FEDERATED MALAY STATES.

REPORT OF THE DIRECTOR OF AGRICULTURE, FEDERATED MALAY STATES AND STRAITS SETTLEMENTS, FOR THE YEAR 1920.

STAFF.

At the commencement of the year, eighteen out of thirty-six appointments for European officers were filled, but one officer was still on war service, and one remained in charge of Castleton Plantation; while five who were granted their leave in 1919 were absent for various periods of the year. Six other officers were granted leave during the year. Thus, only four officers were able to do continuous work throughout the period. So many changes, necessitated by the previous shortage of staff, and to the fact that practically no officers were granted leave during the period of the war, has militated against the scientific work conducted by the Department. With increases in staff in the divisions, and most of the officers now having recently had leave, the advance in 1921 should be very marked.

The following are the changes that have occurred in the divisions in 1920:

Mr. F. de la Mare Norris was appointed Assistant to Director of Agriculture, 1st January.

Chemical Division.—Mr. B. J. Eaton, O.B.E., was in charge until he proceeded on leave to England in May. Lt.-Col. Bunker, D.S.O., M.C., acted for him until his resignation in August. Mr. R. O. Bishop, M.B.E., appointed Assistant Agricultural Chemist on 25th May, filled the post vacated by Lt.-Col. Bunker, and acted as Agricultural Chemist for the remainder of the year. Mr. C. D. V. Georgi, O.B.E., joined the division as Assistant Agricultural Chemist on 22nd December.

Mycological Division.—Mr. A. Sharples, Government Mycologist, returned to duty on 5th January, superseding Mr. W. N. C. Belgrave who had acted since March, 1917. Mr. Belgrave then took up his new duties as Plant Physiologist, and proceeded on leave in July.

Entomological Division.—At the commencement of the year the Assistant to the Director, Mr. F. de la Mare Norris, was acting Government Entomologist and continued so to act until Mr. G. H. Corbett was appointed and took over his duties as Government Entomologist. Mr. P. B. Richards, Assistant Government Entomologist, who was on leave from the commencement of the year, was transferred to the Indian Service on 8th November. Mr. D. Ponniah, Insectary Assistant, availed himself of leave from 13th December.

Inspection Division.—When the year opened, the European staff consisted of two officers only out of ten appointments—namely, the Chief Agricultural Inspector Mr. F. W. South, and the Acting Assistant Agricultural Inspector, Negri Sembilan, Pahang and Malacca, Mr. D. H. Grist (who performed the duties in addition to his own as Agricultural Instructor, Kuala Pilah). Mr. Grist proceeded on long leave, 12th June. Mr. T. C. Nock was in hospital and proceeded on leave on 10th January, and returned on 15th December, when he was appointed Acting Assistant Agricultural Inspector, Pahang North. Mr. F. Birkinshaw was appointed Assistant Agricultural Inspector on 11th March, and Mr. E. E. C. Doscas on 25th July. Both of these officers remained at head-quarters for three months, after which the former was stationed at Taiping as Assistant Agricultural Inspector, Perak, and the latter in Seremban as Assistant Agricultural Inspector, Negri Sembilan and Pahang, and Acting Assistant Agricultural Inspector, Malacca. Mr. J. Fairweather was appointed to the Department on 15th December as Assistant Agricultural Inspector. He will be stationed in Malacca.

A great deal of the work has thus devolved on the Malay staff. Inche Mohamed Amin bin Abdul Rahman was in charge of the work in Negri Sembilan from 12th June till 1st October; Inche Mohamed Noor bin Hamzah continued in charge of Perak North until 15th June; on 19th October he was transferred to Bukit Mertajam to take charge of the inspection work in Province Wellesley and Penang. Inche Kamarudin bin Haji Suleiman continued in charge of Perak South throughout the year, and Inche Ariffin bin Haji Abas remained in charge of Malacca. On 24th February Raja Mohamed bin Haji Aman was placed in charge of Johore North owing to a serious outbreak of mouldy-rot.

Economic Botanist Division.—Mr. H. W. Jack, Agricultural Instructor, Krian, was appointed Economic Botanist on 30th September, 1919, and proceeded on long leave on 28th August, 1920. Mr. W. N. Sands was appointed Assistant Economic Botanist and assumed duty on 6th July. From the date of Mr. Jack's leave he has acted as Economic Botanist.

Agricultural Division.—Mr. F. G. Spring, Agriculturist, proceeded on leave on 17th May. Mr. B. Bunting, Assistant Agriculturist, was appointed Agriculturist and assumed the duties of his new appointment on return from leave on 8th March. Mr. J. N. Milsum, Superintendent, Government Plantations, was appointed Assistant Agriculturist, and assumed the duties of his new appointment on his return from leave on 1st August. Mr. E. Mathieu was appointed Temporary Superintendent, Government Plantations, Kuala Kangsar, and assumed duty on 3rd August.

