildings are covered with a reddish or somewhat transparent veil which only just allows you to see the shadows of the *Trigonæ*. For these reasons the author declines to consider the variety a retrograde one. If the descriptions of the *Mellipones* or *Trigonæ* of other lands are complete, the Indian kind differs from all the others by the presence of the two kinds of honey, three kinds of wax (differing not merely in colour but also in composition), and by the absence of any fixed plan in the building of the nests. The male is longer, 4·5 millimetres, and is also distinguished by the following characteristic. The abdomen is rounded in form and consists of bands of alternate white and dark metallic brown. The antennæ consist of thirteen joints with the tip slightly curved. One finds them all the year round, and it seems probable that they are the last to die in a swarm without a queen. They know how to take their food themselves, how to arrange the different materials brought by the workers, and, when it is a question of attacking an intruder, they are often the first and the most determined. The queen even when not fecundated is longer than the male, 5·5 millimeters. But once her abdomen is distended by the development of the eggs she measures 9 millimetres, sometimes longer. The body is black, a little thinner and longer than that of the worker. The forehead is entirely bald, but the eggs are covered with long reddish down. The cells of the queens are found in the middle of the bunches of workers' cells and are attached in the same way. Those of the drones, however, are generally at the entrance of the hives and are attached on two or three sides by broad traverses in the form of a trellis. These cells are built from the beginning of the nest and are often the first of all. Their form is rounded, while that of the queens' and workers' cells is oval. Length of the workers' cells 3 millimetres; the male cells 3·5 millimetres; queen cells 5 millimetres. The pollen is enclosed in special capsules of rounded form and 8 to 9 millimetres diameter heaped up without order or else arranged in piles. The simultaneous presence of several fertile queens is a quite ordinary occurrence with this *Trigonus*. But the author believes that when the queens are missing the bees have as much difficulty as other kinds in procuring them. He has thus seen the whole swarm perish, the drones being the last survivors. When the swarm is weak in numbers or the queen not very fertile or absent, or when they have large works to be done in the nest, these little bees entirely close all the avenues for weeks together, and if, during this time, matters cannot be settled satisfactorily, they try to drag on existence without going out, living on the remainder of their provisions for as long as they can. They swarm like other bees, but they have this peculiarity that they like living near their own kind. The same tree trunk, the same crack in the wall are often shared by as many colonies as there is room for. What is more, two or three swarms settle in the same cavity as long as there are several distinct openings, all confusion being avoided by solid partitions between the nests. Swarming probably takes place every two months, while other bees even in the plains only swarm twice or thrice a year. Length of the worker 4 millimetres. Body black metallic and bald with the exception of forehead which is covered with whitish down. Abdomen inclines to the triangular in form, wings strongly iridescent. Size of nest varies with locality or numbers of swarm; two or three examined were 45 centimetres and seven or eight in diameter. First work in building is raising the colonnades or ribs of the nest, all joined to one another and sometimes fixed to the top of the nest from the beginning or else gradually raised always a little above the cells which are attached to them. The young bees whitish in aspect for almost fifteen

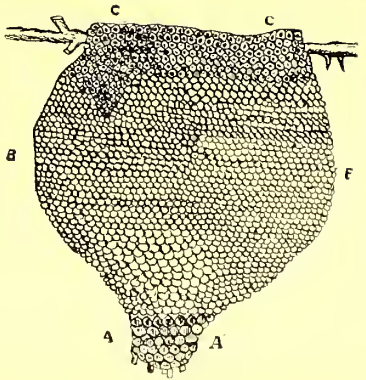
days from the time of their hatching. During all this period their abdomen is much more broad and rounded except in the case of the queen. As the integuments solidify and become coloured sub-triangular form become more and more marked. The noise made by the workers in ventilating the nest is very strident and may be heard at a distance of 2 or 3 metres. The author does not believe in the visits of inspection, leave-takings, blessings by the queen and bowings by the workers, all of which are described by other observers. The queen and the other bees move in all directions very often in a disorderly way and without any motive other than the need for keeping moving. In their different movements the queen and the workers pass and repass and mingle together without any attention, and one must have a very strong imagination to discover the least sign of respect. The author concludes by a remark applicable to all these kinds of bees. The honey of all has the same taste and the same colour. With the *Trigonæ* it is true you find some of a special quality, but the bulk of their provisions is composed of honey resembling that of the others. For whom is it that these bees gather their honey. This is a more difficult problem than you would generally believe. The exact Reaumur, even, seems not to have troubled himself about it. He says, "We know well enough that it is not for us that the bees store up honey, and that there are days, even seasons, which do not permit them to go in search of it," and in which they would moreover go in vain." According to this savant, therefore, the bees gather honey entirely to avoid famine, and this opinion is so universally received that authors who have had to raise the same question in the case of *Melliponæ* of New Granada (a country where there is no winter) give the same reply, They say that in that country there are two seasons of the year—May and June. November and December—when plants bear much less flowers, so the *Melliponæ* are forced to make a reserve in order not to suffer from scarcity. This does not explain to one the reason for the great excess of honey over that required for the bees' needs to the cases in which the bees can go out and gather at least what is necessary for them from day to day. As a matter of fact in this country they go out almost equally all the year round and always find a full supply on the low flowers, and above all on the palm trees, but, nevertheless, they do keep up a surplus store. Moreover, who has not heard speak of wild swarms of bees which have enormous quantities of honey piled up during years to which they do not cease to add in the ordinary way. The notion of a fixed idea and of a mania inherited from their ancestors is untenable, as their centres of origin lie in countries where there is little or no winter. The Hindus, noticing this fact, explain it by saying that the bees do so to have the means of making one good feast a month, and that they choose the day of the new-moon. The meal is so copious and the guests are so excited, especially in the case of *Apis dorsata*, that the honey frequently falls down and passes by. Of course it is said that every one has seen this or seen people who have seen it, and it would only be a retrograde Oriental who would not believe it. The author prefers to believe with Reaumur that nothing is accidental in nature, and that an instinct so admirable and so productive as this must have some object which he believes to be a deliberate design of the Creator and Organiser of the Universe to establish a bond of union between these workers and other beings living round and able to benefit by their product. Considering the general harmony of Nature, it is a mistake to think that there is no special object except cases in which the agent is itself conscious of it, and backward or retrograde as people may think this theory, the author prefers in the case of hypotheses those which do not exclude Almighty.

(The paper concludes with a plate of illustrations, one of a nest of *Apis dorsata* and another of that of *Apis florea* or *Socialis*, and the third of a nest in a tree trunk of *Trigonus irridipennis*, all being drawn from nature by Father H. Sauthier, S.J. For the English abstract of the paper and copy of illustrations, the Society is indebted to Mr. S. G. Roberts of the Indian Civil Service.)



NEST OF *RIGONA IRIDIPENNIS* SMITH.

A, B, Honey Receptacles. B, C, Workers' Cells. C, D, Pollen Cells.



Drawn from Life by H. Sauthier, S.J.

NEST OF *APIS FLOREA* OR SOCIALIS.

A, A, Drones' Cells. B, B, Workers' Cells. C, C, Honey Cells.

MISCELLANEOUS.

Agriculture in Burma.

Myingyan, 9th November, 1907.

SIR,—With reference to your No. 3358, dated the 26th September, 1907, I have the honour to send you copies of reports on Groundnuts, Paddy and Cotton cultivation.

Agriculture is carried on in the district to a very very small extent and to no advanced stage. The honey obtained is not used as an article of trade. It is used almost solely for medical purposes.

Sericulture is not carried on in this district. In the district of Mandalay, Pakokku, Yamethin and Peome sericulture is carried on.

I have the honour to be, Sir,

Your most Obedient Servant,

(Signed) J. S. FARNIVALL,

Deputy Commissioner

To the Secretary of the Ceylon Agricultural Society.

(*Extract from "Season and Crop Report," 1906-07 of the Myingyan District.*)

GROUNDNUT CULTIVATION.

The abnormal increase in area under "other food crops" is due to the increase in the Groundnut cultivation. An idea from the following extract will show its popularity :—

In	1903	there were	136 acres.
,,	1904	do	822 ,,
,,	1905	do	2,348 ,,
,,	1906	do	9,782 ,,
,,	1907	do	31,337 ,,

The groundnut cultivation is popular with the people on account of its inexpensive and easy mode of cultivation, its great outturn, its comparatively low rate of assessment, its suitability to a dry soil which combined with its ready sale at good prices to the oil pressers at Myingyan factories and to Chinese traders who export it. The oil is used almost exclusively for cooking purposes, and though not so popular with the Burmese as sesamum oil is, however, ousting the latter by season of necessity. Sesamum is a very precarious crop, and Myingyan being in what is called the "Dry Zone" of Burmah, the sesamum crop constantly disappoints the cultivators in not maturing. Groundnut is a hardier plant and is able to withstand the effects of the precarious rainfall of the district. Groundnut cultivation is commenced in the months of June and July, and the nuts are gathered on arriving at maturity in the months of October and November.

PADDY.

MAYIN PADDY.—This is a dry weather crop cultivated only in the beds of tanks and lagoons as the water is bailed out to irrigate earlier crops or, as the water gradually dries up from natural causes. The date of sowing differs according to the condition of the water in each locality, and the Mayin crop commencing in November is not finally disposed of till May. Usually November and December sees the ploughing of the nurseries, and December and January the ploughing of the fields. At first the four-tooth harrow is used and then a five-tooth one. The principal seed sown is nalongyi, but nayan (red) and thibon (white) are also

represented. It is reckoned that 15 baskets of seed are sown to an acre of nursery. This produces 1,500 bundles of seedlings which suffice to plant five acres of paddy land. Mayin paddy is planted more thickly than other paddy crops. The seedlings are gathered thirty days after the seed was sown and the crop is ripe 90 or 120 days after the seedlings have been planted. Naylongyi and nayan are 90 days crops, but thibon takes 120 days to ripen. From the time the crop is transplanted until it is reaped it has to be always supplied with water, and the irrigation is performed by means of scoops (kanwe) suring on tripods, and (ku) see-saw scoops. The labour of irrigation is very heavy. The crop yields from 35 to 60 baskets an acre, and 35 baskets is considered a low estimate. The value of Mayin paddy is always 20 per cent. below that of Kankyin and Kankgyi, as it is pronounced to be coarse and tasteless.

KANYIN.—Our Kankyin paddy season commences at the end of June when the ground is broken with the four-toothed harrow. Three days later the three-toothed harrow is run over it, and the nursery is sown. As in the case of Mayin: 15 baskets are sown to the acre and give 1,500 seedlings which, however, will plant six acres of land. The favourite seed used is naylongyi (red) but eikbon (white) is also found and also byatgale and longbyee. The eikbon paddy always demands Rs. 5 per 100 baskets more than nalongyi, but it has the great disadvantage of requiring 150 days between transplanting and harvest, whilst naylongyi takes but 90 days. The byatgale is found chiefly in the Kyankpadung. From sowing till transplanting both kinds are in the nursery about 30 days. The transplanting commences in the waxing of Wagaun (August). The current rate for uprooting 100 bundles of seedlings in the taze tract is four annas per diem per man and two meals. The same hire for uprooting half the quantity on upland maguang paddy nurseries is given, as here the soil is more resisting. The paddy field is prepared to receive the seedlings by ploughing it with the four-toothed harrow whilst deep water stands on it. After three days' interval the field is again ploughed with the three-toothed harrow. Then the harrow used as such, and not as a plough, is run over it. After this the Kyandon (clod crusher) is used. (This is a log of wood about 12 feet long and 6 inches in diameter which is fastened to the harrow stock.) Women are usually employed in transplanting the paddy, and they receive three annas per diem and two meals as their wage. The crop is reaped about November. It takes four men to reap an acre in a day, and their pay is either half a basket each of the new paddy, or four annas and two meals. The paddy is threshed on the ground, and by means of bullocks which trample out the grain whilst the sheaves are stirred up with the threshing stick (Kankseva). The grain is winnowed at once and then spread out on the mats in the sun to dry. The outturn is very variable. Soil, the regularity of the water supply, and the cloudness of the weather all have a voice in the matter. I consider thirty baskets per acre a low estimate.

BENET PADDY.—In this district there is a distinct crop known as the benet paddy crop, and the name of the seed is the same as the crop. This is only found in the taze tract. The grain is coarse and inferior to all other paddy except mayin as regards taste and flavour, and it commands a similar price. No nurseries are made and the seed is sown broadcast on the field and is not transplanted. Four baskets of seed are sown per acre, and thirty baskets is a normal crop. The seed is usually sown in August and is reaped ninety days later.

KANKGYI.—The Kankgyi crop is later than the Kanky in crop. The method of cultivation is precisely the same as that of the Kankyin crop, and it is very difficult to say in this district which group a crop belongs to, as the late planting of the one overlaps the early planting of the other. In the regular mogaung paddy tract of Natogyi and in the large tract of Myingyan and Taungthee, there is a reliable crop except in such a year as 1896-97 when

the tanks did not fill and very little paddy was planted at all. The little patches of paddy land found in every Kwin in the district and which rely on petty shallow depressions (often excavated by harrow only) to supply the necessary addition to the rainfall to bring the crop to maturity have a very precarious existence. Seldom will they have good crops, often they will fail entirely, and always they will give a smaller outturn than the fields below the larger tanks. For this reason the mogaung paddy is divided into two assessment classes.

PAUNGYA PADDY.—In addition to the four paddy crops mentioned, paddy is found in taungyas in the vicinity of Popa. In Popa circle the seed sown is sabasangale and taungbawgyi, and in the Nyaungunya circle ingyinbyn and kunzabya. There is really very little difference between these seeds except in the local nomenclature. The local taungyas do not differ from those in regular taungya tracts. The trees and undergrowth are felled and burnt and the ground is harrowed up in a perfunctory way. Two baskets of seed are sown to the acre. The seed is sown broadcast. The anticipated outturn is ten baskets, though in the vicinity of Popa peak the yield is often fifteen baskets. The price per basket never falls below one rupee.

COTTON.

COTTON.—There are three kinds of cotton found in this district: Wagyi, *Gossypium acuminatum*, Wagale ; *Gossypium wightianum*.

Wagyi lives for three years and is cropped each year if the field is protected from cattle. Wagale and Wani are annals and die off in the cold weather. Wagale is the variety chiefly grown in the district. Wani is grown exclusively for local consumption. Its colour is not red, but is similar to khaki, though somewhat brighter. It does not lose its colour in the wash. The coats of the humblest cultivators are almost entirely woven from this cotton. This variety as well as Wagale has been grown for generations locally, but Wagyi has been introduced in recent years, it is said, from the Thayetunyo district. It is not a very popular crop, but it is considered to do better on light sandy soil than the other varieties. It gives a longer thread than the other kinds. Theoretically a sesamum crop should be reaped off the land the year before the cotton crop is grown and all cotton land should be manured. Cotton does not follow a millet crop, though millet follows the cotton crop preparatory to the land being left fallow for such period as the particular land is considered to need it. In May and June the land is ploughed and reploughed several times with harrows supplied with from seven to three teeth. The seed is sown broadcast in July and is buried in the ground with a three-teethed harrow. The quantity of seed sown varies slightly, but in Natogyi, the best cotton tract, it is invariably four baskets to the acre. Immediately the seed sprouts the soil is broken by the harrow, and when it is 6 inches high, hoeing begins and continues until the crop commences to flower. If the weeds bid fair to obtain the mastery over the crop the four-toothed harrow is again used, but it is not requisitioned unless absolutely necessary as it roots up many plants with the weeds. It is of vital importance to keep the young crop free of weeds, and long lines of men and women are to be seen daily in the fields during the hoeing season. The wages given for hoeing are two or three annas per woman and four annas per man, and two meals to all workers. The crop is perhaps hoed three times in the season ; this depends entirely on the rainfall and the growth of the weeds. Five women are supposed to hoe an acre in a day. Wagyi is plucked in March and April, and Wagale in October and November. The crop ripens gradually and so the plucking extends over a period of weeks. There are generally six different pluckings, the first and the last being the least profitable. When labourers are hired to gather the cotton their wages take

the form of a share of the result. Women usually do the plucking. The shares of the cotton pluckers are as follows :—

1st picking—	½ result.	4th picking —	⅒ result.
2nd „ —	⅙ „	5th „ —	⅙ „
3rd „ —	⅛ „	6th „ —	½ „

The crop varies enormously. In parts of Natogyi 130 viss of cotton per acre is anticipated, and the expected outturn throughout the regular cotton country varies from 50 to 130 viss, but 50 viss is considered a small outturn in this tract. The best cotton soils are the-wun-gon, myeni-the-wun, sane-myenet, and myetha. The value of uncleaned cotton is Rs. 15 per 100 viss. It is sent to Bhamo, en route to China and to Rangoon. It takes 400 viss of raw cotton to make 100 viss of clean cotton for Bhamo and only 300 viss of uncleaned cotton to turn out 100 viss for Rangoon. The local industry of cleaning cotton for exportation was almost killed by the cotton-ginning mill which was started in Myingyan in 1898, and its existence is deplored by the people at large. It has thrown hundreds of the cultivators' wives and daughters out of work who formerly made Rs. 6 per mensem (Rs. 2 per 100) in December, January, February and March by cleaning cotton for the local Chinese merchants. Many petty brokers and merchants too have been ruined. Before the cotton was taken to the mill the seed was dear at eight annas a basket, but now its price is Rs. 2. The seed which passes through the mill is damaged by machinery and is not used for sowing. The mill-owners ship the seed to Rangoon for sale. It contains oil. The cultivator has no difficulty in disposing of his crop; the mill-owners and the Chinamen and their brokers (who are still fighting hard for their business) will always advance money to the cultivators in the regular cotton tract, and the cotton is sold and paid for at the villages and local bazaars and does not have to be carried into Myingyan for sale.

AGRICULTURAL AND INDUSTRIAL EXHIBITION, MYSORE.

REPORT BY C. DRIEBERG,

Superintendent of School Gardens.

SIR,—I have the honour to report that on authority granted by your letter No. 3363 of the 14th October, I proceeded to South India on the 15th to visit the Mysore Agricultural and Industrial Exhibition, and returned to Ceylon on the 31st idem, after a fortnight's absence.

The Committee of Management appointed by His Highness the Maharajah of Mysore in connection with the work of the Exhibition included the Revenue Commissioner (President), the Chief Engineer, State Geologist, Inspector-General of Education, Conservator of Forests, Agricultural Chemist, Superintendent of Government Gardens, Superintendent of Government Industrial Schools, and a few others.

The primary object of the Committee as set forth in their Prospectus was to impart to the Exhibition a purely educative character and to bring together articles, machinery and processes, the use of which it was thought desirable to bring to the notice of the ryot, the artisan and manufacturer, by actual demonstration.

The Exhibition was the first of a series to be held annually about the same time every year. It was kept open from the 5th to the 31st October, the cattle and sheep show lasting from the 17th to the 21st idem. The existence of permanent buildings, known as the police reserve lines, were taken advantage of as a nucleus round which a number of iron sheds were set up for the accommodation of the exhibits.

The Catalogue consisted of the following classes :—
Under Group I.

I. Field Produce—cereals and other grains, pulses, oils and oilseeds.
II. Plantation and Garden Products—Sugar cane, tobacco, coconuts, etc.
III. Vegetables and Fruits.
IV. Dyes.
V. Forest Products.
VI. Sugar, honey, etc.
VII. Dairy Products.
VIII. Essential Oils.
IX. Fibres.
X. Fodder.
XI. Manures.

Under Group II came agricultural implements and machines such as water lifts, oil-presses, husking and winnowing machines, cotton gins, sugar-mills, ploughs, etc.

Under Group III fell textile machines and fabrics, metal work including jewellery, carving and inlaid work for which the State is so famous.

Group IV comprised Live stock.

Among the special exhibits sent in were a collection of improved sanitary appliances from Messrs. Richardson & Cruddas of Bombay, Messrs. Burn & Co. of Calcutta, and Messrs. Spencer & Co. of Bangalore.

A separate section was devoted to the Educational exhibit which was under the supervision of the Inspector-General of Education and housed in the Jubilee Hall.

On the 5th October, the advertised date, the Exhibition was formally opened by H.H. the Maharajah with great ceremony. The President read an able address ; and from it I take the following passage, which appears to more or less correctly represent the state of affairs in Ceylon :—

"The endeavour made by a beneficent Government in the past to impart instruction in Agriculture, and introduce improved methods of cultivation, failed to achieve its object because such instruction did not reach the class chiefly engaged in it, and even the small number that received instruction had to resort to other employment for want of encouragement. But times have now changed. The educated classes feel that the learned professions are over-crowded, that education has been carried out too much on literary lines, and that industrial and scientific education has been neglected. The conviction that our agriculture is primitive in many respects, that our artisans are handicapped in the race of life and unable to stand the competition of better equipped nations, that the productive capacity of our lands is not what it once was, and that the struggle for existence is becoming keener every day, has penetrated the more intelligent even among the masses. The cost of living is steadily rising, and the requirements of the average Indian household have also increased appreciably during the last two decades. Everywhere there is pressing need for creating new sources of livelihood for an increasing number of the literate classes. Therefore, there are indications of a desire on the part of the people to receive with respect and attention, suggestions for improved methods of agriculture, and for the adoption of more effective appliances of manufacture. Even in the matter of co-operation and promotion of mutual credit, signs are more hopeful. The time is, therefore come when, in the words which Your Highness used on a memorable occasion, 'It is possible by an Exhibition to convey to the public evidence of the condition and progress of local industries and to suggest to those interested latent possibilities of improvement.' "

"We may fairly hope that our people have passed the stage of regarding these exhibitions as mere shows calculated to tickle the vanity of exhibitors, or to gratify and minister to idle curiosity, and that they would look upon them as opportunities for profitable advertisement or as object lessons, by a careful study and practice of which, each, in his special walk of life, can achieve better results and improve his condition."

