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Edited by the Director

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BULLETIN OF THE IMPERIAL INSTITUTE

VOL. IX, 1911

CONTENTS

THE IMPERIAL INSTITUTE

OF THE

UNITED KINGDOM, THE COLONIES AND INDIA.

THE Imperial Institute was erected at South Kensington as the National Memorial of the Jubilee of Queen Victoria, by whom it was opened in May 1893.

The principal object of the Institute is to promote the utilisation of the commercial and industrial resources of the Empire by arranging comprehensive exhibitions of natural products, especially of the Colonies and India, and providing for their investigation and for the collection and dissemination of scientific, technical and commercial information relating to them.

Until the end of 1902 the Imperial Institute was managed by a Governing Body, of which H.R.H. the Prince of Wales (afterwards King Edward VII.) was President, and an Executive Council, including representatives of the Indian Empire and of all the British Colonies and Dependencies. In 1900 the building became the property of H.M. Government, by whom the western portion and galleries were leased to the Governing Body of the Imperial Institute, the greater part of the eastern and central portions being assigned, subject to rights of usage, for occupation by the University of London. In July 1902 an Act of Parliament was passed transferring the management of the Imperial Institute to the Board of Trade, assisted by an Advisory Committee including representatives of the Colonies and India, as well as of the Colonial and India Offices, the Board of Agriculture, and the Board of Trade. This Act took effect on january 1, 1903.

On October 1, 1907, in virtue of an arrangement made with the Board of Trade and with the approval of the Secretary of State for India, the management of the Imperial Institute was transferred to the Secretary of State for the Colonies, subject to the responsibility of the Board of Trade under the Act of 1902. A Committee of Management of three members, one nominated by each of the three Government Departments chiefly concerned, has been appointed, and at present consists of Mr. C. A. Harris, C.B., C.M.G.; Sir Alfred Bateman, K.C.M.G.; and Colonel Duncan Pitcher (late Indian Army).

The first Director of the Imperial Institute was Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., F.R.S., who held the office until his death in the autumn of 1902. The present Director is Professor Wyndham Dunstan, M.A., LL.D., F.R.S., who was appointed in 1903.

The staff of the Imperial Institute includes officers with special qualifications in the sciences of chemistry, botany, geology, mineralogy and in certain branches of technology, in their relation to agriculture and to the commercial utilisation of economic products.

The following are the principal departments of the Institute.

Exhibition Galleries.—The collections of economic products, etc., illustrative of the general and commercial resources of the Colonies and India, are arranged, together with other exhibits, on a geographical system in the public galleries of the Imperial Institute, which are open free to the public daily, except on Sundays, Good Friday and Christmas Day, from 10 a.m. to 5 p.m. in summer, and from 10 a.m. to 4 p.m. in winter.

The following British Dominions, Colonies and Dependencies are represented by Collections, which are in charge of Technical Superintendents:—

Canada, Newfoundland; Jamaica, Turks and Caicos Islands, British Honduras, British Guiana, Bahama Islands, Trinidad and Tobago, Barbados, Windward Islands, Leeward Islands, Bermuda; Falkland Islands; New South Wales, Victoria, Queensland, Tasmania, South Australia, Western Australia, New Zealand; Fiji; Union of South Africa, Rhodesia, Nyasaland, St. Helena; Gambia, Sierra Leone, Gold Coast, Northern Nigeria, Southern Nigeria; East Africa Protectorate, Zanzibar and Pemba; Uganda; Somaliland; the Anglo-Egyptian Sudan; Malta; Cyprus; Ceylon; Hong-Kong; Mauritius; Seychelles; Straits Settlements, the Federated Malay States; and India.

Special arrangements are made for the conduct of schools and institutions desirous of visiting the Colonial and Indian Collections for educational purposes.

A stand has been opened in the centre of the main gallery to facilitate the supply of general information and the distribution of literature. Pamphlets, circulars, handbooks, etc., containing information relating to the commerce, agriculture, mining, and other industries of the principal British Colonies, and also to emigration, are available for gratuitous distribution or for sale. The publications of the Emigrants' Information Office, established by the Colonial Office, may also be obtained. Lists of the publications available for distribution are obtainable on application. The principal Colonial and Indian newspapers may be seen on application. An officer of the Institute is in attendance at this stand, which is in telephonic communication with the Departments in the main building.

In 1910 the public galleries were visited by 167,440 persons, and 14,056 Colonial and Indian publications were distributed.