Agricultural Instructors.—Mr. H. W. Jack relinquished the post of Agricultural Instructor on his appointment of Economic Botanist. The post has not yet been filled. Mr. D. H. Grist, Agricultural Instructor, Kuala Pilah, continued inspection work in addition to his ordinary duties, until he proceeded on long leave on 12th June. This branch of the Department has therefore made little progress throughout the year.

EXPENDITURE AND REVENUE.

The following tables show the estimated and actual expenditure and revenue of the Department since 1911. In addition, special expenditure on locusts amounted (for the Federated Malay States only) to $81,145 in 1914, $56,455 in 1915, $38,455 in 1916, $10,490 in 1917, $2,502 in 1918 and $779 in 1919.

EXPENDITURE.

Year.	Estimated.	Actual.
1911	$135,142	$123,236.00
1912	196,611	171,834.84
1913	337,482	339,989.71
1914	420,736	311,903.87
1915	488,931	380,303.47
1916	400,937	365,728.25
1917	473,746	388,627.44
1918	570,982	488,789.74
1919	627,000	558,156.14
1920	774,765	727,709.78

REVENUE.

Year.	Estimated.	Actual.
1911	$ 16,000	$ 14,482.84
1912	15,000	25,575.11
1913	143,000	100,583.25
1914	97,264	101,194.80
1915	140,000	129,829.76
1916	141,000	169,716.50
1917	231,360	305,959.26
1918	334,000	160,430.55
1919	177,300	266,360.54
1920	206,700	161,893.51

RUBBER.

The market for rubber showed the most remarkable fluctuations during the year. The price of the commodity was the highest it has reached for some years during the months of January and February, after which there was a rapid decline throughout the year, until in December there was practically no market for the produce. This decline does not indicate an over-production for normal times, but is entirely owing to the unsettled condition of trade in general in America and Europe.

The following table gives the Singapore prices month by month throughout the year.

RANGE OF RUBBER PRICES, 1920, CENTS PER POUND.

——	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Fine ribbed smoked sheet ...	112	113	107	91	79	80	71	69	61	52	40	34
Good ribbed smoked sheet ...	107	111	104	87	76	78	70	67	58	49	38	33
Fine pale crêpe	111	112	104	89	80	80	75	74	63	58	42	35
Good palish crêpe	107	110	102	87	77	78	72	71	59	57	40	33

On account of this extreme depression of the market, many estates ceased tapping, and there has been a demand in some quarters for legislation to restrict the output of rubber from estates. It is to be hoped that estates will not fail to keep in hand the control of disease work during the time of depression. Without any great outlay of expense, the position regarding general plant health on estates may be improved, by dealing efficiently with such diseases as mouldy-rot, and examining the pros and cons of such questions as alternate-day tapping and periodical resting of areas.

At the time of writing, the market for rubber shows no signs of recovery. Owing to this decline in the price of rubber, the price of labour has declined. It is probable that further economy in the production of rubber will be the most favourable means of reorganizing the industry.

MANUFACTURE.

The superiority of "slab" rubber on account of its comparatively small deterioration during storage was demonstrated. The report of the work is held over pending further investigation.

Testing of Estate Samples.—In addition to the testing of estate samples for tensile strength and rate of cure, a large number of samples were examined for moisture content. This work was carried out as a result of the market ruling on undercured smoked sheet.

The result of the enquiry proved that in the majority of cases the market ruling as to undercuring is not based on a correct principle and that there is no relation between the normal internal moisture of sheet rubber and its liability to develop moulds.

This appears to be a further example of the worthlessness of the present fictitious standards of judging rubber on the open market, and demonstrates the need for establishing exact and trustworthy technical standards in order to safeguard the industry of rubber production.

Estate Visiting.—A number of minor investigations have been made in connection with estate work. Amongst the problems investigated has been the purity of chemicals as used by various estates, and the testing and purification of water supplies for estate factories. In one instance, a proprietary coagulant was examined and found to consist of highly deleterious materials.

Soils.—The normal course has been followed with regard to soil analyses for estates, and an attempt has been made to collate the results from the data obtained. The conclusions, however, can only be expressed in a very tentative manner. It appears from the results of chemical analyses, that much of the soil now carrying rubber is exceedingly poor, and is losing its virginal fertility with such rapidity that artificial compensating elements must shortly be resorted to on a large scale. In many cases, not only is the surface soil being denuded of its plant nutrients more quickly than weathering can replenish the supply, but the underlying subsoil is in an unhealthy condition, and likely to become more so on account of the water table and the character of the subsoil water.

No definite data have been obtained to show the actual relationship between soil acidity and rubber yields, but the high order of acidity exhibited by the majority of estate soils shows that an unhealthy condition for root development is the rule rather than the exception.

The lack of nitrogen is remarkably conspicuous and points to the necessity of investigation of the utilization of nitrogen (under the atmospheric conditions pertaining in this country) by vegetation.

The action of sodium chloride has been considered with a view of determining the toxic effect of this salt as it affects *Hevea brasiliensis*. Its action in subsoil water is the most marked, and the relative poorness in growth of certain large plantation areas is directly attributable to this substance.