H.H. the Maharajah's reply was practical and to the point, as the following passage, referring to the advantages of exhibitions, the questions of agricultural and industrial improvement, and co-operative credit systems will show:—

"It is not to be expected that an Exhibition of this kind should have an immediate or revolutionary influence on the agriculture and industries of a country, but they offer to all classes an opportunity of seeing what their neighbours are producing, to craftsmen they are of special use in indicating the directions in which their skill may be most usefully directed, whilst distributors may learn from them of new markets, on the one hand, and, on the other, of new sources of supply. Whatever disappointments may be in store for us, I have no doubt whatever of their educative value or their far-reaching influence in the cause of progress. I attach great importance to the policy that we propose to follow, of holding these exhibitions annually. Experience shows that, when they are held at long intervals, the lessons learnt from the successes or failures of one year are forgotten when the opportunity of profiting by them next occurs. Exhibitors are apt to remember their disappointments and the trouble and expense incurred, rather than the benefits gained, and the result is inexperience on the part of the Executive, and misdirected energy or apathy on that of exhibitors. It is our hope that an annual exhibition will produce continuity of effort and steady progress on both sides. I do not doubt that the President of the Committee will take steps to make the lessons learned each year readily available to exhibitors. As editor and originator of the *Agricultural Gazette* he is already doing most valuable work in communicating every kind of useful information to the cultivators of the State, and I hope that he will embody in a series of Exhibition bulletins, on Similar lines, the experience gained each year with regard to the several classes of exhibits."

"While I and my Government appreciate the utility of Exhibitions, we recognise the need for continuous effort in other directions. It is with a view to meet this need that, to mention a few instances, a Scientific Agricultural Department has been gradually equipped, that technical schools have been instituted at convenient centres, that a Veterinary Department is in process of formation, that the Geological and Forest Departments have for years been taking stock of the resources of the State and, last but not least, that efforts are being made to organise Industrial and Agricultural Capital. Though this last subject may not seem at first sight immediately connected with the Exhibition, I make no apology for drawing your attention to the existence of the Co-operative Societies Regulation and of a highly qualified officer, specially deputed to advise and assist those who desire to take advantage of its provisions. I have little doubt in my own mind that the main difficulty which at present prevents large classes of the community from successful competition in industrial and other enterprises, is the deficiency of organised capital and the want of confidence between man and man, of which that deficiency is in no small measure the result. Under the co-operative system, any local body of craftsmen or agriculturists, however poor or however limited in numbers, has the means of acquiring gradually, and from small beginnings, sufficient capital to provide for immediate needs and for future progress, and I would urge on all educated and enlightened men, whether immediately concerned or not with agriculture, crafts, or commerce, the duty of promoting these societies to the extent of their ability. Apart from the material return, which

is their immediate object. such societies have, in every country where they have taken root, proved great moral educators and promoters of mutual confidence, self-reliance and honest enterprise. Government have given the facilities, it is for you to take advantage of them."

On my first visiting the Exhibition I was fortunate in having for guide Dr. Lehmann, State Agricultural Chemist, who combines in himself all the duties of an Agricultural Department. Dr. Lehmann had much to do with the Exhibition, and being thoroughly conversant with the exhibits, was able to explain them to me very fully and give me a great deal of useful information.

Among the agricultural exhibits paddy, grains and pulses made a large show, ragi (our kurakkan) being much in evidence. The Agricultural Chemist himself had a most interesting exhibit of his own, illustrating the chemical side of food stuffs and soils.

Sugar cane was prominent among plantation products. Mysore cane is a good yielder of sugar, and demonstrations in its manufacture were given for the benefit of visitors. Under ordinary circumstances a good deal of sugar is lost by fermentation of the juice, which is preventable (1) by boiling the juice as soon after extraction as possible, (2) by keeping utensils thoroughly clean, and (3) by avoiding earthenware vessels. Other points to be borne in mind with a view to getting a maximum yield of sugar are the adding of enough lime, sufficient to turn red litmus fairly blue, and skimming thoroughly in the boiling. The only exhibits from Ceylon were to be found in the Plantation Products Section, and consisted of a few samples of chewing and smoking tobacco from Jaffna. The specimens were by no means very attractive, and it is a pity a small exhibit of our chief estate products could not have been placed on view. Coffee, as was to be expected, was well to the fore as a product of the State.

Among Forest Products were a number of familiar Ceylon woods such as Satinwood, Tamarind, Suriyamara (*Albizzia odoratissima*), but others little known to us, except by name or as manufactured articles, were also to be found. Chief among the latter was white sandal (*Santalum album*), widely distributed throughout the State, except in the high forests. The wood is hard and oily and the heart-wood red or yellowish-brown with a strong scent. The best specimens of this wood fetch as high as Rs. 780 per ton, while even the saw dust is saleable at Rs. 250. The artistic carving in sandal wood is one of the chief local industries. In the Forestry Section was also included some fine mounted specimens of the denizens of the forest.

The reeling of Mysore mulberry cocoons was one of the many interesting demonstrations, which included a competition in cloth weaving in various indigenous and improved looms, ploughing, etc.

The Public Health Exhibit was very striking. The subject of malaria and its causes was fully dealt with. Sewage contrivances, model houses and conservancy methods were all illustrated, and brought home by actual specimens and structures howing for comparison and inference the old and new systems.

An attractive exhibit was the loan collection from the Maharajah's palace—rare specimens of art in stone, wood and metal.

Printing and photo-engraving processes, leather goods and locally distilled liquors were also in evidence.

The State is very rich in minerals from gold downwards, and the Geological Exhibits were fairly representative.

The cattle section comprised some of the finest animals of Southern India, and prizes were awarded for trotting, ploughing, heavy draught, riding, and breeding animals.

A lecture on the Cultivation of Fibre Plants was delivered at the Exhibition by Mr. Cameron, Superintendent of Government Gardens, in which he specially recommended the cultivation of Sisal Hemp in Mysore.

Dr. Lehmann delivered a lecture on the Sugar Industry, of which he has made a special study.

The subjects of other lectures were "Co-operative Banks," "Mineral Industries," "Hand-loom Weaving," "Water and Water-borne Diseases," "Selection and Preservation of Seed," "Recent Researches in Plague," "Milk and Milk Products," "Cattle Disease," "The Improvement of Agriculture," "Printing and Dyeing with Vegetable Stuffs," "Common Insects and their relation to Disease," (the last being the subject of Dr. Pani, late of Ceylon, and now Health Officer of Bangalore).

In addition to the above an Engineering Conference was held on the 21st October.

The Educational Exhibit was formally opened on the 18th October. It was suggested by the Exhibition held in August by the Madras Department of Agriculture—the first of the kind in India. The chief attraction at the latter was a large collection of exhibits showing the work of pupils of English schools received from the Board of Education in England and the London County Council. These were supplemented at Mysore by many valuable exhibits which arrived from England too late for the Madras Exhibition, a collection of Manual Training Models presented to the Mysore Department of Education by the London County Council, drawings, designs, models and specimens of handiwork presented by the Educational Committees of Leeds and Bradford, as well as a collection of Nature Study exhibits presented by Mr. Dymond, His Majesty's Inspector for Nature Study.

The English loan collection comprised many excellent specimens of Nature Study drawings, paintings, clay models, needlework, lace work and embroidery, and exhibits relating to all sections of domestic economy, including cookery, housewifery, laundrywork, the records of school journeys and of school work in every subject taught, the time tables of the County Council Schools, and the schemes of science and other courses. Alongside of the models of wood and metal work from England were the models of Swedish Sloyd as adapted and developed in Boston Normal School for teachers. These were supplemented by local collections of exhibits from both boys' and girls' schools in Mysore, including drawings and models showing much promise. n his address at the opening of the Educational Exhibit, the Inspector-General of Education said :—

"I hope the Exhibition will show to our teachers how greatly the ideals and methods of educationists in Europe and America have altered in matters relating to elementary education during the last twenty or thirty years; how children from the time of their infancy are taught to observe accurately and express their ideas of what they observe in words, drawings or paintings, how nature study has become the basis of all early education, how the eye and hand are trained, first in the Kindergarten and, later, by constructive work, which aftert he age of ten takes the form of Agriculture in "rural schools, and of Sloyd or wood, metal and machine work in town schools, how the aim is to combine with accurate observation and clear reasoning a well-developed body, a healthy self-activity and a resourcefulness and will-power which can only be acquired by scientific manual training."

In connection with this exhibition a short series of lectures was arranged, consisting of lantern lectures on educational subjects, and demonstration classes to show the method of instructing deafmutes and the blind.

While on the subject of education I might refer to my good fortune in meeting with two exponents of the later developments of Education Science, viz., Nature Teaching and Sloyd.

A letter of introduction from the Inspector-General of Education gained for me a meeting with Miss Latter, one of the leaders of the Nature Study movement n England, who has come out on a six months' engagement with the Mysore Government to introduce her methods of work into the State Schools. Miss Latter has fully expounded her scheme in her work on School Gardening, but the advantage of a personal conference was considerable. The progress of School Gardening in Ceylon was a pleasant surprise to her, and it is not unlikely that, before returning to England, she may visit the Island to satisfy her curiosity as to the conditions and results in Ceylon of the work in which she is personally so greatly interested.

Dr. Larsson, at present organiser of Sloyd in Mysore, and who has come out from America on a similar term of engagement, was another interesting personage. He is a Swede, who is in charge of the Sloyd school in Boston, from which, up to date, 275 teachers have graduated. Sloyd is best defined as educational manual training or tool work so arranged and put into practice as to stimulate and promote vigorous, intelligent self-activity, for a purpose which the organizer recognises as good. The practical application of the principles involved I had the opportunity of seeing for myself by attending Dr. Larsson's class at the Memorial Hall, Bangalore, where the full significance of his system of instruction was evidenced. Papers handed to me by Dr. Larsson I have transmitted to the Director of Public Instruction.

While in Bangalore, Dr. Lehmann was kind enough to take me over his chemical laboratory and also show me the experimental work he is engaged on. The laboratory is a monument to the intelligent administration of the State, representing as it does a large expenditure of money for the development of the natural resources of the land—agricultural and mineral. The appliances are of the most recent make, and the general provision for work is as satisfactory as one could desire. I here saw a series of interesting tests in potculture to determine the value of different manures applied under different conditions to one of the common grain crops of the country (*Eleusine corocana*, ragi or kurakkan), as well as other outdoor experiments.

Before leaving Bangalore I took the opportunity of visiting Tata's Silk Farm, where I was glad to meet the permanent Manager, Mr. Odzu, who on the occasion os my previous visit was away on leave in Japan. Mr. Odzu very willingly showed mj all there was to see both in and out of doors, and gave me all the information e desired to have. He claimed that the silk from the Mysore mulberry worm was superior to that of Bengal, and that the most recent valuations obtained from England were decidedly encouraging to the local industry. I procured samples of silkworm nets of different dimensions for facilitating the feeding and cleaning of the worms as they pass from one stage of development to another. I am inclined to think that those who prefer to keep mulberry instead of castor-oil worms in Ceylon could not do better than select the Mysore species, distinguished as *Bombyx meridionis*, which appears in every way to suit local conditions, as I have shown by rearing them at the Government Stock Garden.

I was forcibly struck with the suitability of Casuarina for seaside planting in South India, and would suggest that an attempt be made to utilise it for growing in coast towns like Chilaw, as well as in sandy wastes such as occur in the Jaffna peninsula. I shall be glad to procure seeds for anyone wishing to make the attempt, The cost of a pound will be about Rs. 3. Casuarina is being extensively planted in Southern India for fuel, and as such is a profitable cultivation.

I am, Sir,
Your Obedient Servant,
C. DRIEBERG,
Superintendent of School Gardens.

The Director, Royal Botanic Gardens.

Literature of Economic Botany and Agriculture. XXIV.

BY J. C. WILLIS.

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JUTE *VS.* RICE.

The question whether the expansion of the jute industry has led the cultivator to forsake the growing of paddy for a more profitable crop is one which is often asked, and which has been answered by a section of the Indian public with an indignant affirmative. There are many good people who are much distressed at the thought that the food supply of Bengal is being neglected for the sake of the larger gain which can temporarily be derived from jute. So greatly are they concerned at this diversion of the energies of the agriculturist, that they have been endeavouring in speech and writing to induce the ryot to take what they regard as a more patriotic view of his selection of crops. "The country," they say to him, "must have food, and it is your duty to provide cheap rice even if it pays you better to grow dear jute. Already the fatal effects of the fascination exercised by jute are to be seen in the curtailment of the rice-growing area and the unprecedentedly high price of rice." Further, to assist in keeping down the price of rice they have started a movement which has, as one of its aims, the prohibition of the export of this leading article of food supply. That the intentions of these alarmists are excellent need not be disputed, but the fallacious character of their argument is obvious. Cheap rice necessarily means a small return to the grower for his trouble, and the suggestion deliberately made by those who deprecate jute cultivation is that the ryot should grow rice on such a scale as to reduce his own profits to vanishing point. The contention is palpably unfair. No one would venture to tell a merchant or a lawyer that it is his duty to carry on his business at a loss or at a margin of profit which yields a bare living wage. Why is the ryot alone to sacrifice himself for his country? If it be argued that the advice given is designed for his ultimate advantage, the reply is that he, like every other man, must be allowed to judge for himself where his true interests lie. Any attempt to check the free play of economic forces can lead only to injustice and disaster. Happily, it is unnecessary to discuss the expediency of measures to encourage rice-growing and discourage jute-growing, for it has just been shown that the assertions of fact upon which the alarmist views of the anti-jute agitators are based are wholly inaccurate. On this ground we look upon Mr. Oldham's "Note on the Present High Prices of Food-grains and Possible Causes therefor" as deserving of a more prominent place than the Supplement to the *Calcutta Gazette*. In our judgment it is a most important pronouncement which should have a reassuring effect in rural, if not urban, Bengal. Mr. Oldham does not,

of course, deny that the price of rice has risen, but he shows that the significance of this fact depends upon a number of considerations. If excessive jute-growing were the cause of the dearness of rice, we should not expect to find other grains which are little cultivated or consumed in Bengal in any way affected. But as a matter of fact, while the price of rice is 58 per cent. above normal, the price of wheat is 26 per cent. and that of maize 70 per cent. in excess of the previous average. The price of food-stuffs has advanced all over India, and for this universal enhancement jute cannot be blamed. Coming to the specific allegation that the enhanced price of rice is due to the increased area devoted to jute, Mr. Oldham remarks that "although the total area under jute in the two Provinces has increased during the past six years by more than one million acres, there has been no corresponding decrease in the area under rice. In fact the tendency during the same six years has on the whole, as the returns show, been for the area under rice to increase." Thus jute must in large measure have brought new ground into cultivation. It should also be borne in mind that the jute area is not used solely for that crop, for the practice of growing winter paddy after the jute has been gathered is slowly extending. Mr. Oldham thus explains one of the main arguments against jute-growing, the rise in the price of rice, and shatters another, which rested on the assumption that the rice area had decreased. In dealing with the causes of the enhanced cost of rice, Mr. Oldham propounds a theory which has at first sight the appearance of a paradox but which is nevertheless not incredible. It is that the dearness of rice is partly due to the increased prosperity of the ryot. The failure of the winter rice crop of 1905 and of the autumn crop of 1906 produced a scarcity which would in normal circumstances have driven the ryot to consume Burma rice or coarser grains. But the ryot was not in the mood for reducing the quality of his diet. A profit of 15½ corers from jute-growing in a single year had raised his standard of comfort. He has bought himself an unbrella. He has taken to wearing shoes. He smokes, and prefers to go by train instead of walking. And he has learned to appreciate Bengal rice. As a result of his sense of being well off he refused to buy Burma rice, though large quantities were imported for his benefit, and his demands have tended to help the upward tendency of the price of the Bengal variety. The wages paid at the increasing multitude of mills have had a similar effect upon another section of the population, and thus it may be said that the growing prosperity of the people of Bengal has been largely responsible for the dearness of Bengal rice. For clerks, the professional classes, and urban dwellers generally, the rise is unfortunate, but they are not the only classes to be considered.

II.

Mr. Oldham's conclusions regarding the alleged injurious effect of extended jute-growing upon the rice crop are fully confirmed by the experiments with *aman* paddy which form the subject of a Report compiled by Mr. F. Smith, the Deputy Director of Agriculture in Bengal, and issued as the first of a series of Departmental Records. Mr. Oldham gave reasons for believing that the high price of rice was due to causes affecting other food crops which are not grown in Bengal. He further pointed out that, while the area under jute is being largely increased, there had been no decline in the rice area. And finally he referred to the fact that the cultivator is beginning to realise the possibility of growing rice and jute on the same field in the same year, and of thus obtaining two profitable crops instead of one. That this statement is not in any way optimistic is shown by statistics taken from the settlement records of a few estates in Eastern Bengal. These indicate that nearly half the land on the estates in question on which jute is grown also grows a crop of paddy the same year. If this double crop is expedient from the point of view of agricultural science, then all anxiety on the score of the extended cultivation of jute may be dismissed. Hence the importance of the experiments carried out under the

direction of Mr. Smith, which demonstrate that the double crop is practicable and profitable. Summing up the results of the work done at Burdwan last year, the Deputy Director says emphatically :—"These figures do away entirely with the idea that, if the area of jute cultivation is increased, the people's food supply will be imperilled, for not only is the ryots' food-supply assured by the paddy crop, but in the same year a crop of jute is obtained from the same land, and this extra crop will enable the cultivator to obtain other necessaries of life than those ensured by the paddy crop." The mischievous character of the attempt to induce the ryot to confine his attention to paddy is made very conspicuous by the figures which Mr. Smith cites. Land which will only yield coarse paddy, worth from Rs. 22 to Rs. 28 an acre, will grow jute worth Rs. 125 an acre. To advise the ryot to sacrifice a crop worth Rs. 125 in favour of one worth Rs. 28 would in any case be foolish, but when it is known that he can grow both and make a net profit of Rs. 150 an acre, the misguided agitation in favour of exclusive rice-growing cannot be too strongly condemned. It may be of interest to mention that the *modus operandi* for securing two crops is to sow the jute in the beginning of May. At the beginning of August it can be harvested, and the land, after being thrice ploughed and once harrowed, is ready to receive the transplanted paddy. It is to be hoped that no efforts will be spared to bring these facts to the knowledge of the cultivators. In Bengal this is the true technical education upon which public funds may be expended to the advantage of the whole community. It must not be supposed, however, that the problem of growing rice and jute on the same land has engrossed the activities of the Department. Investigations are also being prosecuted into the most economical manures and their most profitable use. The merits of different ploughs have been tested. Attention is also being given to the problem presented by the many varieties of paddy. Their name, observes Mr. Smith, is legion. Mr. N. G. Mukherji's collection, made for the Indian Industrial Exhibition in Calcutta, contained as many as 1,182 named varieties. It is impossible to suppose that all these are equally good. For market purposes, at any rate, certain varieties are known to command a ready sale and a high price, and it will be greatly to the advantage of the cultivators if they can be led to grow the kinds which are the most trustworthy and yield the best results.—*Indian Agriculturist*, Vol. XXXII, No. 10, October 1907.

Notes and Queries.

BY C. DRIEBERG.

I may mention for the benefit of those who are growing Kola or Bissy nut (*Cola acuminata*) that the use of the nut (according to a Circular report in the *British Trade Journal*) is increasing. It grows best in moist soils from sea level up to 3,000 feet, and attains a height of 30 to 50 feet. A tree ten years old should yield from 100 to 150 lb. of nuts per annum. The price according to a Jamaica report varies from 8s. to 15s. per 100 lb. according to season. The nuts are simply dried for the market. They are considered an excellent tonic and are chewed by the natives for liver complaint. I may mention, on the authority by Sir Henry Blake, that it is also very efficacious in malarial fever.

P.—Here is the latest Indian report on the subject of transplanting single seedlings instead of clumps. The experiments were undertaken by the Bengal Department of Agriculture :—"For the last three years experiments have been conducted to ascertain at what distance apart paddy seedlings should be transplanted, and whether any benefit is derived by planting more than one seedling in each hole. The results for the three years show that it is best to transplant from

9 inches to 12 inches apart, and that planting one seedling per hole, 12 inches apart, has given a better outturn both in grain and in straw than planting two seedlings per hole at the same distance apart. This is a very important result, and it is worth bringing to the notice of all cultivators who grow paddy. In almost every part of the province there is an idea among the cultivators that it is better to dibble in several seedlings together in each hole. In some places four to six are planted, in some places eight to ten, and in parts even a larger number than this is dibbled in together in each hole. It has long been thought that this was a most wasteful practice, and the results of experiment at both the Burdwan and Cuttack Stations corroborate this view. As long as *one healthy seedling* is planted in each hole it is quite sufficient; and this means that the cultivators might effect an enormous saving in the consumption of paddy for seed. It has been estimated that some 3,50,00,000 maunds of paddy are used each year for seed. If three-fourths of this, or even one-half can be dispensed with, there will be a large saving to the cultivators. At Cuttack the results have been the same. At this station, for the last two years he practice of planting one seedling per hole has been compared with planting two, four, and eight seedlings per hole, and one seedling per hole has given the best outturn all through."