A Report by the Director on the Work of the Imperial Institute in 1909 has been presented to Parliament (Cd. 4964-30).

Scientific and Technical Department.—The research laboratories of this Department, which occupy the second floor of the Imperial Institute, were established in order to provide for the investigation of new or little-known natural products from the Colonies and India and of known products from new sources, with a view to their utilisation in commerce, and also to provide trustworthy scientific and technical advice on matters connected with the agriculture, trade and industries of the Colonies and India.

The work of this Department is chiefly initiated by the Home and Colonial Governments and the Government of India. Arrangements have been also made by the Foreign Office, whereby British representatives abroad may transmit to the Department for investigation such natural products of the countries in which they are appointed to reside as are likely to be of interest to British manufacturers and merchants.

Materials are first investigated in the research laboratories of the Department, and are afterwards submitted to further technical trials by manufacturers and other experts, and finally are commercially valued.

Except under special circumstances investigations are not undertaken for private individuals.

A Reference Sample Room is maintained in this Department, in which are arranged samples of the principal materials which have been investigated and valued commercially during recent years, and as to which full information is available.

The Scientific and Technical Department works in co-operation with the Agricultural and Mines Departments in the Colonies, whose operations it supplements by undertaking such investigations as are of a special scientific or technical character connected with agricultural or mineral development, as well as inquiries relating to the composition and commercial value of products (vegetable or mineral) which can be more efficiently conducted at home in communication with merchants and manufacturers, with a view to the local utilisation of these products or to their export.

A very large number of reports on these subjects have been made to the Governments of the Colonies and India, a first instalment of which was printed in a volume of *Technical Reports and Scientific Papers*, published in 1903. A series of Selected Reports is now being issued in the Miscellaneous Series of Colonial Reports. Of these Selected Reports, three have been published, Part I. "Fibres" (Cd. 4588), Part II. "Gums and Resins" (Cd. 4971), Part III. "Foodstuffs" (Cd. 5137), whilst others are in active preparation and will be issued in the course of the present year.

Mineral Surveys, under the supervision of the Director of the Imperial Institute, and conducted by Surveyors selected by him, are in progress in Ceylon and Southern Nigeria. All minerals found which are likely to be of commercial importance are forwarded to the Imperial Institute, where they are examined and their composition and commercial value ascertained. Reports by the Director on the results of mineral exploration in Ceylon, Northern Nigeria, Southern Nigeria, and Nyasaland have been printed in the Miscellaneous Series of Colonial Reports.

African Tropical Service Course.—A course of instruction in certain specified subjects is now given at the Imperial Institute to candidates selected by the Colonial Office for administrative appointments in East and West Africa. Instruction in the subject of tropical cultivation and products in this course is given by members of the Staff of the Imperial Institute.

Library and Reading-Rooms.—The library and reading-rooms of the Imperial Institute contain a large collection of Colonial and Indian works of reference, and are regularly supplied with the more important official publications, and with many of the principal newspapers and periodicals of the United Kingdom, the Colonies and India.

The library and reading-rooms are on the first floor, and admittance to them is obtained through the entrance at the west (Queen's Gate) end of the building. These rooms are available for the use of Life Fellows of the Imperial Institute, and of other persons properly introduced. Books and newspapers may be consulted for special purposes by permission.

Colonial Conference Rooms.—Three rooms, specially decorated and furnished, are reserved on the principal floor for use by representatives of the Colonies for meetings and receptions.

The Cowasjee Jehanghier Hall.—The Bhownagree corridor and rooms in connection with this Hall are in the occupation of the Indian Section of the Imperial Institute, whilst the Hall is available for lectures, meetings, etc.

The "Bulletin of the Imperial Institute" is published quarterly at one shilling (annual subscription 4*s.* 8*d.*, including postage), and may be purchased from Messrs. Eyre and Spottiswoode, Ltd., East Harding Street, Fleet Street, London, E.C., or from agents in the Colonies and India. The *Bulletin* contains records of the principal investigations conducted for the Colonies and India at the Imperial Institute, and special articles chiefly relating to progress in tropical agriculture and the industrial utilisation of raw materials (vegetable and mineral). The Director will be glad to consider for publication in the *Bulletin* any special articles on these subjects, which may be submitted by officials connected with agricultural, geological, mining or other technical departments in the Colonies and India. Such articles should be sent to the sub-editor, Dr. T. A. Henry, Imperial Institute, London, S.W.