In the case of soils carrying coconuts, the salt content has little or no effect on the growth of the tree. Whether the tree takes the chemical into its system or separates it from the water before absorption, is not definitely known.

In connection with soil analyses for estates, it must be recorded that there is a lamentable lack of interest displayed by the planting community in the whole subject of soil investigation, and there appears to be no desire to improve soil conditions by following up analyses with experimental work on fertilization.

DISEASE.

Both the Inspection Division and the Mycological Division have suffered through shortage of staff. With the appointment of three officers for the former division, the control of rubber diseases will be rendered more possible in the coming year, but the division still requires five additional officers to complete the staff. This division inspected 79 estates during the year. The Chief Agricultural Inspector points out that the low price of rubber has led many estates to effect economy by the postponement of sanitation work, and that many small holdings are practically abandoned. These latter areas serve as dangerous centres for the spread of disease and is much handicapping the work of Inspecting Officers.

Mouldy-rot (*Sphaeronema fimbriatum*).—Every effort has been made to restrict the area of infection of this disease, but in spite of active measures in this direction the disease has made headway. In February of this year it was reported in the Muar Valley of Johore, since when it has been found prevalent in several parts of that State. The area in Negri Sembilan has slightly increased. The disease has now been reported on 37 estates in Negri Sembilan and five in Johore. In addition, a record has been kept of its occurrence on native holdings. In this connection, 142 summonses were heard, resulting in 137 convictions and fines amounting to a total of $4,148 in addition to costs. I do not suggest that the efficiency of this control work should be judged by the number of fines. The Inspecting

Officers, both European and Malay, have devoted considerable attention to advisory work, and it is only when the advice offered to natives is ignored that more drastic measures are adopted. The Mycologist has in hand a special investigation of control measures and the Chief Agricultural Inspector has planned a special campaign against this disease, to be put in action during 1921.

The previous three years' work on Black-stripe and Mouldy-rot was published as Special Bulletin No. 31 of the Department of Agriculture.

Black-stripe (*Phytophthora faberi*).—Several estates have intimated that they find increased difficulty in dealing with the attacks of this fungus, even during periods when weather conditions would presumably be unfavourable to the development of the disease. The disease has been notified from seven estates formerly unaffected, the most serious outbreak occurring on the East Coast of Pahang just after the monsoon rains.

Brown-bast.—The Brown-bast Committee held two meetings during the year. It will be remembered that this unofficial committee, consisting of various scientists from unofficial bodies and certain officers of the Agricultural Department, was formed under the Chairmanship of Mr. F. W. South, and when he proceeded on leave, of Mr. R. M. Richards, to unite their energies in the solving of the problem. It would appear that the Committee has ceased to exist, and it was agreed that the labours of the various members be written up by Mr. Richards, and published as a joint publication. This report has not been presented.

The Government Mycologist remarks that brown-bast has been less prevalent during the past two years, and in his opinion the enormous increase in 1917–1918 was brought about by some combination of conditions which did not hold in 1920. The cause of the disease has remained unsolved. The Mycologist has devoted his attention to bark structure and to field experiments, which are still in progress.

STEM DISEASES.

Pink Disease.—This disease is now known to occur on 252 estates, the increase during the year being ten cases. There have been periodical outbreaks in several districts but the control of the disease is well in hand. Perak remains the most infected State.

Summonses for non-compliance of remedial measures amounted to 161, with 146 convictions and fines amounting to $2,335.50 and costs.

Root Disease.—The Mycologist has devoted considerable time to the investigation of brown root disease. The general position regarding root diseases calls for no special mention.

Lalang and Blukar.—The Inspection Division have made special endeavour to render the conditions of small holdings more sanitary. Owing to the general poverty prevailing during the last four months of the year, such work could not be enforced, as it was liable to entail undue hardship on small holders. In connection with the above, there were 137 Court cases, resulting in 118 convictions and $747.50 in fines.

The total number of notices served by the Inspection Division was 6,445 in the Federated Malay States, 1,837 in the Straits Settlements and 731 in Johore. As a result of failure to comply with these notices there were 569 prosecutions, resulting in a total of $8,634 in fines.

It is thus seen that it was considered necessary to prosecute nine per cent. of the natives who were in receipt of notices. Remembering the amount of ignorance in agricultural matters displayed by natives, this is not considered a high figure, but it is hoped that with the assistance of agricultural education, such extreme measures may be less called for as time goes on.

INSECT PESTS OF RUBBER.

No serious new insect pest of *Hevea brasiliensis* has been reported during the year. One case occurred where considerable damage was occasioned to the blossoms and leaves of rubber, caused by the caterpillar of *Hemithea costipunctata*, Noore.

In this instance the lowest branches and blossoms were attacked. It was reported that the insects work down the branch, leaving thereon a blackish discolouration. The leaves curl up, discolour slightly and eventually drop off. The life history of the insect has been worked out on the inflorescences of the rubber through four generations, and will be the subject of an article in a future number of the *Agricultural Bulletin*. The attack is of interest, showing that rubber is not entirely immune to the ravages of insects feeding on the aerial portions of the plant, and at any time a local outbreak of insects might assume great magnitude.