T. M.—The specimens of beans you send are those known in India as Guar beans (*Cyamopsis psoraloides*) called by the Tamils Koth-averay. It has been successfully grown for the last year or two at the Government Stock Garden and the seeds distributed to School Gardens. The plant is a robust hairy erect annual, 2 to 3 feet high. The pods are thickish and from 1½ to 2 inches long. Not only are the ripe seeds eaten, but the tender pods are also cooked as a vegetable and are very palatable. The albuminoid contents as given by Church are 29·8 per cent. against 24·5 in the groundnut (Arachis). Altogether it is a bean that is worth popularising.

J. A.—It has been conclusively proved in Indian experiments that saltpetre and bonemeal produce excellent results on paddy: 60 lb. saltpetre and 250 lb. bonemeal are required per acre. You (and all paddy growers) would do well to satisfy yourself of the benefits of this manure by an experiment. Order a small quantity from any dealer in manures and try it next season; if it is found that the expenditure of a few rupees more will double the crop, the ultimate result may be an appreciable increase in the local production of paddy.

N. D.—I do not know what financial assistance in the case of well-irrigation is granted in the South of India, but I have just read that a special officer of the Bengal Department of Agriculture, who was put on to enquire into and report upon well-irrigation in the Province, recommends its encouragement and suggests that in order to help in the construction and maintainance of wells, loans should be granted by Government under the Land Improvement Loans Act and Agriculturists' Loans Act, and at a lower rate of interest than at present—all such loans to be advanced locally. The Director of Agriculture, Bengal, is said to have secured Government sanction to employ a staff of borers, who will be fully equipped with boring tools, to give assistance to those desirous of constructing wells.

F. N.—I am sorry to say that hardly one in a hundred cuttings of *Prosopis juliflora* were found to stike. I have written for seeds, and you can have plants when I raise them. The tree is prickly and 40 to 50 feet high when full grown. The pods are described as buff-coloured and about 6 inches long. It is these pods that give the tree value as a source of stock food. The common names of the tree are Agroba, Mesquite and Cashaw. Baron von Mueller mentions that it thrives in damp saltish air and at sea level. The Locust bean or St. John's bread (*Ceratonia siliqua*), so far as my experience goes, is unsuited to Colombo. I have sent two plants to Jaffna to see how they will do there.

Correspondence.

FRUIT CULTURE.

SIR,—In the "Illustrated London News" of the 6th July, p. 16, are illustrations *inter alia* of the Mangosteen, called Miram, the most delicious fruit in the world, in connection with which is said "The West Indians say that strawberries are perfect, but that mangosteens are heaven." It appears at present there is only one tree that yields mangosteens in the West Indies. . . . . and it is to be largely cultivated. In the same issue is depicted "The Chrystaphyne" which is none other than "The Chowchow" which grows very easily in Ceylon. As no reference to the mention of these illustrations has appeared in the local press, I think it worth calling the attention of those who can export mangosteens to their being known in London, for recently, I read in "The Times Weekly Edition" of these fruits and mangoes being exhibited at the Royal Horticultural Society. From Natal, what is called a new fruit—the *raartje* was exhibited. It seems to correspond to the smaller mandarin orange. Pines from the Eastern Province of Cape Colony were also exhibited. It would be fully worth the trouble of people in Kalutara, Galle, and Udugama to export mangosteens to London. Pineapples are tinned in Singapore and sold in Colombo—1½ lb. for 35, and 2½ lb. for 50 cents. I cannot understand why the Agricultural Society does not import Litchi plants. Thirty years ago Chinese merchants sold the dried fruit in Ceylon, and it forms part of the preserves from China. A local horticulturist advertises a plant at Rs. 4. "The Illustrated London News" says "The Christaphyne" is coated exactly like a vegetable marrow. At the Agricultural Society, the Hon'ble Mr. John Ferguson, C.M.G., spoke of the "Chowchow." In the same issue of "The Illustrated London News" is depicted "The Mammee Apple" which seems to correspond to the Sapodilla. "The Loquat" is another fruit which does not seem to be appreciated in this country, as I see many trees which are never pruned.

J. VANDERSTRAATEN.

September 17th, 1907.

[The difficulty with the mangosteen is carriage for a month. Litchis have never succeeded in Ceylon, though there are trees upcountry. The Mammee Apple is not the sapodilla, and does very little here.—ED.]

FUNGUS ON RUBBER PLANTS.

DEAR SIR,—I send by this post (I hope it will arrive safely) 6″ of stem of a rubber (Para) plant a year old which shows the characteristic of quite a number of trees growing in a patch of lowlying ground, about 9 acres in extent. The bark it will be noticed, is dry and rough with a bad wound in it with a black rusty fungus on the lower end. The attack is recent but speedy I fear. The black sooty looking fungus, as I take it to be, is much worse on some trees than in others. Large patches of irregular form, being conspicuous are massy. In some of my larger trees the wound is very extensive with a striated appearance, new bark appears very soon after the split of the old, and eventually the wound gets covered but with a gnarled and rugged bark which however appears to grow over a more or less extensive patch of dead tissue. The growth of the trees appears to be distinctly affected. New shoots lose their leaves and eventually die back, and the leaves assume a leathery unhealthy look. In two or three trees attacked some six months ago, which have succeeded in throwing new bark round the wound as described above, the growth appears to have recommenced, but the tree does not look by any means healthy and has a stunted hidebound appearance. I shall be much obliged if you will let me know if this is a canker, and if so, the remedy, the drastic one of uprooting and burning all trees or painting the surface with a mixture or what? This attack

has followed one of cockchafer grubs, consequently the appearance of the whole plot is very discouraging. The seed from which these plants were raised came from Ceylon, but have also been in close contact with a nursery of plants from the Government plantation at Mergui. Any advice will oblige very much.

Yours truly,
J. G. F. MARSHALL.

Tavoy, Burmah, 30th October, 1907.

[The specimens have not been received, but in any case they should be sent to the local department and not here. By the time they reach Ceylon they are covered with many fungi, and it is extremely difficult, if not impossible, to make much of them.—ED.]

ENEMIES OF PARA RUBBER IN BURMA.

DEAR SIR,—Please allow me to make the following corrections in my last letter in your November issue:—

Line 5 "origines male" should of course read "origines mali." For "male rat" read "mole rat" wherever the words appear. For "*new* rainy season," the last line on p. 382 read "*non* rainy season." In 6th line on p. 383 for "in all surprising reason" read "for the all sufficing reason." In line 11 for "Tavoy Evez" read "Tavoy every."

Yours truly,
J. G. F. MARSHALL.

Tavoy, Burmah, 19th December, 1907.

RUBBER TAPPING IN BOLIVIA.

SIR,—I am sending you the enclosed, thinking that it will interest your readers who are interested in the exploitation of rubber and planting of same. In the article mentioned in the June number of your journal, I was surprised at the small ratio of rubber to latex as set forth in the experiments. Truly, what we don't know about rubber, its growth, yield and exploitation is marvellous. Nearly everyone handling this industry has a different experience when tackling almost the same questions in different localities.

Yours truly,
BOSTON AND BOLIVIA RUBBER CO.,
F. J. DUNLEAVY.

Sorata, Bolivia, Oct. 1, 1907.

THE EDITOR,—Your article on rubber picking in Ceylon in the June number of the "Tropical Agriculturist" was most interesting to me, as it must be to all interested in rubber planting and exploitation, and noting how these experiments differed from some of those carried on by myself in the tapping of *Hevea brasiliensis* in their natural habitat at the head waters of the Amazon, on the Mapiri, Kaka, and Beni Rivers in Bolivia, I am sure that it will be of interest to rubber planters and exploiters to give the details of this experiment.

I may mention that while the Hevea of this section grows at as high an altitude as 4,000 feet, it produces at this height very little latex of an inferior quality, and that my experiments were carried on at an altitude of 1,500 feet.

I started out one morning in June at 5 a.m. with the quickest worker and picker on the plantation of the property of the Boston and Bolivia Rubber Co. of nearly one million acres. The picker carried a Machadine for tapping, a small tool about two and half inches long, with a cutting face of three-quarter inches. This is manufactured in the United States, and is the favourite tool for this purpose from here to the Amazonian Flats. Before fifteen minutes the picker was tapping, and I was measuring the trunks of the rubber trees so tapped six feet from the ground. From this time to 10 a.m. the picker had tapped, and I had measured 345 Hevea trees.

during the same time he attached 946 tichelas to the trees. On 35 trees he had placed one tichela, on 103 trees he had placed two, on 128 trees he had placed three, on 70 trees he had placed four, and on the remainder of the trees he had placed five tichelas. The average of the trees measured was 16 inches in diameter.

At 10 o'clock the picker returned to the starting point with his balde, or empty bucket, and began to gather the latex which had exuded from the Rubber trees since placing the tichelas on same. The tichelas were left by the trunk of the tree for the next operation when the picker was tapping same.

At 3 p.m. he returned to camp with his balde of latex to where the buyon or smoking furnace was located. In this part of Bolivia the wood of the Chiri Palm tree is used to fabricate smoke, while lower down the Amazonian Water-shed the nut of the Mutiku tree is used. Both create the dense smoke necessary for the coagulation of latex.

The balde containing the latex was weighed on the store scale—not very accurate—and scaled with the weight of the pail 4 lb. 23 lb. The latex was then poured into a dish, and placed near the fire, when the picker after warming his paddle-shaped baton in the smoke, proceeded to pour the latex over same with a tichela fastened to the end of a two foot handle. I may mention here for the benefit of rubber planters who want to brand their rubber without injuring same, that the best way is to have the brand either cut into the paddle, or raised on same so that the coagulation of latex on same affixes the brand on the rubber, either engraved or embossed. The paddle after being covered with latex was revolved in the smoke rapidly until coagulated. This occupied from eight to ten seconds, when a fresh addition of latex was added to the paddle, and again the latter was revolved in the smoke until coagulated. This was repeated until the whole of the latex was coagulated into one large bolacha of rubber attached to the paddle. During the process I had the paddle with some rubber attached weighed, and it turned the scall at 14 lb., while the remainder of the latex in the dish, with weight of dish deducted weighed 7 lb. The picker continued to add the remaining latex to the paddle until the coagulation was completed, and the paddle was again weighed and turned the scale at 21 lb. The weight of the paddle was 2 lbs., so that there were 19 lb. of rubber for 19 lb. of latex. This indicates that in the rapid coagulation of latex containing a high percentage of rubber there is no weight lost. The balde was then filled with water to the same height as formerly occupied by the latex, and weighed for the purpose of determining approximately the difference of the specific gravity between the latex and the water, and to the surprise of those present it weighed the same.

After two hours the newly-made rubber was cut from the paddle by running a knife on two sides of the bolacha from the handle down, and being in one piece is displayed two anchors, the Company's brand, on one side of the rubber. It was then turned into the store, and sixteen hours after, this same bolacha of rubber was weighed, and was found to have lost 5½ lb. in weight. Twenty days after it was again weighed with a further loss of 3½ lb. This would illustrate to my mind that rapid coagulation is a mistake, and that each coating of latex added to the coagulated bolacha of rubber should be properly browned with the smoke, instead of making it only sufficiently solid to prevent dripping from the paddle. This extra smoking would improve the keeping qualities of the rubber and increase the price of same.

The trees used for the experiment were an average estrado, but most of the trees, as indicated by the tichelas attached, had been overtapped during previous years. This was because the picker did not care to tap new estrados further afield on account of their being at a greater distance from his habitation. He worked two

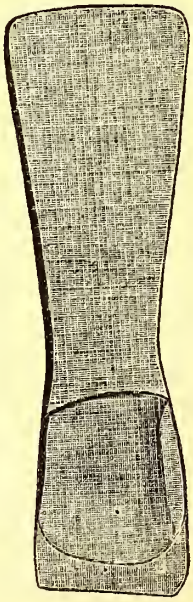
estrados alternately, and his highest delivery of rubber for any one month was 164 lb. dry. Being a quick worker, he, many times, when making an incision with his machadine, would strike hard and inflict a wound in the wood of the tree, thereby damaging its productive capacity for the future.

During the march over this estrado I saw a rubber tree which had been broken off from the trunk forty feet from the ground, and only the trunk was left standing. This trunk was $2\frac{1}{2}$ feet in diameter, and the picker was working the same with three tichelas, and had been doing so for two months. One tree sixty inches in circumference was hollow, and the same picker was working three tichelas on this tree.

The resting season for the rubber trees in this part of Bolivia is from August to December, and as the ratio of rubber to latex is very high, this is probably the cause of it. There are hundreds of new estrados in this section of Bolivia which cannot be worked on account of the lack of labour and transportation facilities. The latter are being rapidly overcome by the building of roads and railways in Bolivia on the one hand, and the construction of the railway round the Madera Falls in Brazil on the other, which will give a safe outlet down the Amazon for rubber in the future, as well as by the mule trails at present constructed, but which will be replaced by the Railways; thus the output of rubber from the Hevea trees for this Republic would be increased, and a corresponding increase in the export of same to ten times the present quantity.

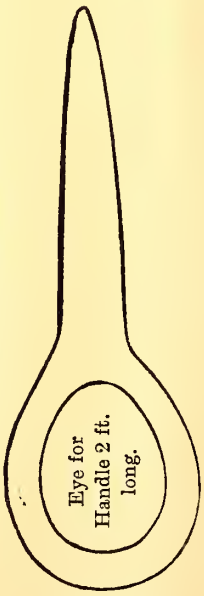
F. J. DUNLEAVY.

Sorata, Bolivia, October, 3rd, 1907.



Side view of Machadine.

Full size.



End view of Machadine.

Full size.

THE SUPPLEMENT TO THE

Tropical Agriculturist and Magazine of the C. A. S.

No. 1.] JANUARY, 1908. [Vol. II.

THE PRODUCTION OF TEA.

POSITION OF GROWERS.

It is well for those who drink tea that after many years' indifference to the discovery made about 1820 that trees were growing wild in Assam the Indian Government procured young plants from China, and seed for distribution in different quarters, in order to promote experiments in tea culture. Upon these foundations, laid seventy years ago at Chubwa, in Assam, has arisen in the eastern dominions of the Crown the industry which now yields 420,000,000 lb. a year, provides fifty millions of our British fellow-subjects with what has become almost a necessary of life, and has something left to spare to meet the call for tea, more tea, that comes from nearly every other country in the world. The story of the industry's uprising—its ebb and flow as the tide of fortune receded or advanced—cannot here be recited in detail, but a few points emerge well worth recording at a time when thoughts are turned to enterprise abroad, and many wish to know what is the true position of producers.

Passing in quick review the Government's experimental gardens before 1840, most of which were transferred to the Assam Company formed in 1839, the beginnings of culture in Dehra Doon, Kangra, and Kumaon soon after, some early plantings in Madras, and the successful experiments in Cachar, Darjeeling, and Sylhet before 1860—in that year 1,000,000 lb. were sent to England from estates already on a commercial footing—we come to planting in the Terai, which followed about 1862, and in the Dooars about 1875, and within the last twelve years the opening of many of the large estates in Travancore. In the meantime tentative experiments were being made in Ceylon, but it was not until its valuable coffee plantations were threatened with extinction, and other products had been tried, that earnest attention was given to tea and the basis laid of the industry which has proved of such great value to the colony. A garden opened more than five and thirty years ago still sends good tea to market, but 1880 was reached before 100,000 lb. were exported—this year the total will be as much as 178,000,000 lb.

The gardens first laid out in India were planted with the Chinese variety of bush, but by degrees this has been widely superseded by indigenous or hybrid kinds, which are more remunerative in many sites and soils; the China plant yields much less weight of leaf, but in Darjeeling fine flavoured tea is made from it. Until quite recent times some of the original stock was still bearing after the lapse of 40 or 50 years, and a little still exists where first planted. Nothing short of that age is accounted particularly old, and the endurance of young bushes treated with the care now given to them is expected to be still longer.

Duration of Bushes.

These facts supply the answer to questions which some are doubtless asking—Is the soil durable, is the bush a long-lived one, is there promise of permanence for this industry? It is true that in India some very ancient plots have been abandoned, as in Cachar and Assam, and that of plantings in Terai perhaps one-fifth, which low prices had made unprofitable, has gone out of cultivation, while in Ceylon, it is said, there are some gardens which are not likely to last. No secret is made of it. In the beginning the pioneers lacked experience; wrong sites were sometimes chosen, such as steep hillsides which have been denuded of their soil, while bushes were treated in a way that a modern planter would deem brutal. In those days there were no scientific experts as there are now, continuously advising growers about their soil, manure, catch crops, and insect pests, while the genius of inventors had not then devised the machinery that now simplifies, hastens, and cheapens the work inside the factory. It is stated that no gardens made on the Darjeeling hills during the past

forty years have failed to last, and from evidence available it is reasonable to believe that the productive life of a tea bush is a question of treatment, soil and climate. Given good soil, favourable climate, and judicious handling, it would be difficult to assign a limit to it. The bushes have been stricken by hail, blight, flood and drought; still they survive, and there is no record of complete failure of a crop. The longevity of tea under careful culture is established; but on the other side must be set the fact that from old bushes such fine quality as young ones give cannot everywhere be made, while land long cropped needs much top-dressing, which entails expense; so prudent planters uproot old bushes to give place to new, or make some fresh extension year by year.

Available Acreage.

An official return enumerates about 530,000 acres of tea in India, of which 21,367 are stated to be immature, but some of the figures are termed imperfect or inaccurate, and stress is laid upon the fact that while the returns of area show an increase of only 86 per cent since 1885, the quantity produced has increased 236 per cent. In other words, if the areas have been correctly stated, the yield per acre has risen from 253 lb in 1885 to 454 lb in 1906, upon the average of all. Growth of indigenous or hybrid kinds, high cultivation, and freer plucking do not alone account for this great increase; part of it is due to the number of young, vigorous bushes with which old acres have been leavened. Apart from this, at least 140,000 acres of the total area are not yet much more than 12 years old, they add to the aggregate productiveness, and under normal conditions should ensure the maintenance or an increase of the annual output.

There is still room for development, if demand for tea should justify it, and if labour were obtainable. Nearly a million acres are held by the Indian planters, taken up for tea, but not yet cultivated; the tenure is secure and the terms are not onerous; much of the land is unsuitable for tea, but some is useful for by-products, and enough remains for large extensions when desirable, except in Darjeeling where, it is said, the limit has nearly been reached. No wide or sudden action in this direction, however, is probable; control has become largely concentrated in the strong hands of shrewd and cautious men, who should know that the hurry of one year may take ten years of care to cure, and are not likely to forget the lessons learned in bygone years, which teach that development must be very slow in order to be safe. Promoters from outside, smitten with a mania for extension, will hardly find a footing or a welcome. The spare lands are mainly distributed as follows:—375,000 acres in Assam, 215,000 in Cachar, 160,000 in Sylhet, 157,000 in the Dooars, 57,000 in Darjeeling, and 17,000 acres in Travancore.

In this respect the position of Ceylon is somewhat different. It has been officially stated that there are 461,000 acres of tea in the island, a figure that needs to be reconciled with the carefully compiled statistics in "Ferguson's Directory," which show that the total is only 390,000 acres. The same authority stated last year that tea cultivation in Ceylon would probably eventually reach 400,000 acres; if that holds good, there is not room for any great extension, while the new factor introduced—namely, planting rubber among tea, suggests the probability that the output will gradually decrease. The rubber trees, however, planted on 41,690 acres of tea in Ceylon are still young and may not grow so quickly as they do in new clearings, while the increased value of tea leads every planter to make the most of it. Helped early in the season by weather that made the bushes flush well, and by the stimulus to free plucking given by the price of common tea, much more has been gathered this year, to the great benefit of growers. What the position may be when the rubber trees reach maturity can only be surmised, but it is probable that less tea than now will be produced, that more will then be wanted and that a healthy tea estate will be a valuable possession. Bushes and soil are affected by age and continuous cropping just as they are elsewhere, but the majority of the gardens are not yet old, and though much has been said about "earthiness in high-grown tea," it should not cause undue misgivings, because the deterioration noticed may prove to be remediable and transitory.

The growers' chief concern, in India and Ceylon alike, is not for their climate, plant, or quality, but about the perennial difficulty of obtaining sufficient coolie labour, the exceeding dearness of foodstuffs, and the high import duty levied here. It is possible that scarcity in the United Provinces caused by the present drought may induce more labourers to move northward and eastward, where work and food, homes, and a fair wage await them, but so far no movement is reported, while, as regards Ceylon, the

latest returns show a falling-off in immigration. Malay and the Straits attracted in 1906 some 50,000 Tamils, thus lessening the number available for Ceylon estates, and it is possible that tea-planters may have to face the question of paying higher wages.

Present Crop Positions.

The crop positions are as follows:—India will make less than was expected, short yields at the end having followed the good increase made early in the season. Last year's total of 240,000,000 lb. may not be much exceeded, and considerably less will be received here. The total export last advised by mail showed an increase of about 4,000,000 lb., which has gone abroad, but later telegrams show that the shipments in the interval have been short, and that there is a considerable falling off in exports to the United Kingdom. Garden returns to the end of October disclosed an average increase of about 2 per cent. in the crop so far gathered, more being made in the aggregate of Assam, Cachar, Sylhet, and Travancore, but less in Darjeeling, Dooars, and the Terai. The best results to growers, which can now be said to be already assured, are for those who have made heavy crops at a low cost-price and have been able to sell them readily at 1d. to 2d. per lb. more than they obtained for their last crop. The average of London sales to date is about 8½d. per lb., against 8d. per lb. last season, and of Calcutta sales 6 annas 10 pies against 5 annas 5 pies in 1906. Ceylon will ship a total of about 180,000,000 lb., contrasted with 170,000,000 lb. last year, including some that is grown in Southern India but sent through Colombo, estimated to be between two and three million pounds. Of the increase only about 3,000,000 lb. will come here, the rest having been sold abroad. London sales average 8d. per lb. against 7¼d. obtained last year, and Colombo sales have returned the growers 41 cents against 35 cents all round in 1906.