The following Societies have their head-quarters at the Imperial Institute:—

International Association of Tropical Agriculture and Colonial Development, British Section.—The object of this Association, the Central Bureau of which is in Paris, is the promotion of the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of natural resources, especially of tropical countries. The British

Section has its head-quarters at the Imperial Institute. Members of the British Section are permitted to use the library and reading-rooms of the Imperial Institute, and a writing-room has been also assigned for their use.

British Women's Emigration Association.—The British Women's Emigration Association has been assigned offices on the mezzanine floor, which are open daily from 10 a.m. to 4 p.m., and advice and information respecting emigration and prospects for women in the Colonies may be obtained there free of charge. This Association works in co-operation with the Emigrants' Information Office in Westminster.

Colonial Nursing Association.—This Association has been assigned an office on the mezzanine floor of the Imperial Institute. Its principal object is the selection of trained hospital and private nurses for service in the Crown Colonies and other British Dependencies.

African Society.—This Society, which is concerned with the discussion and publication of all matters connected with British African Possessions, has been assigned an office on the mezzanine floor, and holds meetings for the discussion of African questions. The *Journal of the African Society* is published quarterly.

Imperial Co-operation League.—This Society has been assigned an office on the mezzanine floor. The object of the League is to promote the closer union of the Empire, more particularly in regard to co-operation between the United Kingdom and the Self-Governing Dominions in matters of defence and Imperial policy.

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BULLETIN

OF THE

IMPERIAL INSTITUTE

1911. VOL. IX. NO. 1.

SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial and Indian Governments concerned.

CEARÁ RUBBER.

A CONSIDERABLE number of samples of Ceará rubber have been forwarded to the Imperial Institute from British Colonies and Protectorates, and the following selection of reports gives the results of the examination of specimens from Ceylon, Uganda, the East Africa Protectorate, Nyasaland, the Sudan, and Southern Nigeria.

CEARÁ RUBBER FROM CEYLON.

The specimen weighed 10 oz. and consisted of three square sheets of light-brown opaque rubber, clean and well prepared, but a little mouldy on the surface. The physical properties of the rubber were very satisfactory.

A chemical examination gave the following results :—

	Per cent.
Moisture	0·9
Caoutchouc	91·3
Resin	3·1
Proteid	3·4
Ash	1·3

The specimen was valued at probably about 8*s.* per lb. in London, with fine hard Para at 10*s.* per lb., and good to fine plantation Para biscuits at 8*s.* 10½*d.* to 9*s.* per lb.

This rubber is of good quality and satisfactory in composition, except that the amount of ash is unusually high.

CEARÁ RUBBER FROM UGANDA.

1. Ceará rubber coagulated by means of lime-juice, and a very weak solution of formaldehyde added as a preservative.

The sample weighed 1½ lb., and consisted of thin biscuits of pale yellow rubber, very uniform in colour and excellently prepared. The physical characters of the rubber were very satisfactory.

The chemical examination gave the following results :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	4·8	—
Caoutchouc	72·8	76·5
Resin	7·6	8·0
Proteid	11·9	12·5
Ash	2·9	3·0

The rubber was valued at from 8*s.* 2*d.* to 8*s.* 4*d.* per lb. in London, with fine hard Para at 10*s.* 1*d.* per lb., and good to fine plantation Para biscuits at 8*s.* 10¼*d.* to 9*s.* per lb.

This Ceará rubber is of very good quality, and its preparation leaves little to be desired. The results of the analysis show, however, that the percentages of resin, proteid and ash are all high, the amounts of the two latter constituents being much greater than is usual in biscuit Ceará rubber.

It is difficult to account for the large percentage of proteid (12·5) present in the rubber, unless it is to be attributed to the method of preparation employed, and it was suggested that it would be desirable to prepare for comparative analysis a few biscuits of the rubber by simply diluting the latex with water and allowing it to stand without any other addition.

2. Ceará rubber prepared with water only.

This specimen of rubber was prepared in response to the suggestion made in the preceding report. It weighed 1¼ lb. and consisted of three pieces of corrugated sheet rubber about ¼ inch thick, which were rather moist internally when received. The rubber was light yellow externally but quite white within, and it was free from vegetable impurities; its physical properties were very satisfactory.