An entomological investigation was conducted to ascertain how much of the acidity in rubber seed oil from stored rubber seed was attributable to the work of insects. The investigation proved conclusively that the problem was mycological and that insects were not responsible for the acidity of the oil.

CULTURAL.

Increased interest is now taken throughout the country in the use of various agricultural implements for the purpose of tillage in both young rubber and coconut clearings, and a number of enterprising companies have obtained motor tractors for this purpose.

More effective efforts are being adopted to prevent soil wash on estates, by the construction of catchment pits, terracing, contour draining, and contour planting of citronella or Guinea grass, and the planting of low-growing cover crops. The cover crops most in demand, and which have in many cases been supplied from this Department, are Boga-Medelloa (*Tephrosia candida*), Giant Mimosa (*Mimosa invisa*), Sarawak Bean (*Dolichos Hosei*), and the Sword Bean (*Canavalia ensiformis*).

The necessity for crop restriction, and the general reduction of costs on estates, has resulted in the almost universal adoption of more conservative systems of tapping. The results have proved the advisability of reducing bark removal to a minimum consistent with the economical production of rubber. The systems of tapping most commonly practised on estates are: a single cut on a quarter, or a third—either daily or alternate-day tapping, or a single V on half the tree, employed only for alternate-day tapping. The system of two cuts superimposed is less frequently seen. It has been proved that this system adversely affects the yield of the upper cut.

Departmental experiments in connection with daily and alternate-day tapping, conducted on old trees, show results which are in favour of the alternate-day system.

Thinning out has also received more attention than formerly, and it is now recognized that it is better to have a limited number of high-yielding, healthy trees per acre, than a larger number of low-yielding, unhealthy trees.

Results of thinning out experiments on Castleton Estate show that trees gave a higher total yield per acre on being thinned out from 108 to 75 trees per acre.

Experiments are in progress on the asexual reproduction of *Hevea*. The results so far show that the most successful method of propagation is likely to be obtained by patch budding.

COCONUTS.

The area under this crop remains about the same as in 1919. The price of nuts has ranged from 4 cents to 10 cents in most districts. In Negri Sembilan it was at one time as high as 25 cents. The Pahang price has ranged from 12 cents each on the coast, to 35 cents per nut at Kuala Lipis.

The price of copra, although showing a wide variation, remained high until towards the close of the year, the average price being about $22 per pikul. The fall of the price of rubber has caused the small holder to realize the value of his coconuts in supplementing his income, especially as the price of coconut products has remained firm for a longer period than has that of rubber.

The following table of copra exported, and the value thereof, has been kindly supplied by the Commissioner of Trade and Customs:

State.	Quantity in Pikuls.			Value in Dollars.		
	1918.	1919.	1920.	1918.	1919.	1920.
Perak	333,870	349,457	330,329	2,354,645	3,953,442	7,369,345
Selangor ...	87,882	90,762	82,225	654,085	1,087,895	1,697,393
Negri Sembilan...	3,856½	3,003	4,270	27,336	41,762	89,364
Pahang	2,617	4,495	3,164	17,259	63,476	60,484
Total ...	428,225½	447,717	419,988	3,053,325	5,146,575	9,216,586

Considerable attention has been directed to the cleaning up of native coconut holdings, but in the latter part of the year the general conditions of holdings tended to deteriorate, as natives were compelled, in many cases, to leave their holdings in order to seek employment.

Work was commenced on individual tree selection for particular vegetative and fruiting characteristics. These tests are being conducted on the Governmental Experimental Coconut Plantation at Sapintas. Yield tests are also being carried out on a large coconut estate with a view of finding the heavy yielders.

DISEASES AND PESTS OF COCONUTS.

Investigations in fungoid diseases and plant pests, and work on their control have been given special attention during the year.

Bud Rot.—The Mycologist has carried out an investigation on bud rot. He has proved by inoculation experiments that the introduction of any organism capable of vigorous growth on coconut bud tissue will cause symptoms previously considered typical of bud rot (i.e., killing and falling over of central leaves), if introduced into the bud direct. Seven different cultures were employed, three bacteria, one a mixture of bacteria, and three fungi. Successful

inoculations were obtained in each case. Controls were kept, most of which recovered, but in some few cases developed symptoms similar to the above. The conclusion would appear to be, and this is supported by general experience in this country, that epidemics of Bud Rot are unlikely to occur in Malaya, unless there is some contributory factor, other than fungus or bacterium, affecting the rate of spread.

Other mycological investigations on coconuts included stem bleeding, transverse leaf break, and nut drop of coconuts.

INSECT PESTS.

Brachartona catoxantha Hamps.—One outbreak of this insect was reported during the year and experiments were carried out by the Economic Entomologist and Chief Agricultural Inspector towards its control. The experiments produced negative results as the insects were successfully controlled by their natural enemies. The attack persisted for about three months.