Dutch and Japanese Teas

The London market, preoccupied with Indian and Ceylon, seems to pay little heed to other kinds of tea, but a grower needs to extend his outlook, watch other sources of supply, and see what competition threatens. These must be examined, and they are confined to Java, Japan, and China. The Dutch island's useful little crop of about 28,000,000 lb. shows no sign of increase, and does not affect the position, though its tea is readily saleable and competes with the lower qualities of British growth. About half the crop comes to London, and has realised 7¼d. per lb. this year, against an average of 6d per lb. in 1906. Japan tea meets ours only in North America, where it finds favour, but has lost ground as the merit of our stronger growths became appreciated. In the season 1904-5 the United States and Canada imported 48,700,000 lb. of it, but only 41,600,000 lb. in 1906-7, while the importation of British-grown varieties rose from 35,300,000 lb. to 37,600,000 lb. It appears, moreover, that production is steadily decreasing in Japan; in 1896 the plantations covered about 146,000 acres, yielding about 70,000,000 lb., but by 1905, the last year for which figures are available, the area had fallen to 130,000 acres, and the total made to 57,000,000 lb. If these returns, which are official, include all produced for trade purposes, there is no present reason to fear competition from that quarter; but at the State farm experiments have been made in rearing plants, methods of manufacture, use of machinery, and improvement of quality which may bear fruit. The outturn of Oolong tea in Taiwan (Formosa) has also declined since the island passed into Japan's possession. Between 1900 and 1905 the wage of farm labourers under contract in Japan rose 17 per cent., while the rates for many kinds of skilled labour rose from 10 to 30 per cent., a consequence of its great industrial developments, raising the cost of producing tea.

China Tea.

China still confronts the British grower in many markets, but, contrary to expectation, has not regained this year very much of its lost trade here (though the percentage increase is large), notwithstanding the demand for cheaper tea than can now be bought elsewhere. Up to November 15th the total China tea exports oversea were 93,000,000 lb, against 83,000,000 lb. in 1906, much of the increase being to America and some of it coming here. China's large trade in black tea with Russia is endangered by the growing reputation and purchase of our produce there. America has taken more of China and less of our growths this year and our home consumption shows an increase of 3,500,000 lb. in China tea. It is claimed that part of this increase is due to the growing consumption in this country of the higher qualities of China teas and an appreciation of their digestive values, though upon this point opinion is not unanimous. Judged by despatches from our Consuls in China, the general feeling there is not hopeful. From Shanghai we

learn that "the Chinese tea-grower is apparently still incapable of realizing that he is losing the European markets. The trees are left unpruned, and the ambition of the small producer is confined simply to obtaining three crops a year from his soil. . . . . the season has been so unsatisfactory for Shanghai shippers that in view of the steady fall in quality and demand, especially in the United Kingdom, several of the largest British firms have abandoned the trade." From Hankow "there were no direct shipments to London, a feature shared only by the years 1899-1900; the subjoined table, in spite of a special Siberian demand, shows a serious decline in the export, even as compared with the bad record of 1905, due to the unrest in Russia and the swamping of the British market by India and Ceylon." From Foochow "the statistics for 1906 show an appreciable improvement, in spite of which there seems a universal opinion among those interested in the trade that the day of China tea is over." When these reports were made silver was much dearer than it is now, a disadvantage to buyers of tea remitting to China; the lower rate of exchange now current may lead to larger purchases by merchants in Europe and America still handling China tea, a point that must be kept in sight.

This completes our review, and the conclusion to be drawn from it is that among the different groups of growers those in India, Ceylon, and Java are in the most secure position. The question follows, What prospect is there that present prices will be maintained? The advance in price has been caused by an expansion in demand, a reduction in stocks both in and out of bond, and the discovery that the fresh supplies available are not quite large enough for all requirements. A reaction might ensue if India's production or China's export were largely to increase during the next year or two, or if consumption were to fall off as a consequence of higher prices being charged to the public; but there is the possibility, on the other hand, that the use of tea may continue to grow larger in countries where it is still small. All these contingencies must be kept in mind, for they are likely to make the position and movements of tea more than usually interesting for some time to come to all who produce, deal in, or use it.—London *Times Supplement*, Dec. 20.

FINE FLAVOURED TEAS.

Prejudice apart there cannot be a question that the choice "chops" of China teas furnishes a more delicate flavour which was not attained in India before the introduction of the Belmont process. We are aware that Mr K Bamber did pretty nearly hit off the desirable in Ceylon, but still there was something wanting. Without reproducing the article on the matter it may be as well to condense the information for the benefit of those who care to undertake the manufacture of such teas as are still retailed by Davidson of Fenchurch Street, Twinings in the Strand and one or two others who pander to the taste of connoisseurs. That there are many of the latter is undoubted and our impression is that if conductors of our hill gardens would lay themselves open to supplying what we may describe as "toned down teas" they would derive a profitable enough trade at the prices readily paid across the counters to the firms above mentioned, which range between half a crown and five shillings per lb. There is no great secret in the toning; Indian tea is harsh and so to most palates, unless blended with the weaker China leaf, unappreciated, but if we eliminate the surplus tannin it can be rendered fit for most people. The process preserved at Belmont was to spread the rolled leaf out thinly on the mat for the night; in the morning the leaf was heaped up under a damp blanket, care being taken to constantly test the mass for any indication of heating when, of course, all had to be immediately re-spread out. Tips came out white instead of yellow, but the grand test was in the cup, for though harshness, in a modified degree, was slightly perceptible, on this being represented to the manipulator the defect was remedied. In 1898 when tea began to drop in Bengal we were favoured with enquiries as to the cooling down of the rolled leaf, and a well-known engineering firm furnished us with an estimate of an apparatus costing R12,000. No difficulty in the manufacture was indicated nor is much alteration needed excepting that the leaf should be rolled slower, for under present methods the "rapid rollers" reduce the mass to a wet stodge staining the tips and setting up undue evaporation from the time the leaf is placed in the trays. With some modifications the process carried out at Belmont was identical with that pursued by Dr. Jameson at the Government Gardens in the Punjab half a century ago, while samples made by the Sylhet Tea Company were priced 2s. 6d. per lb. Unfortunately the Managing Director of this Company would not listen to representations regarding a cooling room, so the method had to be abandoned and the present orthodox manufacture carried out much to the disappointment of a firm in London—Antrobus and Co.—who were prepared to take the whole outturn if up to the original mark. That there is a large demand for fine flavoured tea in Russia, the United Kingdom and America, goes without saying, and by elimination of the superabundant tannin by cooking coupled with slower drying our planters could secure the major portion of this trade.—*Indian Planters' Gazette*, Nov. 30.

TEA ESTATES "GOING OUT" IN CEYLON.

We recall the visit of two or three experienced Assam tea planters to Ceylon some twenty years ago, who came to see us and enquire how best they could inspect some typical Ceylon plantations in order to judge of their quality and condition. They were on their way out from home to resume charge—in one or two cases—of their own properties in Assam. We sketched a programme for them, which included part of Dikoya and Dimbula as on the railway route, and they started off; but returned on the second day quite satisfied and altogether in a chuckling mood over the Ceylon Tea Enterprise. They had not gone beyond Kandy and Nawalapitiya; but they had seen enough, including Mariawatte (!), to satisfy them that our tea gardens could not "*last*." They gave no more than five to ten years at most for the profitable life of the plantations they had gone over, and they were going on to India with the full assurance that the Ceylon Tea Enterprise could never amount to much.

We were reminded of this experience when we read the otherwise clear and able Review of the Tea Industry in India and Ceylon, which is reproduced in full elsewhere from the London *Times* and in which the one unfortunate, and as we think unjustifiable, statement is made in the concluding portion of the following:—"It is true that in India some very ancient plots have been abandoned, as in Cachar and Assam, and that of plantings in Terai perhaps one-fifth, which low prices had made unprofitable, has gone out of cultivation; while in Ceylon, it is said, there are some gardens which are not likely to last. No secret is made of it." We know of no evidence to warrant this belief, in respect of Ceylon, unless it be found in the fact that throughout 42,000 acres of our tea, the new product "rubber" is inter-planted, and, therefore, the surmise is made that the tea must eventually disappear before the rubber? That, we confess, is within the bounds of possibility, more especially if rubber fulfils certain sanguine expectations of high profits out of all proportion to those derived from tea. In that case, it may be thought advisable to get rid of the tea; but we are quite sure that a good many years must pass before this takes place, if it ever does altogether, and meantime every care is being taken of both tea and rubber, while never before was tea cultivation in Ceylon so well fostered and so generally prosperous. The only clouds at present have reference to the possibility of an unduly dry season and a shortness of labour. But we may find both these clouds lifting as the season goes on.

RECORD TEA YIELDS.

(*To the Eidtor.*)

Rakwana, Jan. 8th.

DEAR SIR,—To settle a wager will you or your readers oblige me with any information as to whether 870 lb tea per acre all round off a total acreage of 350 acres constitutes a record for Ceylon and if not, what is the record? Thanking you in anticipation.—I am, yours, &c.,

"RAKWANA."

P.S.—Likewise is 1,400 lb. an acre off any particular field a record? R.

RECORD TEA YIELDS—"Rakwana" raises an interesting question in his letter given above and undoubtedly a yield of 870 lb of tea per acre off a total of 350 acres is a magnificent return; but it does not make a "record" for Ceylon. That "record," we apprehend, belongs to Mariawatte for Mr Salmond, the then Manager roported to us in January, 1901, that the crop for 1900 over the whole estate of 458 acres was equal to no less than 996 lb made tea per acre—the largest ever gathered up to that date. Nowhere in India or Java, we said at the time (and our challenge has remained unanswered) have we ever heard of such a yield over so large an area. This, of course, beats "Rakwana's" 870 lb over 350 acres. But in respect of his 1,400 lb off one field (what extent?), we are not sure that he may not score the record. At any rate the highest yield we have for Mariawatte is 1,384 lb (all over 101¼ acres) in 1890 and 1,357 lb in 1900. (For 17 years this field averaged 1,144 lb.; while for nine years the average over the whole estate of 458 acres, equalled 822 lb.) In 1901, before the rush into rubber, we ventured to estimate that there were "18,000 acres of the finest tea land planted in Ceylon capable of bearing 800 lb and upwards per acre; 80,000 acres equal to an average of 600 lb, and 300,000 acres equal to 250 to 400 lb."

PUBLIC SALES OF TEA IN COLOMBO AND LONDON.

LONDON

1906. Date.	Pkgs. Sold	Reuter's Av.	1907. Date.	Pkgs. Sold.	Reuter's Av.
Jan. 5	23,000	7⅝	Jan. 11	31,000	8⅜
,, 12	31,000	7¼	,, 18	27,000	8
,, 19	32,000	7⅛	,, 25	21,000	7⅞
,, 26	19,000	7⅜	Feb. 1	20,000	7⅞
Feb. 2	23,000	7	,, 8	20,000	8
,, 9	21,000	6¾	,, 15	22,000	8¼
,, 16	25,000	6⅝	,, 22	27,000	8⅝
,, 23	22,000	6¾	Mar. 1	27,000	8⅝
Mar. 2	24,000	6¾	,, 8	21,000	8⅝
,, 9	21,000	6¾	,, 15	20,000	8⅝
,, 16	22,000	7⅛	,, 22	21,000	8⅜
,, 23	19,000	7⅛	,, 28	17,000	8¼
,, 30	26,000	7⅛	Apr. 5	Easter	
Apr. 6	19,000	7⅛	,, 12	21,000	8¼
,, 12	25,000	6⅞	,, 19	22,000	8⅜
,, 20	No sale		,, 26	26,000	8⅜
,, 27	23,000	7	May 3	23,000	8⅜
May 4	30,000	7	,, 10	25,000	8¼
,, 11	30,000	7	,, 17	24,000	8⅛
,, 18	27,000	6⅞	,, 24	Whitsuntide	
,, 25	24,000	7	,, 31	34,000	7⅞
June 1	32,000	7	June 7	32,000	7⅞
,, 8	No sale		,, 14	27,000	7½
,, 15	32,000	7⅛	,, 21	31,000	7⅛
,, 22	34,000	7	,, 28	26,000	7⅛
,, 29	30,000	7⅛			
July 6	28,000	6⅝	July 5	30,000	7¼
,, 13	29,000	6½	,, 12	30,000	7⅜
,, 20	23,000	6½	,, 19	26,000	7⅜
,, 27	30,000	6½	,, 26	31,000	7½
Aug. 3	31,000	6⅝	Aug. 2	34,000	7⅛
,, 10	Bank Holiday		,, 9	Bank Holiday	
,, 17	36,000	6½	,, 16	35,000	7½
,, 24	31,000	6⅝	,, 23	28,000	7½
,, 31	26,000	6⅝	,, 30	29,000	7⅜
Sept. 7	24,000	7	Sept. 6	21,000	7½
,, 14	22,000	7¼	,, 13	19,000	7½
,, 22	21,000	7¼	,, 20	21,000	8
,, 28	20,000	7⅛	,, 27	21,000	7⅞
Oct. 5	20,000	8¼	Oct. 4	21,000	7⅞
,, 12	16,000	8½	,, 11	19,000	8⅛
,, 19	20,000	8¼	,, 18	15,000	8⅝
,, 26	21,000	8¼	,, 25	20,000	8⅜
Nov. 2	14,000	8½	Nov. 1	15,000	8⅞
,, 9	17,000	8½	,, 8	13,000	8⅞
,, 16	17,000	8½	,, 15	10,000	8⅝
,, 23	18,000	8⅝	,, 22	14,000	8⅝
,, 30	17,000	8⅝	,, 29	14,000	8⅝
Dec. 7	18,000	8¾	Dec. 6	19,000	8⅝
,, 14	14,000	8¾	,, 13	15,000	8⅝
,, 21	18,000	8⅝	,, 20	28,000	8½
	1,058,000	7¼		1,093,000	8⅛

Quantities sold in the past 10 years :—

	Pkgs Offered.	Pkgs. Sold.		Pkgs. Offered.	Pkgs. Sold.
1898	1,115,000	1,050,000	1903	1,047,000	957,000
1899	1,123,000	1,046,000	1904	1,027,000	958,000
1900	1,295,000	1,179,000	1905	1,194,000	1,094,000
1901	1,197,000	1,055,000	1906	1,141,000	1,058,000
1902	1,160,000	1,052,000	1907	1,142,000	1,059,000

COLOMBO, 1907.

	Offered. lb.	Sold. lb.	Aveg.
Jan. 4 ...	2,569,979	2,131,878	41
,, 9 ...	834,068	744,080	43
,, 16 ...	1,633,389	1,300,041	41
,, 23 ...	2,025,557	1,657,885	40
,, 30 ...	1,238,741	912,828	40
Feb. 6 ...	1,173,482	997,855	41
,, 13 ...	1,194,895	1,026,543	43
,, 20 ...	1,617,998	1,443,559	44
,, 27 ...	1,250,524	993,811	45
Mar. 6 ...	1,332,566	1,136,107	45
,, 13 ...	1,396,494	1,262,153	46
,, 20 ...	1,510,187	1,288,535	46
,, 27 ...	1,468.302	1,167,522	44
April. 3 ...	Tea Sellers' Holiday.		
,, 10 ...	2,270,576	2,013,902	44
,, 17 ...	1,873,687	1,638,491	44
,, 24 ...	1,536,734	1,115,780	43
May 1 ...	1,530,598	1,137,994	41
,, 8 ..	1,987,030	1,502,555	37
,, 15 ...	1,984,484	1,655,249	37
,, 22 ...	2,004,621	1,688,487	37
,, 29 ...	1.675,863	1,426,865	37
June 5 ...	1,752,483	1,614,510	38
,, 12 ...	1,851,526	1,660,868	39
,, 19 ...	1,896,804	1,577,941	39
,, 26 ...	1,929,132	1,902,618	39
July 3 ...	1,743,230	1,361,523	39
,, 10 ...	1,703,335	1,372,383	40
,, 17 ...	1,779,863	1,523,603	41
,, 24 ...	1,815,966	1,598,818	41½
,, 31 ...	1,472,731	1,263,988	42
Aug. 7 ...	1,407,272	1,097,778	42½
,, 14 ...	1,450,980	1,178,721	43
,, 21 ...	1,631,502	1,255,243	43
,, 28 ...	1,474 534	1,193,991	44
Sept. 4 ...	1,318,309	987.901	44
,, 11 ...	1,102,424	880.874	42
,, 18 ...	1,426,167	1,106,863	43
,, 25	Tea Sellers' Holiday.		
Oct. 2 ...	1,988,562	1,546,865	42
,, 9 ...	1,157.236	961,644	42
,, 16 ...	1,117,961	895,960	44
,, 23 ...	1,409,991	1,039,801	43
,, 30 ...	1,464,050	1,255,704	43
Nov. 6 ...	1,370,623	1,007,835	43½
,, 13 ...	1,305,930	989,227	41
,, 20 ...	1,449,906	1,222,569	41
,, 27 ...	1,533,922	1,291,506	42
Dec. 4 ...	1,724,232	1,558,113	44
,, 11 ...	1,588.197	1,485,028	44
,, 18 ...	2,340,230	2,138,561	45*
	78,316,873	65,212,556	42

* Approximately.

Quantities sold in the past 10 years as follow: —

	lb.	Avg.		lb.	Avg.
1898 ...	28,866,004	34	1903	46,172,487	38
1899 ...	32,472,040	38	1904	53,309,443	36
1900 ...	38,242,926	34	1905	55,861,862	34
1901 ...	38,345,861	33	1906	54,611,601	36
1902 ...	42,874,499	34	1907	65,212,556	42

RUBBER TAPPING PATTERNS: THE "CHAIN-GAMMA."

Mr. C Boden Kloss writes as follows in the "Agricultural Bulletin," Singapore, for November :—All methods of tapping rubber trees are, one may say, combinations or variations of the oblique incision and probably the two most popular methods in use in Malaya at present are the V and the herring-bone. It is objected however to the former that so many cups are required. The latter is frequently to be seen deprecated on account of the central channel which is a mere conductor of latex, being unproductive in itself and wasteful of cortex. It is said also that it lessens the tension of the bark and therefore tends to minimise the output of rubber. If such is so with the full herring-bone, how much more proportionately is the vertical channel uneconomical in the case of the half-herring-bone! Examining recently a series of trees tapped by the latter method it appeared to me that if the length and position of the conducting channel were somewhat altered it could be made both productive of latex and thus less wasteful of bark while, besides, the natural tension would probably remain unaffected. I therefore sketched out the following pattern (Fig. 1 the dotted line representing the original verticle channel) of a modified half-herring-bone—I should like to say improved, but from lack of opportunity to test it cannot yet do so—which, if we desire to stick to the alphabet for tapping nomenclature, instead of a number of Roman Vs occupying the tree at intervals, might be described as a column of Greek Ys ascending the trunk—ascending because tapping must be done from base upwards. A very symmetrical pattern that would probably heal rapidly is also obtained by reversing each alternate Y. Having gone so far it was of course obvious that the alteration should be carried to its logical conclusion and thus Fig. 2 was obtained. The basis of the method is itself a very simple pattern, productive throughout all its length. This is a continuous regular zig-zag, but I am not aware that it has been experimented with in this form for the orthodox zig-zag seems to be two oblique cuts joined by a vertical, and so useless, channel. The advantage of the full pattern however is that the flow from the lateral projections at once forms a leading stream which is joined by the descending latex from each step above as tapped, and so obviates any likelihood of delay or overflow at the angles. I fancy that the pattern will be found very productive and of value when it is required to obtain a large amount of rubber per tree. The proportion of scrap will probably be small owing to the strong flow of latex throughout; the fluid from above helping to wash down that below and thus differing from the ordinary herring-bone where the latex in the lateral cuts soon begins to coagulate. From time to time various tapping patterns have been tried and found unsatisfactory, the single incision, for instance, and the Ceylon spiral which is now being regarded as hardly fulfilling all that was expected of it, and the above ideas will perhaps find a place in the same category, but as I am at present unable to experiment with them myself I should be glad to hear, through your pages, what results have been obtained by any one who thought the notions worthy of a trial.

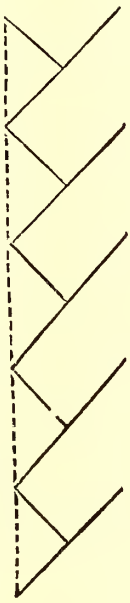


Fig. 1.

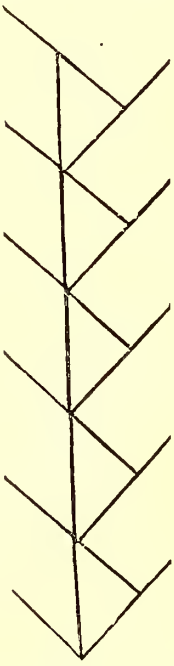


Fig. 2.

AFRICAN RUBBER AND RAILWAYS.

A potentially rich rubber-producing district of Portuguese Africa is to be opened up by a new railway just authorised by the Colonial Government. The railway in question is from the Port of Inhambane to the military post of Inharrime, both of which are in the district of Inhambane. An average annual export of 32 tons of india-rubber is accredited to the district in question during the last two years.—*India Rubber Journal*, Dec. 16.

PARA RUBBER SEED.