Oryctes rhinoceros.—These beetles have given considerable trouble in many districts, notably in Malacca and Province Wellesley and in Krian, Klang and around Seremban. Instructional work has been carried out in districts where attacks are prevalent, and a Malay Bulletin on the subject prepared. The spread of this insect through coconut areas is frequently traced to the presence of market and village refuse heaps. Frequently there is no provision made for the destruction of such rubbish by local authorities.

Rhynchophorus Scach., R. ferriugenous (Red Weevil).—This insect has been studied in detail by the Government Entomologist, and the Chief Agricultural Inspector has collaborated with him towards this end.

Plesispa reichei, Chap.—The skipper caterpillar (*Hidari irava*), and nettle caterpillar (*Thosea* sp.) have been recorded, the former pest being the subject of special investigation, not yet concluded.

The Inspection Division have prosecuted in 249 cases for failure on the part of natives to comply with orders to clean up coconut holdings or to take in hand the control of insect pests. These cases resulted in 227 convictions and $959 in fines.

PADI.

Mr. Jack, Economic Botanist, was in charge of the padi experiments at Krian until he proceeded on leave in August, when Mr. Sands acted for him; also taking over the padi work in Pahang when Mr. Grist proceeded on leave in June.

Considerable progress was made at the Titi Serong Experimental Station in Krian with selection of heavy yielding strains of local varieties of wet rice. This experimental station has now an area of 16½ acres, 10 acres of which were purchased during the year. A large store room is in course of construction.

In addition to pure line work, 1,700 samples of local varieties of padi were collected and work is proceeding with 206 of these as foundation stocks.

Of previously selected lines, three varieties—viz., Padi Sa'raup, Radin, and Pahit were grown in multiplication plots preparatory to distribution for seed purposes.

After the results of the 1919–1920 harvest had been obtained the pure lines of padi Sa'raup were reduced to 252, Radin to 16 and Padi Pahit to 11, together with 186 selected foundation stock varieties.

Two small experiment stations, one at Kampong Kedeh and one at Sungei Bogak, are retained for testing seed in different localities.

Green manure crops of six varieties of plants were the subject of experiments, but the results were negative, owing to difficulty in regulation of water supply.

Experimental work has proceeded at Kajang with the object of improving the local crop.

The experimental work on dry-land padi at Pekan, Pahang, consisted in the examination of the varieties, cultural experiments and manuring, especially green manuring. A progress report is to be published shortly. It shows that, although the dry-land padi of the district gives such poor yields, yet there is every hope that, given more efficient cultural methods, together with improved seed, considerably increased crops may be expected. The British Resident, Pahang, has experimented with the ploughing of dry padi land with tractors, and although the actual working of the tractor was imperfect, yet the experience gained was of great value. The Agricultural Instructor, Kuala Pilah, has forwarded a report on "Wet Padi Planting in Negri Sembilan". After stating the methods of cultivation adopted in Negri Sembilan, Mr. Grist proceeds to give an account of a series of padi experiments carried out near Kuala Pilah over a period of four years, and makes suggestions as to possible methods of increasing the yield of padi in the State.

This report will be published at an early date.

AREA.

There has been a considerable increase in the area planted with padi during the year. The area under wet padi has increased by nearly 12,000 acres, to over 142,000 acres, and the dry padi area over 32,000 acres to over 55,000 acres. The wet-padi season was good, which accounted for the increase of crop per acre over that of 1919. The following table gives the comparative area cultivated with wet and dry rices in the Federated Malay States for the past three seasons, together with the gross and average yields. A gantang of padi weighs approximately 5 lbs.

Seasons.	1917–1918.			1918–1919.			1919–1920.		
State.	Area.	Yields.	Average.	Area.	Yields.	Average.	Area.	Yields.	Average.
	Acres.	Gantangs.	p. a.	Acres.	Gantangs.	p. a.	Acres.	Gantangs.	p. a.
				WET PADI.					
Perak	73,823	19,924,756	270	77,838	15,117,549	194	82,608	21,415,606	259
Selangor ...	2,370	474,000	200	3,013	612,154	203	4,263	379,648	89
N. Sembilan ...	24,691	4,471,330	181	28,214	4,806,476	170	28,574	5,356,505	188
Pahang ...	22,746	3,588,447	157	21,290	3,029,834	142	26,613	3,993,388	150
F.M.S. Total ...	123,630	28,458,533	230	130,355	23,566,013	180	142,058	31,145,147	
				DRY PADI.					
Perak	7,828	1,046,215	133	16,500	2,532,140	153	40,912	4,654,649	114
Selangor ...	470	70,500	155	2,034	294,250	144	9,270	913,475	98
N. Sembilan ...	50	6,210	124	216	23,740	109	1,036	101,391	97
Pahang ...	4,590	450,156	98	4,517	348,330	77	6,256	679,153	108
F.M.S. Total ...	12,938	1,573,081	121	23,267	3,198,460	137	57,474	6,348,668	

PESTS.

Although padi is remarkably free from fungoid pests, yet the damage occasioned annually by insects and rodents is very considerable. The insects pests of padi, in particular, *Podops coarctata Fabi.*, leaf hoppers, "Army worms," and stem borers have been reported in various districts, and the life history and control of these pests has occupied the attention of the officers engaged on such work.

The control of rats, when they appear in large numbers, is a very difficult problem, and requires the vigorous co-operation of the landowners. In general, it may be said that the control of padi pests will follow better methods of cultivation and sanitation, and more efficient control of the water supply.

OILS.

Various investigations have been made with regard to oil-bearing plants; in particular with the African Oil Palm (*Elaeis guineensis*) and numerous commercial enquiries have been answered. The special varieties of the palm received from Nigeria in 1914 are now fruiting, and it is proposed to plant up further areas from the seeds of these selected palms, at the Experimental Plantation, Serdang. A systematic investigation was made of the fruit of this palm obtained from two different sources, and a series of figures obtained for the normal yields of oil to be derived from the pericarp and kernel of the seed. A detailed investigation of the vegetative and fruiting characters of certain selected palms was started during the year.

Citronella grass oil has been examined by the Agricultural Chemist, who states that it is evident that the citronella grass at present growing on the Government Plantation at Gunong Angsi, Negri Sembilan, gives a good yield of oil, and the characteristics of the product proclaim it to be superior to much of the oil at present on the market. It appears that citronella grass distillation might be made a profitable side line on rubber plantations.

Other points have been investigated in connection with rubber seed oil, and castor seed oil. The fall in the price of castor oil, and the absence of a market for seed, except in large quantities, has resulted in the lack of interest now being taken in the cultivation of this crop. One enterprising company is, however, erecting machinery on its estate for the purpose of extracting oil from castor oil seed.

OTHER FOOD CROPS.

During the first half of the year, the demand for food-stuffs planting materials was maintained, and large quantities of seed of various food crops were distributed to estates through the Planters' Stores & Agency Co., Ltd., Klang. With the improvement in the supply of rice, the demand for planting materials showed a considerable falling off for the second half of the year.

The Planters' Stores & Agency Co., Ltd., Klang, undertook the receipt and distribution of the seeds as Agents for the Department, and during the year this firm distributed the following planting materials: Maize, 4,690 lbs.; wet padi, 22,805 lbs.; ragi, 40,362 lbs.; hill padi, 236,805 lbs.

The total value of the above seeds was $23,405.35. In addition to the above, smaller quantities of planting material were distributed direct by the Department and included Italian Millet (*Setaria italica*), Bulrush Millet (*Pennisetum typhoideum*), Little Millet (*Panicum miliare*), Kodo Millet (*Paspalum scrobiculatum*), Sorghum (*Sorghum vulgare*), Green Gram (*Phaseolus Mungo*), Black Gram (*Phaseolus Mungo, var. radiatus*), Pigeon-pea (*Cajanus indicus*), and an improved strain of Ragi (*Eleusine coracana*), received from Madras, together with tubers of Yam (*Dioscorea* spp.), and Jerusalem Artichoke (*Helianthus tuberosus*) and cuttings of Sweet Potato (*Ipomoea Batatas*). Of the cereals, hill padi and ragi gave the most satisfactory results and were in the greatest demand by estates, whilst sweet potatoes were perhaps the most popular of the root crops.

A number of small machines suitable for grinding ragi or other food crops were imported from England and distributed at actual cost price to those estates interested in the cultivation of food-stuffs.

MISCELLANEOUS INVESTIGATIONS.

Paper.—A small committee was formed during the year to consider the possibilities of paper manufacture in this country. They decided that the experimental work should be placed under the Agricultural Department. The experimental plant has been put in running order and a few necessary additions made. The experimental work has progressed sufficiently far to show that waste paper can be successfully used, and that under proper conditions it would constitute a useful source of supply for a cheap rough printing paper. The economic side of the question has still to be examined, together with the possibility of instituting factory conditions on a plant designed solely for experimental purposes.

Insect Collections.—The Systematic Entomologist has been engaged in re-arranging the entomological collection, identifying insects, naming a collection of Termites and translating Holmgrou's Termiton Studien. He spent about two days a week for about five months in arranging the State Museum collection of insects.

Cinchona.—Analyses made of the bark of both *Cinchona Ledgeriana* and *Cinchona succirubra*, grown at Gunong Angsi at an elevation of 1,500 feet, showed that the alkaloidal content satisfied the requirements of the British Pharmacopœia but not the standard required by manufacture of the salts. The trees, from which the bark was obtained, were grown from seed and not from selected grafts of known strains.

Land has been reserved at Gunong Angsi and elsewhere, for the cultivation of cinchona on a fairly large scale.