The prices which are obtainable at the present time for Para Rubber seeds for planting purposes being so high, other means of disposing of them are not necessary, but with hundreds of thousands of trees becoming seed-bearers the supply of seed for planting will soon be in excess of the demand. The commercial value of the seed of *Hevea braziliensis* has up to the present been rated on the amount and quality of the oil it possesses. This oil is similar in its character to Linseed oil and for the manufacture of paints, varnishes, etc., and other purposes for which Linseed oil is used Para seed oil compares favourably. The following analysis of Para seed oil shews its composition which in comparison to Linseed is as good or better in everything except in Iodino value :—

Specific gravity at 15° C	... 0·9303
Free fatty acids—Acid value	... 10·7
Calculated oleic acid	... 5·4 per cent
Ester value	...195·4
Neutral oil	... 94·6
Saponification value	...206·1
Iodine value	...128·3

The oil has not yet been obtained in sufficient quantities for its qualities to be adequately tested, but manufacturers have offered a price of £10 to £12 per ton for decorticated seed in good condition. In order to estimate the weight which may be expected per acre or per 100 trees, I weighed in Ceylon a large number of seeds between 7,000 and 8,000, and found the average weight of each seed to be 3-20ths of an oz. or 111 seeds to 1 lb. The shell of the seed has as far as we know at present no commercial value and in order to save bulk it should be removed before shipping. It has been found that the loss in oil in decorticated rubber seed during transit to Europe is very little. To find the relative weight of shell and kernel, I carefully weighed a few average seeds, and after taking the shell off weighed shell and kernel separately. The relative weight of kernel to shell is found to be 59·7 or approximately 60 per cent.

WEIGHT OF HEVEA BRAZILIENSIS SEED, COTYLEDONS AND SHELL.

Number.	Total weight.	Shell.	Cotyledons.	Percentage of Cotyledons to total weight.
	Gr.	Gr.	Gr.	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	1·91	58·28
12 ...	4·65	1·89	2·49	53·54
Totals ..	47·286	19·88	27·02	—
Averages	3·938	1·656	2·25	5·97

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

111 Para Rubber seeds	=	1 lb.
12 432 ,,	,,	1 cwt.
248,640 ,,	,,	1 ton.

The kernel *i.e.* the decorticated seed is 60 per cent of the total weight of seed, therefore 414,400 seeds will make 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. Cost of putting on market :—

	dollar.	c.
Freight 40s per ton (say dollar 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 dollar 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 give dollars 39·36 profit *i.e.* dollar 7·00 per acre.

In these prosperous times when rubber profits are calculated by hundreds of dollars per acre, the discussion of an additional profit of $ 7 per acre may seem trivial, but since the seed cannot be allowed to remain in the ground and must be removed, some steps must be taken to deal with it. When a constant and large bulk of rubber seed is sent to Europe it is possible that the price of this commodity may increase very considerably and become an item of importance in the profits of a rubber estate. The value of the seed for cattle cake has not yet been estimated, the seed is greedily eaten by animals and has a high nutritive figure.

Consignments of the present crop decorticated and with the shell on are being sent home by the Department of Agriculture and the market values and condition of these on reaching Europe will be made the subject of a further note.

J. B. CARRUTHERS.

—*Straits Agriculture Bulletin* for Nov.

SMOKED RUBBER.

DA COSTA'S PATENT RUBBER COAGULATING PLANT.

Whatever may be the differences of opinion between Manufacturers as to the value of the different species of Crude Rubber available in the world's Markets, they are certainly unanimous in pronouncing the product of the Para Rubber Tree, as prepared by the natives, to be the best of all species of Rubber. The native process of smoking the latex of the *Hevea Brasiliensis* (Para Rubber) in the Amazon region is only persisted in because no other process has met with the approval of Manufacturers.

Sheet and Crêpe Rubber were manufactured in Brazil long before the Rubber industry was thought of in the East Indies, but it had to be abandoned because of the manufacturers' preference for the native smoked product.

Every chemical ingredient now used in the East Indies to preserve the Rubber or assist in the coagulation, has been tried again and again and, in every instance, where the assistance of chemicals has been resorted to, an article of good appearance has been produced, but always inferior to the smoked Rubber when tested by the manufacturers' standard. The fact is that any chemical agent, of whatever nature, introduced into the latex of the Para Tree in a liquid or palpable form, injures the resiliency of the Rubber produced, as repeated trials have clearly demonstrated.

The real cause of this continues to be one of nature's mysteries, but it is an undoubted fact. Whilst it is known by long experience on the Brazilian forests, that heat will coagulate the latex from the Para Tree, it is also beyond doubt that fumigation alone will impart to the finished product its lasting properties of resiliency and tensile strength that have made the products of the *Hevea Brasiliensis* famous all the world over. So too, as regards the latex of the *Castilloa Elastica* tree, nothing but very fierce heat will kill the enzymes it contains and unless these are destroyed the Rubber produced therefrom will always be jet black and more or less tacky, if kept for any length of time.

On the face of these facts, and because the method of smoking latex by the native process in Brazil is not only very expensive and exceedingly tedious, but also certainly detrimental to the health of the operators, the inventor of this plant thought of devising means of

DOING MECHANICALLY

all that is now done by hand in the Rubber forests of Brazil. The Da Costa Patent Coagulating Plant which is the result of practical experiments and tests, and is now manufactured solely by Messrs. David Bridge and Co., Engineers and Rubber Machinists, Castleton, Manchester, England, for whom Messrs. Zacharias & Co. of Kuala Lumpur are acting as sole agents in the Malay Peninsula, needs no chemicals of whatsoever nature, so long as tropical forest woods are available for heating the boiler as well as green foliage of palms of any sort for generating smoke in the boiler furnace. The coagulating and smoking by means of this plant is the simplest of all operations in the Rubber Industry and may be performed by any inexperienced hand. The process is as follows:—The latex being brought from the field is strained only provided it contains mechanical impurities and is then poured into the coagulating tanks. Steam is meanwhile being raised to about 30 to 35 lb. per square inch in the boiler, forest woods alone being used for this purpose. On the burning wood in the boiler furnace are then thrown green Palm leaves, nuts, or any green twigs of tropical trees; the distillation of the woods producing acetic acid, whilst the fumes of the green foliage would be found to contain creosote to some extent. These fumes are accumulated in a special receptacle, after being expunged of all cinders and are then forced into the coagulating tanks by a steam injector. The force of the steam violently agitates the latex and during this operation every particle of it is reached by the smoke. In about ten minutes (more if the quantities to be dealt with are large) the whole mass coagulates and separates from the lyes and floats in the water caused by the condensation of the steam injected into the tanks. The coagulated substance is allowed to cool off in the tanks, and must afterwards be taken to a small press and blocks are then reblocked in cube form and afterwards dried either in a special stove or vacuum dryer. If the first size blocks are only lightly compressed into the form of cubes, they can be easily torn as under by the manufacturers and used in their machines without the extra labour of previously cutting them into convenient sizes.

QUALITY OF THE RUBBER PREPARED.

Rubber prepared in this way retains every native element of the resiliency and tensile

strength of the native Para, and will last as long as the wild Rubber if kept in a crude state for years.

This Coagulating Plant has, therefore, not only the advantages of dispensing with the assistance of chemical agents in a liquid form but also allows the producer to send to the market the only preparation that satisfies all the Rubber Manufacturers' needs throughout the whole world. In addition to this, it also possesses the unique property of being the only apparatus which can convert the latex of the *Castilloa Elastica*, *Funtumia Elastica*, etc., etc., into a Rubber of equal market value, appearance and colour, to that of the best Para exported from Brazil.

RUBBER MANUFACTURER'S REPORT.

A Rubber manufacturer's report regarding smoked rubber produced by Da Costa's Patent Coagulating Plant is as follows :—

Referring to your letter of the 6th of September, re special smoked Para Rubber sample, I have pleasure in passing you under separate cover today, a piece of the Rubber washed out from the sample sent, as well as a piece, of the prepared Vulcanized sheet 3/16" thick made from the same sample. May be seen at Messrs Zacharias Ltd. Co's. office. The mixture of course contained no drugs or other material, but just sufficient sulphur for Vulcanizing purposes. There are also three round samples 5/16" and 3/8" and 7/16" diameter. There are four samples of Vulcanized Rubber and the sample of washed Rubber will show up the value and quality of the Rubber. I am very pleased with the Rubber and must say it has worked out better than I really expected and I consider the smoked Rubber worth anything from 4/6 to 5/6 per lb : there is, however, an excess of moisture over and above the best Para.—*Malay Mail*, Dec. 23.

THE LATEST SUMATRA RUBBER CO.

Sumatra continues to attract the attention of rubber company promoters. Mr. Fritz Zorn in the latest edition of his useful manual makes special allusion to the possibilities of Sumatra when he writes :—"Perhaps the most noteworthy feature of the last twelve months is the way in which some of the newer rubber producing centres have been coming to the front. Sumatra, especially, is very much in evidence, and the performances in the way of production already achieved by some of the more mature estates there, point to great future potentialities for the Island as a source of supply." The New Sumatra Rubber and Tobacco Co. is the most ambitious concern that has yet been launched in Sumatra and the capital of £250,000 is only approached by the well-known Sumatra-Deli Rubber Estates, Ltd., which has a capital of £240,000. Of the directors mentioned Mr. Keith Arbuthnot has already interests in Sumatra being a Director of the United Serdang Rubber Plantations, Ltd. If this is the Sumatra flotation which has several times been alluded to as likely to go through early in January there is, we believe, on the estates to be acquired a fair amount of old rubber—trees up to 11 years old now—and altogether the property will have 864 acres of five-year-old to 13-year-old rubber two years hence, in bearing at a cost of £30 per acre besides a considerable acreage of younger periods.

RUBBER NOTES.

The Select Committee of the Demerara Court of Policy has modified the terms and conditions under which Crown lands in the Guiana Colony are proposed to be sold or leased for the purpose of growing rubber. A number of important alterations were approved for the consideration of the Government. It was decided to recommend that lands for the purpose of rubber growing should not in the first instant be granted absolutely, but should be leased, and a motion that it be a condition of the lease that no rent be charged during the first ten years was also carried. A further motion that the lessee of lands leased for planting rubber should have the right to purchase the land at the end of ten years if he had complied with the conditions of the lease was adopted by four votes to three, and it was decided to recommend that the period for which leases should be granted should be ninety-nine years, instead of the period of twenty-five years, as stated in the original conditions. Other recommendations decided upon were that during the first ten years 2 cents per pound should be collected on rubber, that no royalty be charged after ten years, that the annual rental should be 20 cents an acre after the tenth year to the fifteenth, and from the sixteenth year onwards 50 cents per acre per annum ; and that $1 per acre should be the purchase price. It was stated that, besides the application of the British Guiana Rubber Corporation for 4,000 acres in the north-west district, application had been made in respect of two other tracts of land, one of 640 acres on the right bank of the Essequebo River, Bonasika Creek, and the other of 1,280 acres on the left bank of the Essequebo River.

THE RUBBER PLANTING POLICY.

The current opinions regarding the most profitable species to cultivate are based on results of only a few years' standing, and though they are sufficiently distinctive to allow us to say that some species are capable of yielding excellent crops of rubber, they cannot in any way be accepted as final. The fact that *Hevea brasiliensis* has so far given the best yields does not entitle anyone to even say that it will, in the long run, be the most profitable to cultivate; still less is one justified in condemning other species because their yielding capacities have not, in the first year of tapping, proved equal to Para rubber trees. A certain amount of definite knowledge can be gained by a microscopic analysis of the plant structures possessing the channels wherein latex accumulates; a study of these particulars enables one to approximately gauge the rubber capacity of each species and the best methods of tapping them; but experiments initiated by men with a knowledge of these vital points are of little, if any, practical importance until they have been tested in and out of season through a period of many years. We are not aware of any complete scheme of experiments which have been carried out on trees of *Ficus elastica*, *Castilloa elastica*, *Funtumia elastica*, and the various species of Palaquium, Ficus, or Landolphia, and until the necessary results are available, there is nothing to justify the condemnation of any one of these species.

Rambong Rubber.

Planters have been able by very simple implements and methods of tapping to obtain very profitable yields from Para rubber trees, and taking such as a standard, they have felt justified in recommending the destruction of *Ficus elastica* trees because the latter have not, in the same or a longer period of time, given similarly good results. But they have evidently not been aware of the fact that the laticiferous system of *Ficus elastica* is entirely different from that in *Hevea brasiliensis* and requires an entirely different system of tapping. Furthermore, the poor results have all, so far, been chronicled from work carried out on trees of this species which have been allowed to grow in their own way; the formation of ridges and crevices on the fluted stems of such trees appreciably reduces the available tapping area, and the interlaced aerial roots prevent that supervision which is necessary if the rubber has to more than pay for the cost of harvesting. From a plant sanitation standpoint a block system of unlike species is desirable; *Ficus elastica* is indigenous in the Indo-Malayan region, and is of a vigorous and hardy type; these and many other reasons can be brought forward to support our contention that this species should not be entirely lost sight of at the present time.

Yields from Para Rubber Trees.

In recent issues of the "India-Rubber Journal" we have given up-to-date information regarding the yields obtained on all the prominent Para rubber estates in the Indo-Malayan region during the last three years. The year 1906 showed a large increase per tree, and the present year has been characterised by a further total increase from most of the estates. But it is fairly safe to say that the yields have, more often than not, been obtained from the primary bark by a system of tapping which has necessitated the removal of a large proportion of that tissue. There are very few records available showing the rubber obtained from the renewed bark, and we are, in a great measure, ignorant of the yielding capacity of the newly-formed elements. The increased yields per tree have, in some instances, been secured by almost completely stripping the cortex; in other cases the total increase has been due to a larger number of trees having attained the minimum tapping size. There is, therefore, very little reliable information on which the planter can confidently and accurately calculate the probable future annual returns from Para rubber trees.

Yield per Unit of Bark.

It is possible, in virtue of the nature of the laticiferous system of *Hevea brasiliensis*, to form an approximate idea of the minimum yielding capacity of trees of known sizes and ages. This can, to some extent, be done by keeping careful records of the amount of bark removed and the yield of rubber obtained on each section of the estate. On several properties the amount of bark removed at the end of a year has been determined and the yield of rubber per unit of bark excised established. The results, however, have been of very little value, for the simple reason that the bark has often been removed so quickly that latex similar in composition to that in the primary bark has not been allowed to accumulate either in the remaining primary or in the subsequently formed renewed tissues. The

available results only allow us to form an estimate of the yield of rubber obtainable during the first three or four years' tapping and nothing more. But the success of the industry depends upon the average yield per year for twenty, thirty, or more years; to say the least the absence of knowledge on this most essential point should prevent the average rubber expert from being too dogmatic in his procrastinations as to the ultimate relative value of rubber-yielding species yet in the infancy of their trial.

In order to determine the yield per unit of bark it is obvious that the tapping operations should be carried out sufficiently slow as to permit of the accumulation of concentrated latex possessing the maximum proportion of caoutchouc, but not so slow as to render the system of no practical value on an estate dependant for its success on the constant employment of a fixed, resident, native, labour force. If the bark is removed too quickly the yield of caoutchouc for every unit of bark removed will be lower than what it ought to be; such a system would not suffice to maintain the trees in perfect health, and labour would, to some extent, be wasted.

We suggest to our planting readers in the tropics that very valuable data can be collected by them on this most important point, and trust that in the annual reports which will soon be prepared the directors will insist on information of this character being given. It is to the advantage of every sound property to give the widest publicity to the statistics relating to the rubber-producing capacity of the trees in terms of the amount of bark excised. H. W.

—*India Rubber Journal*, Dec. 16.

OVER-PRODUCTION OF RUBBER.

A question which is much discussed among rubber planters in British Asia, and even more among the thousands of British investors in plantation companies, is whether there is danger of overproduction. This is a very practical question, and deserving of all the attention that it has received, because the world is not yet rich enough to spend millions of money in promoting any enterprise without assurances that it will not be thrown away.

There may be some encouragement in the fact that history has recorded so few examples of "overproduction." Every grower of wheat or cotton or cucumbers, for example, may not always find a profitable or even a ready sale for his crops, but it can hardly be said that, on the whole, overproduction of any of these commodities has ever occurred. It is true that when the cultivation of quinine bark was once begun, so many persons engaged in it on a large scale that the rate of profit declined to an extent that caused some of the planters to retire from the field. Yet probably more quinine is produced now than any time in the past, and it is reasonable to suppose that it pays the producers, or they would stop gathering the stuff. Similarly, it was a common thing a few years ago, in the United States, to hear that cotton was no longer a paying crop, but the production has increased steadily in amount, and in years of largest production prices have ranged higher than in former times, and the cotton planters are becoming a wealthy class.

It may be said, by the way, that quinine is hardly a necessity in the sense that cotton and rubber are, because substitutes for it can be more readily named. In any event no one is apt to use quinine who can avoid it, whereas millions of people are anxious to acquire or use more cotton and rubber than they can now obtain, or pay for. This fact alone should be a sufficient guarantee to the doubtful that overproduction of rubber is not likely to occur. And so long as rubber—or any other commodity—is a real necessity of life, it is going to pay somebody to produce it.

Still, it may be argued that it must be possible to plant too much rubber, and that it is only wise to stop planting this side the danger line. To this it may be answered that, while surprising yields have been gained on some plantations, and while the same trees seem to yield more and more rubber every year, the number of cultivated trees now yielding is insignificant compared with the actual consumption of rubber. There are, it is true, some millions of younger trees, planted some years later than the trees now producing rubber, so that they will not be tappable for some time to come, when without doubt the total demand for rubber will have been greatly increased, while the native supplies will have been lessened. Any trees which may be planted hereafter will be still longer in coming to maturity, so that overproduction at least does not seem to us imminent.

A point of more immediate interest is that the intending investor in existing plantations should convince himself (1) that the trees he is asked to pay for can be accounted for and (2) that he does not pay too much for them.

—*India Rubber World*, Nov. 1.

HINTS ON TAPPING AND PREPARING CASTILLOA RUBBER.

Mr V S Smith writes as follows in the *Mexican Investor* :—

Having received many inquiries how to best tap the Castilloa rubber tree and prepare its latex into rubber, I shall herein give a few hints as to the best methods known.

It will be found that in tapping the most practical method is to make the cuts in pairs one on each side, terminating in a V point. These pairs or double cuts should not be closer together than 20 inches.

For catching the latex I use a device of my own, extremely practical and of little cost. Spouts made in this shape, slightly curved, 2 by 3 inches, with a point ¼ inch long filed sharp, made of common roofing iron, are driven in the bark half an inch below the point cut. A slight stroke of the tapping tool drives it in firmly and without injury to tree. This deflects the flow into the pans, which are of tin 5 by 8 by 1½ inches in depth. I make them by slitting down the corners and interlocking the points, using no solder. The cost of pan with its spout is about 6 cents Mex. I doubt if a more efficient, practical and cheaper method could be devised.

Fifteen pans and spouts suffice for each worker. After cutting fifteen trees he returns to gather up his pans and spouts, pouring the milk into his can. Taking spouts away so soon prevents more sap running into the pan, for the rubber ceases to run before the sap. Each man is furnished with a scraper of thin metal made to the shape of the groove, for scraping out that which remains in cut.

Each man makes for double cuts on from 80 to 100 trees. He then goes over again scraping out that left in cuts, and brings home half a kerosene can of milk by 11 a.m. This is his daily task.

As for a tapping tool, I venture to assert that the U-shaped blade which I invented in 1905 and patented same year will never be improved upon. The essential part and upon which the claim is based, is a thin piece of inch-wide steel bent to a U-shape with a slight flare, and ends fixed firmly on a handle 20 inches long and a movable guide for adjusting to depth required. Indians learn to use it in a few minutes. With it I have made the third tapping on my trees, now six and seven years old, planted in 1900 and 1901. First tapping was in 1905. No trees have died or seem to have been injured in the least.

Now for washing. Mix the milk with an equal portion of water so that it may be easily strained through fine wire cloth, to cleanse it of all trash. Then put into tanks with about 80 per cent. of water. In a few hours the rubber risos and the dirty water may be let out at bottom. Three changes are sufficient.

If desired to coagulate the rubber at once and cut into strips, pour juice of the so-called Moon vine (or any other coagulator chosen) into tank, then cut into inch strips and pass through rollers to press out excess of water.

My plan, because the cutting process is tedious, is to skim off the milk into trays with perforated bottom, 1 by 3 feet by 2 inches in depth, over which spread a smooth cotton cloth. Sprinkle the coagulating juice over and in an hour or two it is drained and coagulated. Turn on to a smooth board, remove the cloth and run through the rollers.

I use an ordinary wooden sugar-cane mill. If too tight it makes crepe rubber. Make loose at first, continue to pass through, tightening each time till no more water flows, and hang up to dry.

This makes smooth sheets ½ inch thick by 14 by 40 inches, easily pressed into blocks of convenient size for shipping.

The tendency is against thin sheets and crepe rubber, and rightly so, for thin sheets oxydize rapidly whereas thick pieces practically not at all. Then it costs too much in the various manipulations, also it is too bulky for handling.

All our rubber prepared in this manner was sold at $1.23 gold per pound.—*Tropical Life.*

Cocoa Exports from Ecuador.—The extent of this export from Ecuador is not, perhaps, generally recognised. In his report just issued (Cd. 3727-29) Mr. Consul Cartwright says that the record crop of cocoa so far has been that of 1904, when the quantity available for export was 562,810 quintals, or say 25,000 tons. The following year gave 459,293 quintals, or a little less than 21,000 tons. This short produce was, however, more than compensated for by the regular and rapid increase in value. The average price of cocoa in 1905 was 30 sucres, or about £3 per 50 kilos f.o.b. Guayaquil. In 1906 this had been increased to an average of 34 sucres or £3 8s., and now in 1907, a still further increase of nearly 40 per cent has taken place, the average price for the year being 47 sucres, or £4 14s per 50 kilos. This has been of great benefit to the agricultural and commercial interests of Ecuador, and has largely increased the value of its exports. The Government duties are not *ad valorem* but per weight exported, so that the financial position of the executive has not improved in the same proportion as prices have appreciated.—*Journal of the Society of Arts*, Dec. 20.