Sugar-cane (*Saccharum officinarum*).—With the high prices ruling for sugar, the question of reviving the industry has received a certain amount of attention during the period under review, and applications have been made for large areas of land for the purpose of taking up the cultivation of sugar as a sole crop. A committee was formed to investigate the matter and report to Government as to the advisability of granting facilities for the cultivation of sugar, with a view of re-establishing the industry on a permanent basis. With the help of the Agricultural Inspection Division, a collection was made of local sugar canes from the different districts throughout the Federated Malay States and Straits Settlements, and these were planted at the Experimental Plantation, Kuala Lumpur. An effort was also made to introduce the best types of canes which are now being grown in all the more important sugar-growing countries in the tropics, and the planting materials is expected to arrive early in 1921. Land is being offered at special terms for sugar-cane cultivation, and suitable areas are being reserved.

Fibres.—A small experimental plot of Rosella (*Hibiscus Sabdariffa var. altissima*) was grown at the Government Plantations, Kuala Kangsar, and the Superintendent in charge reports that the results so far obtained have been very satisfactory. The plant is easily grown, and no machinery is necessary for the preparation of the fibre for market. The quality of this fibre is stated to be equal to the best Bengal jute.

Brazil Nut (*Bertholletia excelsa*).—The trees planted at the experimental plantation continued to show satisfactory growth, and some of them are now producing fruits.

Aleurites (Chinese Wood Oil Plants).—The stocks of young plants of *Aleurites montana* and *Aleurites mollucana* were taken from the nursery beds and planted out on terraced land at the Experimental Plantation, Kuala Lumpur, during October.

Grasses.—A sample of seed of *Paspalum dilatatum*, received from Australia, was sown at the Experimental Plantation, Kuala Lumpur, and very promising results were obtained. It appears probable that this grass may be found suitable as a fodder for cultivation on the better types of land in the Peninsula.

Fruits.—Arrangements have been made for the propagation of fruit seedlings at the Government Plantations, Kuala Kangsar, and a considerable amount of planting material has been collected for this purpose. It is hoped that quantities of fruit seedlings will be ready for distribution early in 1921.

The fruit plantation at Batu Tiga was extended by the addition of a number of species hitherto not represented in the collection.

Ornamental Plants and Trees.—There was a big demand for ornamental plants, flowering shrubs and trees, and large quantities of planting materials have been supplied to the numerous applicants throughout the Peninsula.

CASTLETON ESTATE.

The estate is of 208 acres, practically all of which is under rubber, and in bearing. The number of trees per acre has been reduced to 80.

A more conservative system of tapping—viz., one cut on a single quarter instead of a single V daily as practised formerly was inaugurated during the year. The total amount of dry rubber harvested was 89,020 lbs. against 116,933 lbs. in 1919. The estimated crop for 1921 is 88,035 lbs. It will be seen that the change in the tapping system resulted in a reduction in crop of 24.71 per cent. on last year's figure; the yield per tree being 486 lbs. against 637 lbs. in 1919.

The various experiments on manuring, cultivation, dynamite, phosphate and tapping were continued.

GOVERNMENT PLANTATION, PONDOK TANJONG.

The area of the estate is 591 acres. The whole of the old area (278 acres) was tapped, but the bark renewal was poor, and a reorganization of the tapping was commenced. The crop harvested was 120,722 lbs. of dry rubber.

By the end of 1919, 150 acres of new clearing had been felled, and 100 acres of this cleared and burnt. During the year under report a further 30 acres of jungle land has been opened.

SAPINTAS ESTATE.

The progress made in the planting up of the estate is seen by a perusal of the following comparative figures for 1919 and 1920:

	1919. Acres.		1920. Acres.
Coconuts planted	563.9	...	907.1
Rubber ,, ...	88.6	...	88.6
Cleared but not yet planted	342.0	...	41.6
Additional new land clearing in progress	102.0	...	116.0
Buildings	17.5	...	17.5
Reserve jungle and blukar	892.6	...	951.9

Coconut Area.—An area of 55.3 acres was planted up with "King Coconuts," the seed nuts being obtained from Permatang and Sungei Nipah Estates; and a further 158.9 acres with "Glugor" nuts, experimental distance planting—i.e., 28′ × 28′ square and equilateral; and 30′ × 30′ square and equilateral; 46.3 acres part planted with specially selected nuts from Dindings, Bagan Datoh Estates, 87.5 acres with "Glugor" nuts, standard planting. Total acreage planted during the year 348 acres.

Appearance.—There has been considerable improvement in both the field conditions and growth of the trees during the last nine months of the year under review, especially in the young areas.

Six hundred and ninety-five acres of coconut have been kept under cover crop (White Ubi and experimental covers), 333 acres clean weeded, while 89 acres rubber were part clean weeded and part mimosa cover.

The older areas under rubber show great progress, but the young area is backward, owing to the wet condition of the land.

Seed coconuts have been received from ten sources, and are the subject of experiments in selection. A special nursery of African Oil Palm has been laid out.

The cultivation of food-stuffs was discontinued. Experimental work was carried out with the following crops: *Centrosema*, Giant mimosa, *Erythrina indica*, *Clitoria*, *Crotalaria juncea*, sweet potato and the passion flower. The most promising results were obtained from the cultivation of Giant mimosa and Clitoria.

GOVERNMENT PLANTATION, KUALA TEMBELING.

The total cultivated area is 466 acres under rubber, 178 acres of which are in bearing. Tapping ceased from March, owing to the high cost of production and the low price of the commodity.

GOVERNMENT PLANTATION, KUALA KANGSAR.

Tapping of the rubber ceased at the beginning of May and 15 acres of rubber were felled after that date. Work has proceeded in cleaning up this land of all rubber stumps and the planting of a fruit nursery. The nursery now contains beds of over 30 varieties of fruit trees.

The orange trees and pomelos have received attention in manuring, pruning and spraying. Experimental work has been carried out with *Hibiscus Sabdariffa* as a fibre plant, at Kota Lama Kiri, with a view of obtaining a supply of seed for future propagation.

FRUIT NURSERY, JUASSEH.

Owing to lack of staff little has been done at Kuala Pilah in the upkeep of this nursery. The fruit trees planted during the last four years have made good progress. The work of clean weeding of the plantation has been put in hand.

GENERAL.

In the death of Mr. J. D. McCulloch, the planting industry has lost a public-spirited worker, and his demise will be regretted not only amongst those who were privileged to be his personal friends, but also by those whose knowledge of him was impersonal, but who appreciated his untiring efforts on their behalf. Mr. McCulloch was an original member of the Agricultural Advisory Committee, and as such was always ready to assist me by his knowledge of the country and of planting; and by a sound appreciation of the agricultural needs of this country.

The Advisory Committee held three meetings. My thanks are again due to the help rendered by the gentlemen who formed this Committee.

Water Hyacinth.—The Krian district was cleared of this pest to a great extent by contract work, early in the year. In June a permanent patrol gang was formed in Krian which did very good work, so that the Assistant Agricultural Inspector reported towards the close of the year that the State lands and rivers in Krian were practically free from the pest. Work was commenced on clearing the Perak river between Kuala Kangsar and Parit, but was stopped by floods in November. The weed has been brought under control on the State lands around Taiping.

An Amendment Enactment No. 5 of 1920 to the Federated Malay States Agricultural Pests Enactment 13 of 1913 came into force on 8th May. The provisions of the Amendment have faciliated the work of the Inspection Division by giving a Magistrate the right to order a convicted person to carry out the measures required in a stated time, and to inflict a further fine in the event of disobedience. This saves the necessity of issuing a fresh notice after conviction.

A successful conference of Malay Officers of this Department was held from 16th to 19th August, at which these officers read papers on agricultural subjects and held discussions in the Malay language. The papers read are being published in the *Malay Agricultural Bulletin* and certain English translations in the *Agricultural Bulletin*.

The first senior course of lectures to Malay apprentices, in progress during 1919, was concluded in January. The second senior course of lectures was commenced in May and concluded in October, with the prescribed examination.

The third junior course of lectures commenced in November and remained in progress until the end of the year. Various European officers have taken part in giving these lecture courses. The results of these courses have been good, the Malay apprentices and probationers making steady progress in their work.

Agricultural shows have been held in various parts of the country, at which officers of the Department assisted in various ways.

The Department's publication, *The Agricultural Bulletin*, was published for the first six months of 1920, but the production of this organ has fallen into arrears owing to shortage of staff. A special Bulletin No. 31 on "Black-stripe and Mouldy-rot of *Hevea brasiliensis*" was published and, I think, has filled a want in the dissemination of knowledge on these two diseases. Special Bulletins in the Malay language were published during the year on the following subjects: No. 11, "Mouldy-rot"; No. 12, "Padi Planting in Pahang"; No. 13, "Native Holdings and their Sanitation"; No. 14, "Padi Pests".

No further steps have been taken in the establishment of a Government Stock Farm. Approval of the project had been given, but the vote for the commencement of this work has been deleted from the 1921 Estimates.

Large Scale Farm.—Work was commenced in October, on the opening up of the large Scale Experimental Plantation at Serdang, in Selangor. This plantation will be devoted entirely to experimental work on crops other than rubber and coconuts, and ultimately it is expected to provide valuable information on the cultivation of these crops when grown on a commercial scale. The extensive planting programme which had been drawn up includes the cultivation of food-crops and plants yielding oils and fats, fibres, spices, drugs, dyestuffs, fodder plants and miscellaneous products. An effort is being made to collect planting material from the various Agricultural Stations throughout the tropics and this material will be planted out in nurseries as it arrives. The original proposals for this Experimental Plantations were put forward by Messrs. E. Macfadyen, A. J. Fox and myself in 1913. An area of about 200 acres has now been felled and cleared, whilst 10 acres of this area have been specially reserved for nursery beds, a large number of which have already been planted up with seeds, bulbils and cuttings of the various crops under trial.

Kuala Lumpur,
22nd April, 1921

L. LEWTON-BRAIN,
Director of Agriculture, F.M.S. & S.S.