THE INDIA RUBBER MARKET.

MESSRS GOW, WILSON & STANTON'S REPORT FOR 1907.

13, Rood Lane, London, E.C., Dec. 28, 1907.

The Rubber producing industry in Malaya and Ceylon continues to expand, while the price of British grown Rubber maintains its position at the top of the markets of the world. There has recently been a very rapid increase in the cultivation of Rubber both in Malaya and Ceylon. The features of the past year having been the large opening up of both these countries with *Hevea Braziliensis*, and the inception of many new Companies.

THE POTENTIALITIES OF THIS NEW BUSINESS

are so great that it is diffi cult to forecast what the result may be in a few years' time. So far the soil and climate of both Malaya and Ceylon appear thoroughly well adapted to the healthy growth of *Hevea Braziliensis*, the species so far giving the best returns to growers, while the profits even at recent quotations, are very satisfactory. The price of Rubber has, however, fallen very materially during the past year, and while the finest class of Rubber from our Eastern Dependencies was selling in January at 5/9 per lb., its value has generally declined until in November it fell to 3/10, the lowest point reached since August, 1902. Since then there has been a slight recovery and it is now quoted at about 4/-. The highest prices obtained was in the month of May, 1905, viz., 6/9¾. No doubt one of the chief causes for the recent decline was the financial trouble in the United States of America, which has prevented many houses there from filling their requirements. The fact of these difficulties coming at a time when the motor and electrical industries were quiet, further accentuated the depression.

THE TOTAL QUANTITY EXPORTED

from Malaya from January 1st to the end of October, 1907, was 683 tons, and from Ceylon, 181 tons, the quantity for the prevous two complete years from these places being 130 and 385 tons from the former, and 75 and 146 tons from Ceylon. It is gratifying to see not only that manufacturers continue to take the product from our Eastern Dependencies so readily, but that they are willing to pay a much higher price than for any other kind. When plantation was selling at 5/9, Para was worth 5/2½; today the highest price for Rubber from the Far East is 4/-, while that of Para is 3/5½. There is now very little doubt that in six or seven years' time production will have increased to a large figure, but it is impossible to say whether the price will by that time have fallen to any very great extent, as the

CONSUMPTION OF THE ARTICLE

seems likely to increase rather than otherwise, owing to the number of uses to which Rubber is put, and to the expansion of the various classes of motor industries. All this speaks well for the future of British-grown Rubber. The reputation which it has already acquired is mainly due to its purity and careful preparation, and if planters will continue to aim fo super-excellence in these respects, and keep their working costs as low as possible, it looks as if many years of prosperity were in store for the industry.

Revised table showing total quantity and average prices of plantation rubber offered at auction during the last two years :—

	No. of Pkgs. Offered.	Quantity in Tons. Ceylon.	Malaya.	Total.	No. of Pkgs. Sold.	Average price paid.
1907	15,380	192½	621½	814	7,388	4/9 5-8
Same period 1906	6,462	98¼	250¾	348½	4,139	5/6¼

NOTE.—This cancels the table given in our market report of the 20th inst.

PERUVIAN RUBBER.

The vast eastern slope, called the Montana—a somewhat misleading title—at present yields only one product of commercial importance, namely, rubber. It was not until 1885 that the exploitation of Peru's enormous rubber forests began and on that date Iquitós, although founded some years earlier, was a settlement of no importance. At present its population exceeds 20,000, and it is one of the most progressive and enterprising cities in Peru. It ranks as the third port of Peru in its foreign commerce, being exceeded only by Callao and Mollendo, its combined exports and imports averaging about $4,000,000. The former consists almost entirely of rubber, of which the exports for the last year for which statistics are available, amounted to $2,142,000. Peruvian rubber, inasmuch as it finds its way to the sea via Para, is usually known to commerce as Para rubber, but should a shorter and more expeditious route ever be constructed across the mountains to a Pacific port, whence the product could be shipped via Panama, it would enter the world's markets with an identity of its own.—*Dun's International Review*, Dec.

THE WORLD'S CULTIVATED RUBBER AREA.

Dr. Pehr Olsson-Seffer—who has been in Ceylon and round the world—is very confident Mexico is ahead of all other lands with its extent under cultivation. We take leave to doubt the correctness of this interence, and we append (1) our Mexican friend's table as we find it in "Modern Mexico" with (2) our own corrections of the figures in a parallel column, and of countries omitted in Italics :—

Countries.	Dr. O's Figures. Acres Planted.	Ceylon Observer Figures. Acres Planted.
Mexico ..	95,000	95,000
Malay Peninsula ..	92,000	150,000
Ceylon ..	85,000	155,000
Africa ..	30,000	30,000
Central America ..	14,000	14,000
Java ..	10,000	20,000
Sumatra ..		14,000
India ..	8,200	
and Burmah ..		15,000
Brazil ..	6,000	6,000
Venezuela ..	3,400	3,400
Ecuador ..	3,000	3,000
New Guinea ..	2,500	1,000
Borneo ..	2,000	4,000
Colombia ..	1,800	1,800
West Indies .	1,600	1,600
Other countries (South Sea Islands, &c.)	1,000	2,000
Total acres ..	355,500	515,800

The compiler was aware of our figures for Ceylon; but by taking 250 trees to the acre he cut down the total area from 150,000 acres to the figures he gives above. He should know that Eastern rubber planters do not believe in as many as 250 trees to the acre.

RUBBER.

New Source of Rubber.—A tree of the Moracea family growing in Tonquin, and called by Dubord and Eberhardt (*Comptes rendus de l' Acad. des Sc.*) *Bleckrodea tonkinensis*, has a latex containing a higher percentage of caoutchouc than that of *Hevea brasiliensis*, the rubber obtained from it being, it is said, equal to high quality "Para."

Synthetic Caoutchouc.—In a recent note we referred to Harries' views as to the possibility of producing rubber from starch. Léon Grognot claims to have effected this important synthesis in another way, viz., by the action of heat upon a mixture of glycerin and dibasic or polybasic organic acids, in particular succinic acid. Certain of these acids form plastic compounds with glycerin, which on further heating lose water, and become converted into hydrocarbons analogous to those of rubber. As an example he describes the preparation of the rubber-like material from succinic acid. About equal parts of the acid and glycerin are heated rapidly in a vessel provided with an agitator, so that all parts of the contents are brought quickly into contact with the heating surface. The vessel is covered, but provided with a tubulure for the escape of gases and water or other vapours, and is heated over a direct flame or upon a sand or oil bath. Water and then combustible gases are evolved, and when the temperature reaches 200 to 220°C. the mixture suddenly changes to a plastic mass of high consistency that may be utilised in the rubber industry. The operation is stopped at this point, or if greater hardness is required heating is continued at a lower temperature. The inventor represents the plastic compound as an inner anhydride of the two reacting substances, and assumes that on dehydration and loss of carbonic acid, hydrocarbons result, and concludes, "in this way a synthetic caoutchouc is obtained."—*British and Colonial Druggist*, Nov. 15

MIXED PLANTATIONS.

So far the public, though they have been advised otherwise, have plumped for plantations possessing rubber trees only, and have shown a distinct preference for estates of *Hevea brasiliensis*. But have they ever thought that the cultivation of that species, as a single product, is yet in its infancy and that the best results on which their opinions have been formed are still only two or three years old? Do they know that Para rubber trees have, in their native habitat, survived in the struggle for existence, when grown in association with neighbouring trees and shrubs? Are they aware that Para rubber trees, when widely planted, can often be successfully grown with permanent inter-crops of cacao and other products? We are doubtful whether many persons now interested in rubber plantations are aware of the dangers which forests of the same species are generally liable to; for our part, we are inclined to believe that a planting policy which allows a permanent soil rotation by means of established crop and an isolation of groups of one species by dissimilar species may be a more permanent and not necessarily less remunerative system of cultivation. The introduction of other products on the same estate has its disadvantages, but the main objections against such a system can be overcome by judicious management. It is easily possible to prevent a rubber estate from being converted into an experimental garden and yet grow crops which have survived together in their native countries. We shall refer to other points of importance in subsequent issues.—*India Rubber Journal*, Nov. 18.

SISAL FIBRE.

Brisbane, Nov. 16th, 1907.

DEAR SIR,—With reference to sisal fibre cultivation, I send you my pamphlet on the "Sisal Industry." I have studied out the matter both in S. America and in this country, and have a plantation here which is thriving well and will be ready in another year to commence operations on. The pamphlet has been well received in Mexico, where it was reproduced in the *Mexican Investor* (January 19th and 26th, 1907). Perhaps you may find something worth noting in it.—Yours faithfully,

A. J. BOYD,

Editor, Queensland Agricultural Journal.

[We are much obliged to Mr. Boyd for a copy of his instructive and well-illustrated pamphlet entitled :—

The Sisal Fibre Industry in Queensland, with Notes on Mauritius Hemp, Murva, and the Mexican Zapupe Fibre, by A. J. Boyd, Department of Agriculture and Stock. 1st August, 1906.

Simultaneously we have received a copy of a Special Report by Commissioner F. H. Watkins "Upon the Caicos Islands, with special reference to the further development of the Sisal Industry," dated June last. It is worthwhile giving the conclusion of Mr. Watkins' report :—

General Conclusions.

Before embarking on any industry it is well to study carefully all the circumstances connected therewith, and to weigh the probable chances of success or failure. In the sisal industry there exist three essential conditions necessary to arrive at profitable results, namely :—

(1) Capital, on account of the somewhat expensive machinery for extracting the fibre, and the length of time which must elapse before a return is made for the expenditure of several years.

(2) A large area of land, especially where the soil is poor, to maintain the cultivation in regular succession.

(3) An abundant and cheap supply of labour.

The last two conditions can be fulfilled in the Caicos Islands ; capital has to be introduced.

It may not be out of place to consider, briefly, and summarise what may be regarded as the advantages and disadvantages associated with the industry.

Advantages.

(1) Land may be purchased cheaply or obtained at a nominal rent, 4d per acre, in the Caicos Islands.

(2) The experience which, in the initial stages of all undertakings, has to be purchased by inevitable mistakes at considerable cost, is now available,

(3) It may be thought that, if more fibre is produced in these islands, the prices may fall, but it is improbable that the largest possible output of the Bahamas and of the Caicos Islands would ever be sufficient to exert an appreciable effect on the question of supply and demand in the fibre market. On the contrary, it is important that the expert of fibre from the Bahamas and these islands should be increased to justify a separate name (*e.g.*, as Sea Island in the case of cotton) to distinguish it from that produced in Yucatan. At present, the price of the fibre exported from these islands is, in spite of its superiority, governed largely by that obtained for the inferior qualities made in Mexico.

(4) The universal usefulness of, and the enormous and continuous demand for, sisal, preclude the possibility of overpreduction. In 1905, the total export of sisal from Mexico amounted to 597,289 bales, weighing 212,375,231 lb, of the value of $90,625,430 (Mexican).

(5) When once the industry is firmly established and the initial stages passed, remunerative prices are always obtained for sisal properly extracted and graded. As an index of what returns may be expected, the figures of the last 18 years, given below, may be instructive :—

(1) Lowest price obtained, 2⅞ cents per lb, equal to £12 5s per ton.

(2) Highest price obtained, 8½ cents per lb, equal to £39 13s 4d per ton.

(3) Average price, 6 cents per lb, equal to £28 per ton.

(4) Present price, 6⅞ cents per lb, equal to £32 1s 8d per ton

A rough estimate of the cost of production, exclusive of purchase or rent of land, machinery, freight, supplies, commission, and interest, but inclusive of local salaries and wages, may be placed at £7 to £10 a ton.

(6) The unconquerable vitality of the plant and the fact that the fibre, when extracted, does not deteriorate by lengthy storage, are important matters for consideration.

(7) As it is improbable that the sisal plant would thrive within a "frost-visited" region, the possible area of cultivation is limited, and, as has already been indicated, the plant requires a peculiar soil for its most favourable and profitable growth.

(8) Looking at the industry from an official standpoint, its development would put to profitable use large tracts of land unsuitable for any other cultivation, and would afford, on a large scale, employment to many who, even now, have often-times the alternative between starvation and emigration.

Disadvantages.

(1) Chief among the drawbacks attached to sisal cultivation is the slow return for the outlay, because four or five years have to elapse after planting before the fibre can be placed on the market.

(2) The soil suitable for sisal is such as to preclude the possibility of catch and rotation crops, and there are no by-products to aid in meeting the expenditure of the long years in the early stages

(3) The isolated life and peculiar conditions of the Caicos Islands are not likely to prove attractive to those desirous of settling and managing their own properties. It is far more satisfactory and economical to place in charge men acquainted with local conditions and the habits and character of the native labourer than to send out as managers men who, however well qualified they may be to supervise machinery, are ignorant of the elements of tropical agriculture. Unaccustomed to the climate, food, and people, the new-comers, although receiving double the salary given to a man born in the place, speedily grow dissatisfied, and the chances of success are hampered by constant changes in the management and by the pet schemes and experiments of each new manager.

Conclusion.

When the survey of the Caicos Islands is complete and the extent of the Crown lands determined, it will be worthy of consideration to take measures for extending this important industry, which offers great possibility to the labouring population of the Dependency, and seems to assure large and certain profits to capitalists content to await patiently their returns and to allow the cultivation to be conducted on sound and economical principles.
—ED, *C.O.*]

COQUILHO-NUTS.

H. M. Consul at Bahia reports that coquilho-nuts are exported from Bahia in steadily increasing quantity yearly. The nuts average in size something larger than a hen's egg, and consist of a central kernel embedded in an extremely hard pulp. The kernel yields an oil of very fine quality, which is used locally as a lubricant for watches and for other dolicate mechanisms. The chief value of the nuts, however, would seem to lie in the pulp surrounding the kernel. Out of that pulp are manufactured buttons of all kinds, also a considerablo proportion of the rosarios used throughout the world by both Christians and Mohammedans. Most of the coquilho-nuts exported from Bahia go to France, where the pulp is utilised in the manner stated. The exports in 1906 amounted to 47,883 kilos., beeng an increase of 6,080 kilos. over 1905.—*Chemist and Druggist*, Dec. 14.

IMMUNITY TO DISEASE AMONG PLANTS.

The diseases of plants and the immunity to disease of certain varieties is a subject which should engage the interest of tropical planters, as on their plantations fungus and other diseases are very numerous. The following is abridged from a lecture delivered in Manchester by Professsor Weiss.

The question of immunity to disease has been so closely studied and so frequently discussed in connection with the diseases of man that it seemed to me that it might be of interest to bring together somo of the facts now known to us about the incidence of disease among plants and the theories which have been advanced as to the cause of the immunity which some species and varieties exhibit to various diseases.

The late Prof. Marshall Ward has shown that *Puccinia dispersa*, the brown rust of grasses, seems to exist in several "biologic forms," each of which attacks only one group of nearly related species of Bromus, and the same condition obtains in the Erisipheæ, or mildews, according to Salmon. How is it that these fungi are incapable of infecting such nearly related host plants as are represented by the species within a single genus? The suggestion was originally made that differences in the thickness of the cell walls, fewer or smaller stomata, longer hairs, &c., were the obstacles which repelled the fungi and rendered certain species and genera of plants immune to the attacks of particular fungi. Working with the different species of Brome, Marshall Ward was, however, able to show that there was no relationship between the stomata, hairs, and so forth, and the infectibility of the species. Immunity did not in any way depend upon the anatomical characters of the host plant, but entirely on physiological reactions of the protoplasm of the fungus and of the cells of the host. In other words,

INFECTION AND RESISTANCE TO INFECTION

depend on the power of the fungus protoplasm to overcome the resistance of the cells of the host by means of enzymes or toxins, and reciprocally on the protoplasm of the cells of the host to form anti bodies which destroy such enzymes or toxins, just as is the case with resistance of animal organisms to their bacterial foes. Salmon has shown in his experimonts that susceptibility in a leaf normally immune to the attacks of the biologic form of a particular mildew may be induced by various mechanical means, such as cutting the leaf or searing it with a red-hot point of a knife, or by exposing the leaf to ether or alcohol vapours, or by exposing it to heat. The resistant vitality is thereby impaired, and the fungus gains the upper hand. Plants, if not immune to a particular disease, may be rendered so to a certain extent by similar methods to those employed in the case of animals. More or loss successful injection experiments have been made in the case of fruit trees suffering from chlorosis, and as a result animal parasites have been got rid of as well. Undoubtedly if the general vitality of the tree can be raised some diseases can be thrown off.

Marchal has stated, 1902, that young plants of the lettuce could be rendered immune against *Bremia latucae* by feeding the plants with a solution of copper sulphate (1 in 30,000). This view has received support from Laurent and Massée, but Salmon has not been able to confirm these results. It will be seen that the views are still somewhat conflicting, and too much must not be expected from such methods of treatment.

THE HOPE OF THE AGRICULTURIST

lies in another direction. Plants, like animals, are subject, as Darwin has shown, to a considerable amount of variation, and all characters, whether anatomical or physiological, are subject to change or mutation. Immunity to disease, dependent as it is on certain physiological peculiarities, the secretion of anti-toxins, rather than on anatomical structure, is similarly a subject of variation. We see this readily illustrated when passing through a field exposed to some epidemic disease, where here and there plants are found which have been either only slightly damaged or not attacked at all. These should bo selected for breeding purposes, and thus hardier varieties can be produced. Another method which has shown itself useful for

PRODUCING RESISTANT FORMS IS BY HYBRIDISING.

It is a well-known fact that hybrids, while partaking of the nature of one or both of the parents in most characters, generally exceed both in vegetative vigour—a characteristic to which the sterility of some hybrids is attributed. But vegetative vigour, as we have seen above, is generally associated with immunity to disease, and hence hybrids are often found to be more resistant. This is not always the case, for in this respect hybrids vary too, but the French horticulturists, MM. Bouttes and Guillon, have been successful in producing hybrid vines which are more resistant to the mildew than either of the parents.

In the selection of immune varieties one is faced with the unfortunate fact that many of the most resistant forms are the least valuable, producing poorer fruits and seeds than the delicate forms. But by judicious hybridising this defect of the immune race can be largely counteracted. Mr Lewton Brain has collected a good deal of information on this point. Both in the case of vines and in wheat many disease-resisting forms have been produced.

IN CONNECTION WITH COTTON CROPS,

it is remarkable how great is the range of variation with regard to the resistance of the plants to the wilt disease (*Neocosmospora vasinfecta*). By selection and suitable hybridising, Rivers has been able to obtain varieties which remained untouched by the disease, while of the neighbouring crops 95 per cent. were destroyed. In the West Indies the Bourbon cane has been given up on account of disease, but very useful and disease-resisting hybrids have been produced by crossing the valuable but easily attacked Tjeribon cane with the resistant Indian Tschan cane.

It will thus be seen that breeders have the power by careful selection to combine disease-resisting powers with relatively great fertility, and therein lies our hope for the future success of agriculture—*Nature*, Nov. 7.

CARNAUBA WAX

is a species of vegetable wax, which is obtained from a palm tree (*Copernicia cerifera* Mart.) The palm in question grows wild and in abundance throughout many parts of the West Indies and is being tried by at least one firm we know of in Ceylon. Carnauba wax is an article of high commercial value. It has been used during many years past for the manufacture of fine-quality candles, also during latter years as a basis for boot polish. Quite recently, it appears, the discovery has been made that carnauba wax is the substance most suitable for the manufacture of records for phonographs and gramaphones, and the additional demand thus created has had the effect of materially increasing the value of the wax in question. At the present time the market prices of carnauba wax range from £170 to £225 per ton. The value of the wax is dependent upon three factors—tint, texture, and richness in oil, and for trade purposes the wax is graded into three qualities. The first quality is of uniform pale cream tint, smooth and homogeneous in texture, and is rich in oil. The inferior qualities are darker and less uniform in colour, somewhat porous in texture and less rich in oil.

MARKET FOR INDIA AND CEYLON TEA PLANTING SHARES.

A Review of the Year 1907.

The feature of the year under review, so far as the market for tea was concerned, has been an almost complete reversal of the conditions of the preceding year. Following on the tendency which manifested itself towards the end of 1906, we have to chronicle a more or less steady and sustained high value for the commoner classes of tea, accompanied by a low and unsatisfactory market for the finer kinds of Assam, Darjeeling, and high elevation Ceylon teas. These two divergent tendencies were no doubt largely due to cause and effect. Apart from this abnormal feature, the market has, on the whole, been well sustained, and has been helped by a fair absorption of British-grown tea in markets outside of Great Britain.

When accounts for the year 1906 were issued in the spring, results panned out extremely well. The finer tea producers had had the cream during the autumn of 1906, while the cheap-tea producers got the full benefit of high prices for the latter part of the selling season in early 1907. Taking a representative batch of Indian companies, we find the aggregate profits amounted to no less than £650,000, against previous year's £485,000, and only £340,000 for 1904.

Share values were, as usual, mainly influenced by the actual or anticipated state of the Mincing Lane market. During the fist six months those of the Assam and Darjeeling companies shared with the Sylhet, and Dooars ones in the general movement to a higher level, but during the autumn the first-mentioned class suffered a heavy set-back, which was all the more noticeable, as the producers of Cachar, Sylhet, Dooars, and Travancore were in many cases speculatively raised to a very high level, such shares as Chubwa and Dooars Company rising even higher than the highest reached during the period of inflation at the end of last century. These contradictory features are sustained right up to the close.

Interim reports and accompanying interim dividends are for the most part favourable, but directors now follow (and rightly so) a cautious policy in making such interim distributions before the outcome of the season's working can be known with certainty.

Crops from Northern India and Ceylon are moderate in quantity, and although supplies from Southern India tend to become a more important factor, and Java and even

China have (owing to the high price of common tea) considerably increased their sendings, there seems no reason to anticipate an excess of supply over demand in the near future.

The great and over-shadowing feature of the year, however, has been the well-sustained demand from foreign countries, which has been greatly aided by the propaganda of the Indian Tea Cess Committee, especially in Germany and Central Europe. Experience of eighteen months' work has been so satisfactory that it is now the intention of the London Toa Association to contribute more liberally to the work of the recently appointed Commissioner for Europe. If this campaign proves as successful as gives promise, results may have a very important bearing on the future of the tea industry in the not improbable event of overproduction again menacing the position of the planting community.

There have been additions to issued capital during the past year, which we may summarise as follows :—

	£
Assam Company ..	13,000
Assam Dooars ..	30,000
Borjan ..	14,000
Consol. Estates, Central Tea, Ceylon Land and Produce, and Ouvah Coffee Companies ..	80,000
East Ind. Tea and Produce ..	120,000
Hope Tea Company ..	168,000
Kilcott Company ..	15,000
	£390,000

while the Jorehaut and Majuli Companies have split their £20 and £10 shares respectively into £1 shares.

The volume of dealings in the shares of tea companies has been, to an even greater extent than in 1906, considerable. The greatest activity was displayed (1) in January to March, (2) about the end of June, and (3) during October, considerable slackness characterising the intervening periods. This latter feature, however, was more the result of the depressed state of the mining, and investment markets generally than of any weakness in the tea position.

The general outlook both for tea and for shares seems favourable, but probability seems to point to a reversal before long of the respective positions of the cheaper teas and the shares of companies producing them on the one hand, and of the finer kinds and the shares of companies producing them on the other. The former would appear at present to be over-valued and the latter under-valued, and those who are contemplating investment would do well to give due weight to this fact.

We append our usual abstract showing the range of values during the year for the leading shares :—

INDIAN SHARES.

1907.

	Jan.	Bot.	Top.	Dec.	Rise.	Fall
Amalgamated Ord. ..	3	2⅞	3⅛	2⅞	—	¼
Amalgamated Pref. ..	7⅜	7¼	8 5-8	7¼	—	¼
Assam Co. ..	37⅛	30	39	30⅝	—	7
Assam Front. Ord. ..	8½	8⅜	10¼	9	½	—
Assam Front Pref. ..	10¼	9⅝	10⅝	10	—	¼
Attaree Khat ..	6⅝	6	7 1-8	6⅞	—	—
Bengal United Ord. ..	10	9½	13⅛	13¼	3¼	—
Bengal United Pref. ..	9	8½	9	9	—	—
Brahmapootra ..	10½	10	11¼	11¼	¾	—
British Indian Ord. ..	3	2 7-8	4 3-8	4¼	1¼	—
Cachar Dooars Ord. ..	5⅜	5½	9½	9	3½	—
Chandpore ..	16	16	18⅜	18½	2½	—
Chargola Ord. ..	1⅛	1⅛	1 3-8	1⅛	—	—
Chargol Pref. ..	1⅛	1 1-8	1½	1 1-8	—	1-8
Chubwa Ord. ..	6¼	6½	8¼	8	1½	—
Con T. and Lands Ord. ..	3	2 1-8	4 5-8	4½	1½	—
Con. T. and L, First Pref. ..	9¼	8¼	10	8½	—	1
Con. T. and L. Second Pref. ..	9	9¾	12¾	12½	3½	—
Darjeelling ..	13½	12	15	11½	—	2
Dar. Con. Ord. ..	3	3	4¼	4¼	1¼	⅛
Dar. Con. Pref. ..	8¼	7¾	8½	7¾	—	-
Dooars Ord. ..	20	18	23	20½	½	-
Dooma ..	17⅜	15½	18¼	15½	—	2
Eastern Assam ..	6½	6½	8	7½	1	—
East Ind. and Cey Pref.	3½	3½	5	5	1½		
Empire Ord ..	9½	9½	12	11	1½		
Empire Pref ..	9	8 3-8	9 1-8	8½	—	½
Imperial Ord ..	6¾	6½	8¾	8¼	1½	—
Indian of Cachar ..	4	3½	4½	4	—	—
Jetinga Ord ..	5-8	5-8	7-8	13-16	3-16	—
Jetinga Pref ..	4½	4¼	4 5-8	4½	—	—
Jhanzi ..	5	4½	6 1-8	4½	—	
Jokai Ord ..	12½	12	14	12½	—	½
Jorehaut ..	2	1 7-8	2 1-8	2	—	—
Lebong £8 ..	12½	10½	12½	10½	—	—
Lungla Ord ..	7⅛	7⅛	9½	9¼	1⅞	1⅛
Lungala Pref. ..	10¼	9 7-8	10½	10¼	—	—
Majuli Ord. (Old £10) ..	7½	7¾	8½	8	½	—
Makum ..	9-16	9-16	¾	5-8	1-16	—
Moabund Ord. ..	1 1-8	1	1¼	1 1-16	—	1-16
Nedeem Ord. ..	8¾	8¾	11	11	2¼	—
Needem Prefs. ..	8½	8½	8¾	8¾	—	—
Scot. Assam ..	8	6½	7¾	6⅜	—	1⅛
Sephinjuri Bheel ..	14/	14/	19/9	19/	5/		
Singlo Ord. ..	3½	3½	6	5½	2	—
Singlo Prefs. ..	5½	5½	7¾	7½	2	—

CEYLON ORDINARY SHARES.

Alliance	10	10	10¾	10	—	—
Anglo-Ceylon ..	106	110	132	124	18	—
Ceylon Plantation ..	35½	34	37	34	—	1½
Consolidated Estates ..	15	15	24	22	7	—
Dimbula Valley ..	6	6	6½	6	—	—
Eastern Produce ..	7	6¾	9½	8½	1½	—
Lanka	4¼	4¼	6¾	6	1¾	—
New Dimbula ..	3 5-8	3	3¾	3 3-8	—	¼
Nuwara Eliya ..	10	10	11½	10½	½	—
Standard £6 ..	14	12¾	14	13	—	1
Yatiyantota ..	15½	15½	16½	15½	—	—

—*H. & C. Mail*, Dec. 27.

TREES AND LIGHTNING.

The trees most apt to be struck by lightning are those that conform most naturally to the law of electrical motion—that electricity moves along the path of least resistance. Flammarion, the great French scientist, published in 1905 a list of different kinds of trees, showing the number of times each species had been struck by lightning during a given period. The figures are : 54 Oaks, 24 Poplars, 14 Elms, 11 Walnuts, 10 Firs, 7 Willows, 6 Beeches, 4 Chestnuts, but not a single Birch.—*The Reader*

THE COCONUT BLEEDING DISEASE.

Veyangoda, Jan. 10th.

DEAR SIR,—It is satisfactory to know that the Agricultural Society is circulating leaflets with information bearing on the new disease—some call it old—and on the most effective treatment therefor. Something more is needed than the circulation of information, viz., the prompt enforcement of remedies. The Society is helpless to do this. It rests with Revenue Officers to ascertain from their Headmen whether they are doing anything themselves in fighting the disease in their own gardens, and in inducing the villagers to combat it. The answer, I fear, will be that nothing has been done, or practically nothing. I have made inquiries in this neighbourhood, and have so far failed to find that the people are aware of the gravity of the situation. It is because I consider the outlook serious that I now address you, in the hope that publicity may lead to energetic official action. The appointment of Pest Committees and Inspectors, to see that trees attacked are either treated, or cut down and burnt, should not be delayed if the progress of the pest is to be stayed, and if the operations of those who believe in remedial measures are not to be nullified by the negligence or ignorance of their neighbours.

It was not many months ago that in reply to an inquiry from the Society, I stated that only about a dozen trees were attacked on this estate. Now it would be safe to multiply that number by ten. Whether it is that the disease has spread since, or that only closer examination has made me acquainted with the true state of things, my experience points to the need both of closer observation and vigorous action. It is immaterial whether those are correct who say that the disease is an old one, pointing to the scars which almost every coconut tree shows, or those who, like myself, believe the disease to be of recent origin. Mr Petch's opinion points to a serious danger, and those who cut out the diseased stem find that the damage done by the fungus is far from superficial. It is easy to deal with it now. It will be more difficult presently. Meanwhile, the vitality and productiveness of the tree are likely to be seriously affected.—Yours,

F. B.

CAMPHOR: ANNUAL REPORT FOR 1907.

The values of crude camphor have diminished throughout the year, particularly in the second half, the decline over the year being about 60 per cent. This is due to increased production in South China, where, however, the output is irregular, and unless replanting takes place the industry there may become extinct in a few years. Japan is improving and extending cultivation of camphor-trees both in Japan and Formosa, and so means to avert the profitable introduction of synthetic camphor. Refined camphor closely followed the decline in crude. Up to 5s was paid for English bells in March, but from May to August the market was depressed, and Japanese competition in refined becoming exceedingly keen, values dropped 1s. 4d. in August, a further 5d. in September, and 3d. in November (when bells touched 2s. 9d.), with a recovery of 2d. in December. These reductions in price have told against synthetic camphor, which, nevertheless has made some headway. New companies for its production are working in England, Germany, France, Switzerland, and the United States, and up to the present most of the product has gone to celluloid manufacturers; although it is now put up in tablet form, there is a difficulty in disposing of the output, unless at prices materially below those of refined. When natural camphor was at its dearest some suspicious parcels came from China, the optical rotation differing so much from the natural as to lead to the suggestion that the optically inactive synthetic camphor had been purposely mixed with it. Whether this was the case or not, it is satisfactory to know that we have a means of detecting admixture of the two kinds.—*Chemist and Druggist*, Dec. 28.

THE CEYLON TEA CROP ESTIMATE FOR 1908.

Messrs Forbes and Walker estimate the Ceylon Tea Crop for 1908 at 182,000,000 lb., distributed as follows :—

	lb.
United Kingdom	106,000,000
Russia	24,000,000
Continent of Europe	2,500,000
America	12,000,000
Africa and Mauritius	1,250,000
Australia	24,000,000
India	1,250,000
China and Singapore	11,000,000
Total	182,000,000

Against 178,000,000 lb. estimated by the Ceylon Planters' Association.

DIVI-DIVI.

A Useful Tanning Tree.

Of exotic trees established at various centres in Southern India, one occasionally meets with *Cæsalpinia coriaria*, otherwise known as "Divi Divi", the latter appellation being possibly derived from the West Indian or South American vernacular name. But the tree is seldom found in much quantity, and the export of its valuable pods, used for tanning and making ink, is of trifling importance at present. Cultivation in Botanical Gardens, by the Forest Department, and at other experimental stations throughout India, has made known the culturable and climatic requirements of the species, and it only remains to utilise the experience thus gained to establish plantations for the benefit of both the planter and the State. As a tanning material the sinuous pods are of great value, the produce of a full grown tree being worth, on the average, R5 to R7 annually. The pods at first pale green, then changing to reddish brown and dark chocolate, are profusely borne in clusters all over the tree. The tree is rather extensively planted about Madras, and good growth is reported from Calcutta, Cawnpore, Khandesh Bombay, Bangalore and other centres. Seed can also be opened from nearly all the public, gardens on the plains. With such a wide range of successful experiment there should be little difficulty in finding suitable sites for plantations. The statement made in "Watts' Dictionary," that in its native habit the tree is "found in marshy situations" must be taken with caution. The same thing was said about the Para Rubber tree when it first came to the East, and it is now well-known that both trees require good drainage in this country.

To obtain rapid growth a clayish calcareous soil has been recommended, while red soil is said to have the opposite effect. But when the red soil of Mysore is properly loosened and pulverised, growth is not slow. What the tree really needs is a pliant root medium of fairly good soil of any kind, and when this is not procurable naturally, large pits should be dug for the seedlings. The latter should also be well established in pots or baskets, being at least a foot high and pretty sturdy at the time of planting, say, in July and August for preference. An annual rainfall ranging from 35 to to 70 inches seems favourable both to growth and the production of pods. In unbroken soils of a compact or hard nature, as also in poor land, growth is decidedly slow; and the sapling remains in a whippy condition for many years. But under proper treatment the tree attains a productive size in eight to ten years, and eventually becomes a handsome object requiring considerable space. The short trunk throws out a number of woody limbs which, in their turn, give off numerous drooping branches, producing in a single specimen the form of a huge umbrella. Several trees of this type may be seen in the Residency grounds at Bangalore, where they flower profusely at the close of the year and ripen fruit two or three months later. At the flowering season the species is very attractive, the small yellow flowers—sweetly scented and swarming with bees—forming a striking contrast with the sombre green of the foliage. To form a plantation trees should be put out at 20 feet apart each way, the intention being to remove every alternate tree as growth demands it. The species is long lived and very tenacious of life. After the initial cost of planting the outlay would be trifling. As the pods ripen they fall to the grouud. Full sized ones are said to contain 50 per cent of pure tannin and are worth about R125 a ton or approximately the same amount per acre. The removal of the seed from the matured pod is a difficult operation and can only be done by hand-picking, pounding and maceration. Its romoval is also necessary to preserve the purity of the tannin in the legume, an oil in the seed being injurious to the latter. For commercial purposes it has been suggested to reduce the pod, or legume, to a condition of chips or powder before the seed can do any harm. As an Indian marketable product divi-divi should certainly take a more important place than it does at present.

—*M. Mail*, Jan. 17. J. C.

S. FIGGIS & CO.'S ANNUAL REVIEW OF INDIA RUBBER MARKET, 1907.

PLANTATION RUBBER GROWN IN CEYLON AND BRITISH MALAYA (FEDERATED STATES, PERAK, MALACCA, JOHORE, STRAITS), SUMATRA, JAVA, &c.

The supply has increased more rapidly than was anticipated, and planting much more (too much.) We estimate from

	tons		tons		tons
Ceylon	230	against	160	1906 and	70 1905
Malaya	780	,,	350	1906 .,	75 1905

The Rubber as a whole has been well prepared, but the imports of late show a larger proportion of common than previously. The average price per pound shows a great reduction, owing to the very serious decline since October caused by the great crisis in America. Manufacturers have shewn a decided preference for Sheet, Biscuit and Crèpe; the latter should not be drawn out too thin or have visible air or steam bubbles in it, and some lots of thick Crèpe, nice strong rubber about 1-6ths of an inch thick, were much appreciated and sold well. We think it has been profitable to planters to wash and clean the rubber thoroughly, and to prepare as large a proportion as possible of good colour—*also not to send many qualities or very small lots* Block has not been in favor generally, and unless clean resilient hard quality can be sent, it may be better to ship as Crèpe. We repeat our recommendations of a year ago.—Pack it in good dry condition (excess of resin much objected to). Into strong cases of 1 cwt. to 2 cwt. each. No paper, fullers earth, &c., to be used. Keeping *different qualities and colours separate* and *not to mix immature Rubber with older*; to send separately dirty barky pieces, and to *wash out all the bark* in Crèpe, Block and Sheet. All fine qualities should be loose Crèpe, Sheet or Biscuit—not run to mass. To smoke the Rubber when convenient, because "smoking" appears to increase its resiliency but keep it as clear and yellow as possible. Our London charges are very small. Brokerage ½ per cent. All samples are paid for, and the only deduction is—Discount 2½ per cent. Draft (on all Rubber) ½ per cent. Planters get these back in the higher prices obtained. Smoked rubber appears to have greater resiliency and to be more suitable for many purposes than unsmoked. "Smoking" prevents the "proteins" in rubber from decomposition, and generally from "tackiness." All fine rubber from Para is smoked. The very serious decline in price since October is mainly due to the serious crisis in America and the closing of many factories there. But, considering the enormous increase and general expectation of "planting" rubber in most tropical countries, (coupled with the prophetic figures of immense supplies of Plantation within two or three years), values were far too high. The decline will, we hope, cool many new enterprises and prevent too large extension of planting. *There is no sign of such increased demand or new uses for Rubber as to warrant too rapid an increase of supply. If it becomes too large values will suffer We cannot expect much increase of consumption in 1908 in the present state of trade and the over-production of motors everywhere this season.*

Brazil shows no sign of reducing her output, though perhaps she may do so in the *next* crop owing to the serious losses on this crop. Brazil exported over 41,500 tons. There are rumours about the manufacture, by old and monied people who do not often put money into disastrous speculation, of what was erroneously described as Synthetic rubber. We shall watch results with curiosity (and doubt). The lower price may retard or reduce the manufacture of "substitutes," but they are largely consumed.

The manufacture of reclaimed rubber is very considerable and increasing. Rambong and Castilloa have not been liked and sold cheaply. Last January we quoted fine sheet, biscuits, and crepe 5s 6d to 5s 8d, brown and dark ditto 4s 9d to 5s 4d. Prices advanced to middle of March, declined to 5s for fine by end of May; rose 6d to 7d, but subsequently again to 5s in September, and seriously declined during the last three months with the financial crisis in America. Today's quotations are for fine 3s 11d, dark and brown 3s 5d: fine Para 3s 5d. The world's supply in 1907 was nearly 69,000 tons, as against 65,000 tons in 1906 and consumption nearly the same as 1906, say about 66,000 tons. Of rubber planted we estimate in the East over 350,000 acres—

	1907-8. Acres.		1906-7. Acres.
Ceylon	150,000	against	100,000
Malaya, Malacca, &c. (containing about 14 million trees, not one million tapped in 1907)	100,000	,,	90,000
Borneo	11,000	,,	8,000
Dutch, East Indies, Java, Sumatra, &c	70,000	,,	25,000

Mexico, Nicaragua and Honduras have been planting and are increasing:—probably by now 20,000 acres planted; also Colombia, Ecuador, Bolivia and Peru. India is more rapidly

extending and has probably about 25,000 acres planted. Some in Burma and Mergui: the Phillipines (small as yet), Samoa, Hawaii, and beginning in New Guinea and other Islands, Queonsland and Seychelles. The West Coast of Africa is hard at work with plantations, and more progress has been mado in the Congo region and German West Africa, also in British East Africa, Uganda and the West Indies, probably 2,000 acres. Brazil exported in 1907 about 41,500 tons against 38,000 tons in 1906, and Manicoba has increased, also Guayule from Mexico which has gone freely into use in America and the Continent. Prices of Guayule are very much lower and quality greatly improved, probably 3,000 tons were made.

REVIEW OF PARA PRICES FOR 1907.

We began 1907 with price for fine Hard 5s 2½d, Soft 5s 0½d, Negrohead scrappy 4s 1½d, Cameta 3s 1½d, Caucho Ball 4s 3½d. By end of March the latter had declined to 3s 7½d, Negrohead 3s 10d, fine hard 4s 11d. In June prices were lower again, 4s 7d fine Hard, but there was a large business and activity for American account in July, when Hard sold at 4s 11d, Negrohead 3s 11½d, Cameta 3s 2d, Ball 3s 10½d. The market became quiet and declined in September to 4s 5d, 3s 10d, 2s 7½d and 3s 7½d relatively. Prices declined a further 4d per lb. by end of October, and after some recovery, fell seriously in November—Hard fine selling down to 3s 4d, fine Soft 3s, scrappy 2s 8¾d, Cameta is 1s 10½d. Ball 2s 7d. In early December there was a recovery of 4d in fine, 2d per lb. on other qualities, but at the close our quotations are lower—fine Hard 3s 5d, Soft 3s 2d, Negrohead scrappy 2s 10d, Cameta 2s 0½d, Island (scarce) about 2s, Caucho Ball 2s 9d, showing a fall in value for the 12 months of 1s 9½d on Fine, 1s 1½d on Negrohead. Soft Cure has been abundant, and during recent months the value receded from the former difference of 2d on Hard, to 4d, whilst Soft Entrefine has been most difficult of sale at a serious reduction.

BALATA was in regular supply. Sheet advanced to 2s 6½d, but closes at 2s 2½d. Block was up to 1s 11d, closing at 1s 6½d. GUTTA PERCHA sold slowly during tho year at moderate prices.

WILSON, SMITHETT & CO.'S RUBBER REPORT.

JANUARY 3RD, 1908.

INDIA RUBBER.—During the fortnight which has elapsed since our last issue, consequent on the Christmas holidays, a quiet tone has prevailed, but quotations for Para close slightly lower for spot at 3s 5d per lb., and for delivery at 3s 5¼d to 3 5½d per lb., according to position. The total receipts for 1907, which we print below, show an important increase, but this is wholly accounted for during the first half of the year.

The London landings last month were 251 tons, and 242 tons were delivered, the Liverpool figures being 1,568 tons and 1,251 tons respectively, including Para kinds 1,006 tons and 725 tons.

PLANTATION.—The landings during the month were 94 tons, and deliveries 96 tons. The movements of Plantation sorts during 1907 were 1,125 tons landed, compared with 1,016 tons delivered.

	1907. Tons.	1906. Tons.	1905. Tons.	1904. Tons.	1903. Tons.
Para Receipts, Jan.-June	23,435	19,800	19,720	17,075	17,600
Para Receipts, July-December	14,230	14,680	14,690	13,310	13,470
Total	37,665	34,480	34,410	30,385	31,070
Comparative value of Para 31st December	3/5	5/2¾	5/5	5/1	3/11
Stock of all growths in London	1,017	739	590	460	264
Stock of Plantation London	157	66	—	—	—
Imported London twelve months	3,674	2,734	2,269	2,088	1,348
Delivered London twelve months	3,238	2,570	2,140	1,889	1,322
Stock all growths Liverpool 31st December	2,265	960	1,029	860	1,176
Stock Para Liverpool 31st Dec.	921	370	573	177	546
Ceylon shipments 1st January to 9th December	216	136	59	30	18

During the first three months of 1907 a firm tone characterised the market. At the opening auctions on 4th January when the quotation for Para was 5s 2½d per lb, first qualities of Plantation biscuits and sheet realised 5s 6¾d to 5s 7½d per lb. An upward tendency prevailed until the early weeks of March, values of first qualities having then advauced to 5s 8d to 5s 9½d per lb. From that time until the end of November an almost continuons decline took place with but few slight checks, the lowest price touched for plantation being 3s 8d to 3s 10d per lb in November, while Para had then declined to 3s 5d per lb. A further fall to 3s 3¾d in the latter quotation was recorded, but no business in Plantation was reported at a lower figure; during December a reaction took place and first qualities recovered to 4s 0d to 4s 4½d per lb, but at the closing auctions of the year fell back again to 3s 10d to 3s 11¼d in sympathy with para, which had again declined

to 3s. 5½d., after having touched 3s. 8¾d. per lb, The increased output from all plantations has been most satisfactory to those interested, and the decline in values is in no way due to an excess of production, but is mainly attributable to the unsettled financial condition in America, to the closing of several large manufactories there, and to the general stagnation caused by these conditions, as well as by the high rates prevailing for monetary accommodation. In a declining market manufacturers have naturally shown great caution in buying, and in the place of orders from the United States, Europe has been required to absorb a larger proportiou of the constant arrivals of para at the Coast. During the past year manufacturers have shown improved intorest in plantation kinds, aud the increased production during the next few years should be readily saleable, although in all probability the premium in price over Para may be further curtailed. A year ago we noted the appearance of block rubber, but the demand during 1907, and particularly during the later months, does not encourage the continuance of this form of preparation. The finest amber quality is in rather slow demand, but any deviation from regularity in colour much increases the difficulties of effecting satisfactory sales, and the lower grades are only saleable at relatively moderate prices. Biscuits and Sheet have been throughout the year readily saleable, and the Trade generally regard these forms of preparation with the most favour, but regularity in colour and general appearance is most necessary. Crepe has sold well, particularly the first quality, but whereas at one period absolutely white Crepe was in strong demand, recont arrivals of this quality appear to have more than satisfied the prosent requirements. Scrap Crepe has materially declined in value, but this is largely due to the very quiet demand recently for all medium and lower grades. Fine Scrap continues to command relatively satisfactory prices, but the darker kinds have been less easy to dispose of.

WORLD'S COCOA CROP AND CONSUMPTION.

H. M. Consul-General at Hamburg (Sir W. Ward, C.V.O.) has forwarded the following report, based on information published in the *Gordian*, a German journal dealing with the cocoa trade, on the world's cocoa production and consumption during the year 1906, as compared with the two preceding years :—

The following table shows the cocoa crops during the year 1906, and the two preceding years in the various cocoa producing countries of the world :—

WORLD'S COCOA CROP.

Countries.	1904.	1905.	1906.
	Kilos.	Kilos.	Kilos.
Brazil	23,160,028	21,090,088	25,135,307
San Thomé	20,526,000	25,379,320	24,6 9,560
Ecuador	28,564,123	21,127,833	24,237,630
San Domingo	14,557,739	12,784,660	14,5 7,669
Trinidad	18,574,434	20,018,560	13,162,86
Venezuela	13,048,838	12,700,555	12,884,609
British West Africa	5,772 597	5,620,240	9,738,964
Grenada	5,226,700	5,455,000	5,057,030
Ceylon	3,254,800	3,542,613	2,507,152
Jamaica	1,650,000	1,48 ,509	2,503,142
Cuba	2,735,592	1,792, 44	2,475,692
Hayti	2,531,3 3	2,343,2 0	2,107,9 5
Java	1,140,109	1,491,795	1,62 ,247
Fernanda Po	2,010,766	1,862,945	1,557,864
Surinam	894,044	1,611,851	1,480,568
German Colonies	1,109,153	1,454,153	1,367,977
French Colonies	1,215,000	1,179,401	1,262,090
St. Lucia	800,000	700,000	800,000
Dominica	485,366	506,700	600,000
Congo Free State	241,382	194,638	402,429
Other countries	80 ,000	800,000	1,000,000
Totals	148,248,024	143,231,605	149,020,695

It should be remarked that the world's cocoa crop of 1904 was greater than that of any previous year, and that it exceeded the crop of 1903 by about 15 million kilos ; this increase in 1904 having been due to the exceptionally large crops of that year in Ecuador, Brazil, Trinidad, San Domingo, Venezuela, and the Gold Coast. In 1905, as will be observed, there was a decrease of about 5 million kilos. in the world's crop ; but that of 1906 exceeded the crop of 1904 by about 770,000 kilos., and was thus the largest world's crop on record.

Brazil occupied in 1906 the first rank amongst all cocoa producing countries, whilst in 1905 San Thomé, in 1904 Ecuador had occupied that position. Inasmuch as Brazil is easily able to increase its present cocoa cultivation to a far greater extent, it is quite possible that it will now continue to hold the foremost place as a cocoa-producing country. The exports of cocoa from Brazil were destined chiefly for the United States of America, Great Britain, Germany, and France.

The cocoa crop of the Portuguese Islands of San Thomé and Principe, though still very considerable, showed a slight falling-off in 1906. It is considered questionable whether San Thomé will ever again hold the position of the first cocoa-producing country in view of the very limited area of land now remaining available for fresh plantations, whilst in some other countries, such as Brazil, there appears to be still an unlimited extent of land available for cultivation.

The second largest cocoa crop in 1906 was produced in Ecuador, the country which previous to 1904 had always held the first rank. During the last few years, however, the production of Ecuador seems to be subject to considerable fluctuations. The prominent port for cocoa exportation from Ecuador is Guayaquil: in 1905, for instance, 17,051,531 kilos, of cocoa out of a total export of 21,127,833 kilos, were shipped from that port. In 1906 the total exports from Ecuador amounted to 24,237,630 kilos.

San Domingo deserves special notice, as it is likely to become an important cocoa-producing country at some future time. During late years many more plantations have been added to those already in existence, and production is steadily increasing, whilst there is still a large area of land available for cultivation, which will no doubt be planted within a few years.

The 1906 crop in Trinidad was considerably smaller than that of 1905, and exports which had reached more than 20 million kilos, in the latter year amounted in 1906 to only 13,162,860 kilos. It is, however, stated that cocoa planters in Trinidad have now taken serious steps towards ensuring a more regular, and also a greater crop, whilst the Government of the island is assisting their efforts by furnishing expert advice.

The production of cocoa in Venezuela has of late years made only slight progress, though there is stated to be a large extent of land available for plantations, in addition to that already cultivated.

The yield of the cocoa plantations in British West Africa, viz., the Gold Coast and Lagos was a very satisfactory one in 1906, and largely exceeded that of the previous year. The total exportations from both colonies in 1906 was 9,738,964 kilos., as against 5,620,240 in 1905, thus showing a very considerable development in production; whilst numerous new plantations are being laid out every year. Together with San Domingo, the Gold Coast is now attracting the greatest attention amongst cocoa-producing countries.

Before 1904 the cocoa crop of Grenada exceeded that of the British West African Colonies; but since then conditions have changed, for whilst in 1904 the crop in Grenada was 9,226,700 kilos. and that of British West Africa 5,687,964 kilos.—in 1906 Grenada produced only 5,057,030 kilos., whilst the crop in West Africa was 9,738,964 kilos. Nearly all the Grenada cocoa is exported to Great Britain. It is, however, stated that new plantations have been started in Grenada during the last few years, and that extensive improvements have been introduced, so as to ensure a return of the island to its old productiveness.

A decrease is apparent in the 1906 cocoa crop in Ceylon, as compared with 1905, but it is expected that the output will be recovered in 1907. The prevalence of numerous diseases amongst the cocoa plants in Ceylon is stated to be the chief cause which prevents a satisfactory development of production in that island.

Owing to the united efforts, both of the authorities and of the planters themselves, which had been carried on during recent years, Jamaica experienced a considerable advance in its cocoa production in 1906, which amounted to about one million kilos.

Whilst the Cuban cocoa production in 1906 was larger than that in the previous year, it has to be borne in mind that a considerable portion of the crop is consumed in Cuba itself, as there are numerous factories established there.

Cocoa production in Hayti is declining in extent, and the condition of things there is not considered satisfactory. On the one hand the laws of the country prevent the investment of foreign capital in cocoa plantations in this island and on the other hand there is a great want of means of communication with the interior for enabling produce to be brought to market.

The production of Java in 1906 slightly exceeded that of 1905; it is however, not known whether the increase was due to the fine weather or to the yield being augmented by the new plantations. The larger proportion of the Java and Surinam crop is usually exported to Holland.

No reliable statistics regarding the 1906 cocoa crop of Fernando Po are available: the exports are, however, roughly estimated at one and-a-half million kilos, that is to say, rather less than those of 1905.

The Dutch Colony of Surinam experienced an unfavourable harvest in 1906, inasmuch as more than two-thirds of the cocoa crop was destroyed by disease.

The exports from the three prominent German cocoa-producing Colonies during each of the three years 1904-6 have been as follows :—

COCOA EXPORTED FROM GERMAN COLONIES.

	1904. Kilos.	1905. Kilos.	1906. Kilos.
Cameroons ..	1,079.000	1,413,553	1,247,121
Samoa ..	19,518	27,500	92,219
Togo ..	10,635	13,100	28,637

The cocoa production of Togo is likely to remain only of limited extent, owing to the want of suitable land for cocoa plantations. Cameroons and Samoa are gradually becoming more and more productive ; and it is the opinion of German experts that some day Samoa will be able to raise a crop of 700.000 or 800,000 kilos. of cocoa.

The crops of the French cocoa-producing Colonies have not experienced any considerable increase of late years. The exports from each of these colonies during the years 1905 and 1906 have been respectively as follows : —

COCOA EXPORTED FROM FRENCH COLONIES.

	1905. Kilos.	1906. Kilos.
Guadeloupe ..	637,804	675,322
Martinique ..	469,982	472,897
French Congo ...	50,558	89,587
Guiana ..	14.716	15,697
Madagascar ..	6,255	8,297
Reunion ...	86	290
Total ..	1,179,401	1,262,090

St. Lucia had a satisfactory crop in 1906, and future prospects are also said to be favourable in view of the addition of new plantations whilst much land still remains for cultivation.

The condition of affairs in Dominica is likewise promising. For the world's market Dominican and St. Lucia cocoa are of small importance, the quantity raised being comparatively small and the whole crop being generally sent exclusively to the English market.

The cocoa production of the Congo Free State is increasing in quantity from year to year : and whilst cultivation is being gradually extended further means of communication are being established in the shape of roads and railways.

All other districts which have not been specially enumerated above, are stated to have produced together about one million kilos. of cocoa in 1906, an increase of about 200,000 kilos., as compared with the preceding year.

The consumption of cocoa in the various countries of the world during the year 1906 as compared with the two previous years is shown by the following table :—

WORLD'S COCOA CONSUMPTION.

Countries.	1904. Kilos.	1905. Kilos.	1906. Kilos.
United States of America ..	33,159,628	34,958,420	37,654,473
Germany ..	27,101,400	29,633,100	35,260,500
France ..	21,799,600	21,747,600	23,403,800
United Kingdom ..	20,552,664	21,106,000	20,132,040
Netherlands ..	12,184,400	10,737,400	11,224,000
Switzerland ..	6,839,100	5,218,400	6,466,900
Spain ..	5,816,359	6,112,945	5,607,864
Belgium ..	2,794,008	3,018,997	3,865,816
Austria-Hungary ..	2,510 100	2,668 500	3,312,800
Russia ..	2,055,700	2,230,400	2,675,940
Italy ..	479,600	971,500	1,385,000
Denmark ..	996,000	1,125,000	1,190,000
Canada ..	600,000	654,088	1,035,182
Sweden ..	870,914	900,000	1,000,000
Australia ..	550,000	600,000	650,000
Norway ..	472,137	493,813	580,043
Portugal ..	180,000	138,000	150,000
Finland ...	63,099	60,000	86,252
Total .	139,022,709	142,374,163	155,680,604

It will be seen from the preceding figures that the world's consumption of cocoa in 1906 greatly exceeded that of the previous year, viz., by about 9½ per cent. whilst the increase in 1905, compared with 1904, had only been 2½ per cent, and that the considerable increase in 1906 was due mainly to the greatly increased consumption in Germany. In view of this fact, it appears not improbable that within one or two years Germany will take the first rank amongst the cocoa consuming countries.

The increase of the consumption of cocoa in France in 1906 as compared with 1905 amounted to about 1,750,000 kilos. This increase is stated to have been mainly due to the larger consumption of the Swiss chocolate factories established in France.

The cocoa consumption in the United Kingdom in 1906 will be seen to have decreased as compared with 1905. As a beverage or as food cocoa and chocolate appear to be less popular in the United Kingdom than they used to be. Whilst, however, the consumption of Swiss chocolate increases in Great Britain the chocolate manufactured in Great Britain is chiefly exported to British Colonies.

Of the other countries mentioned in the above table, all with the exception of Spain and Denmark show an increase in their cocoa consumption for 1906, as compared with the previous year, though in the case of the Netherlands, Switzerland and Portugal the figures for 1904 were not quite reached. It will be observed that whilst in Australia cocoa consumption seems to increase very slowly, the rate of the annual increase in Canada has been a more rapid one.

The stocks of Cocoa remaining on hand in all countries of the world at the end of the year 1904, 1905 and 1906 amounted to 55,348,651 kilos. 56,079,212 kilos., and 49,879,326 kilos. respectively.

ORANGE-GROWING IN CEYLON AND IN OTHER TROPICAL LANDS.

We have come upon an interesting letter addressed by the late Mr. W. Ferguson, F.L.S., to the editor of the *Observer* in 1881 on the above subject, but never published. It runs as follows :—

"I fear that you cannot make a fair comparison between Ceylon and the regular orange-growing countries you refer to. In the latter, oranges are grown in groves and over large extents like our coffee (tea) fields, whereas in Ceylon I do not know any place where an extent of ground has been set apart for orange trees alone. Mr. R L M Brown tried to grow all kinds at Mahara ; but I do not think he succeeded. The orange trees in Ceylon are isolated plants, growing round houses and in gardens amongst other plants, and one would be at a loss to know where all the oranges sold in Colombo come from. Galaha estate has been famous for its oranges for the last 25 years or so, but they are planted in avenues along the roads in the coffee. They have not been so good nor so plentiful for some years past, I think. You know that we grow the large and small Mandarin oranges, the Jama (or Java) naran and Heenjamanaran, varieties of the *Citrus aurantium*, but the common orange grown here, is, I think, an inferior variety of the same species—also the Spanish orange. I suppose the immunity of this plant and the others from disease arises from the fact of their isolation or scattered positions. There may be something also in the fact that our trees are of Indian origin, and not of European or West Indian."

A planter who has given some attention to the cultivation of oranges in a high district, after a perusal of the above, remarked :—

"I knew the Kitoolmoola-Galaha avenue well in the early 'seventies, but I fancy those trees are all dead and gone ere this as the citrus family out here has suffered greatly from blights of sorts for many years, and it is only liberal cultivation which keeps them going now-a-days. Young trees suffer just as much as old, and I recall one authority prophesying ten years ago that all our orange trees were doomed. He was no mean authority in the botanical line, but he was not quite correct there, as though I have lost a few, I have still many trees over 30 years old, which are as vigorous as ever they were."

We had hope to gather some practical information from Bonavia's big volumes on the orange ; but a reliable critic considers Bonavia far too pedantically scientific, and inclined to make mountains out of molehills. One way or other there must now be a very great number of orange trees growing in the hills as well as low country of Ceylon and at times the fruit quite abundant in our markets ; but at other seasons it is very scarce and high prices are paid in Colombo for a few oranges up to 20 to 30 cents each when required for a special, perhaps, medical purpose. We have heard an experienced medical practitioner, long in Kandy, declare that his own favourite treatment of himself when out of sorts, was by "oranges" —so many according to the seriousness of the attack—rather than any drug ! And many old residents find great advantago to health in beginning the day with one or two oranges and sometimes the more bitter they are the better. Meantime, as regards orange culture in Ceylon, can any one tell us if much success has attended the importation and planting of grafted oranges of recent years ? After writing this, we thought of referring to tho gentleman who had most to do with importing, and here is the result :—

Mr A J Pearson, as is well-known, has been taking a keen practical interest in the importation of grafted fruit trees to Ceylon, but he was unable to tell an *Observer* reporter who saw him today how far his efforts have been successful except to state in broad outline that the experiment, owing to climatic conditions, has no turned out in some cases as well as he expected. He has supplied, he says, during the past few years, thousands of grafted orange trees from Australia and he agrees with us in thinkin that it would be very interesting to know how far these have been successful. He believed in some districts the climate has been in the way of successful results while in drier districts the trees have turned out fairly well. He is of opinion that we should call for reports from those who went in for the experiment and needless to say we shall be only too glad to publish in our columns results sent to us. In some cases the trees have grown satisfactorily, but havo failed to produce fruit of the colour they assume in their native *habitat*. In Hatton the ripening season has been found to be unsuitable for the grafted oranges, while on the Badulla side they have done much better, although Mr. Pearson has not been informed

of a single notable success. Mr. Pearson is therefore led to infer that on the whole Ceylon is unsuitable for orange cultivation except for the native types. Altogether he imported about a dozen varieties of grafted oranges from Australia.

Mr Pearson also introduced grafted peaches, apricots, vines, figs, olives and lemons and of these, too, he has not heard except that lemons have been found to grow well at the top end of the Maskeliya valley. It will be equally interesting to have reports of these too. In this connection we call attention to a short paper from the "West Indian Bulletin" reproduced hereafter and entitled "How to Encourage Orange trees to bear early" by the Hon. T. H. Sharp, Jamaica.

HOW TO ENCOURAGE ORANGE TREES TO BEAR EARLY IN JAMAICA.

By the Hon. T. H. Sharp, Jamaica.

I think it a fair estimate to say that not more than 20 per cent. of the oranges produced in Jamaica are exported, and that of this quantity fully 10 per cent. cause losses to the shippers by shipping late. This sad state of affairs is probably due to the fact that during the time when the foreign market requires the fruit it is not mature here, and when our fruit is fully matured and fit for market, competition by other fruit causes such a glut that losses occur.

If oranges can be got fully matured and exported in the months of July and August they command a high price. Hitherto, we have been shipping immature fruit during those months and obtaining better prices than could be obtained for beautiful fruit later on.

Suggestions have been made by persons in authority who are not traders, and who do not understand what it means to send oranges into a market when they are not required, that nothing should be shipped except it is mature, because it brings a bad character on the country. It is, however, probable that as long as a good price can be obtained for the oranges, be they ever so unripe, it is better to ship them and realise than to hold back until they are well matured and fully ripe but not in demand on the market. It has also been contemplated by those who do not fully understand the trade, that legislation should be resorted to, so as to prevent the shipment of immature fruit. The orange, however, is a perishable article, and therefore, the buyer governs the market and not the seller.

Before suggesting any means by which the tree may be encouraged to bear early, I should like to draw attention to the fact that it is probable that there is hardly a day in the year in the island of Jamaica when a few first-class ripe oranges could not be obtained. What is the cause of this?

There is no period fixed for the maturing of an orange from the time the blossom appears until it is fully ripe; it all depends on the conditions obtaining. Generally seven months may be relied upon.

Whenever an old orange tree is about to die, it makes a last effort to reproduce itself by bearing heavily.

Fruit buds at all times are lying latent in the trees, and the general idea that the tree after bearing its crop has to take a long time before it can make its fruit buds is probably erroneous. In Jamaica, there is a partial rest for vegetation. It is of a spasmodic nature and greatly depends upon the cold winds after the heavy 'fall' rains.

There may be said to be two distinct energies in a tree: one the energy of reproduction, the process of which causes the production of fruit, the seed of which carries on the life; and another, the energy for the formation of the tissues. One of these two energies may often be observed to predominate over the other, either in bearing fruit or in growing tissues solely; or they may run concurrently, when it may be observed that the tree is growing and bearing at the same time. The varying exercising of energies is brought about by varied conditions, and, therefore, artificial means should be resorted to in order that conditions may be produced to force the energies to predominate one over the other as required.

Pruning causes the energy for the formation of tissue to act, and a shock to the system causes the energy of reproduction to be exercised. In the first case, it may be observed that soon after pruning a good deal of young shoots are produced, and it may be seen that the shock to the system of the tree causes it to force out the latent fruit blossoms. The latter has often been brought about by accident, such as by a fire scorching a part of the tree, or by a waggon wheel running up against it. The cutting away suddenly, of large over-hanging shade trees, or the dumping of a large quantity of fermenting manure against a tree has often produced the same results, and, therefore, bearing these points in mind, it has been shown that trees can successfully be caused to blossom when required. Old congested trees in the parish of Manchester have also after treatment been caused to bear at the proper season.

Orange trees taken in hand immediately after the 'fall' rains should have all dead wood and unhealthy branches and fruit pruned off. This should be done about the last week in October. If your tree responds to the treatment by a heavy flow of sap, which is easily recognised by the appearance of young shoots and the colour of the leaf, you will know it is healthy.

Checks to the growth of the trees, such as could be caused by bruises, &c., would make them blossom, and having once got an early bearing from your trees, they will most likely continue, with the adoption of simply pruning and cultivating, to bear early, and it may be anticipated that it will not be necessary to bruise the trees more than once in every four or five years.