A chemical examination gave the following results:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	3·5	—
Caoutchouc	86·1	89·3
Resin	5·7	5·9
Proteid	3·6	3·7
Ash	1·1	1·1

The rubber was valued at 4*s.* 3*d.* per lb. in London, with fine hard Para quoted at 5*s.* 2*d.* per lb.

This specimen of Ceará rubber is much superior in composition to the previous sample. The percentages of resin, proteid and ash are all much lower, and the amount of caoutchouc consequently greater. It appears, therefore, that the method of coagulating the latex by simply adding water and allowing it to stand will give a much purer rubber than the process adopted in the previons case.

CEARÁ RUBBER FROM THE EAST AFRICA PROTECTORATE.

1. From the Kibos District.

The specimen weighed 2½ ozs., and consisted of a small ball of pale brown rubber which was very moist internally when freshly cut. The rubber was slightly sticky, but exhibited fair elasticity and tenacity.

An analysis gave the following results:—

	Rubber as received. Per cent.	Composition of dry rubber. Per cent.
Moisture	12·4	—
Caoutchouc	58·9	67·2
Resin	10·5	12·0
Proteid	12·1	13·8
Insoluble matter	6·1	7·0
Ash	2·4	2·8

The sample was too small for trustworthy valuation, but rubber of similar quality would probably realise about 3*s.* per lb. in London, with fine hard Para quoted at 4*s.* 3½*d.* per lb.

The percentages of resin, proteid and insoluble matter present in this rubber are all rather excessive. These defects may, however, be due in part to the fact that the latex coagulated spontaneously in the incisions and the rubber had consequently to be collected as "scrap." Practically the whole of the resin and proteid present in the latex would therefore be included in the rubber.

2. From Kisumu.

This sample was stated to have been obtained from Ceará trees about 18 months old at the Mill Hill Park Mission Station near Kisumu. It consisted of a small ball of light brown rubber, rather sticky externally and moist within. The rubber exhibited poor elasticity and tenacity.

An analysis showed the rubber to have the following composition:—

	Rubber as received. Per cent.	Composition of dry rubber. Per cent.
Moisture	10·0	—
Caoutchouc	59·8	66·4
Resin	8·7	9·7
Proteid	13·9	15·5
Insoluble matter	7·6	8·4
Ash	4·02	4·46

The sample was too small for trustworthy valuation, but rubber of similar character would possibly realise about 3*s.* per lb. in London, with fine hard Para at 5*s.* per lb.

The relative values of the pricking and herring-bone system of tapping Ceará trees, as regards the yield and value of the rubber obtained and the effect upon the trees, will have to be determined by experiments in Nyasaland. The chief objection to the pricking method is that the rubber is obtained in balls or as "scrap," but the use of a washing machine would obviate this drawback.

CEARÁ RUBBER FROM THE SUDAN.

The sample was labelled "Rubber from Ceará plantations in Mongalla," and consisted of five small biscuits of pale yellow rubber, which were clean, well prepared, and free from impurities. The rubber exhibited good elasticity and tenacity.

The rubber had the following composition:—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	2·2	—
Caoutchouc	80·1	81·9
Resin	5·8	5·9
Proteid	9·8	10·0
Ash	2·1	2·2

The specimen was valued at 4*s.* 10*d.* per lb. in London, with fine hard Para at 5*s.* 10*d.* per lb., and good to fine plantation Para biscuits at 5*s.* 1*d.* to 5*s.* 4*d.* per lb.

This rubber, derived from two-year-old trees, is of very good quality, and its preparation is quite equal to that of any Ceará rubber on the market. In composition it is not quite so good as some specimens of plantation Ceará from Ceylon, but it is superior to samples from East Africa which have been examined at the Imperial Institute.

The results of this investigation are very promising, and indicate that the Ceará trees at Mongalla may be expected to furnish rubber of very good quality.

CEARÁ RUBBER FROM SOUTHERN NIGERIA.

1. From Lagos.

The specimen consisted of about 3 ozs. of rubber in irregular lumps, which had been formed by the aggregation of very small balls. The rubber was light brown and free from visible impurity. Its physical characters were not very satisfactory, as the greater part of the sample appeared to be slightly perished, especially on the outside of the lumps, and the rubber was very deficient in elasticity and tenacity.

The rubber was found to have the following composition :—

	Rubber as received. *Per cent.*	Composition of dry rubber. *Per cent.*
Moisture	6·4	—
Caoutchouc	62·8	67·2
Resin	3·4	3·6
Proteid	22·4	23·9
Insoluble matter	5·0	5·3
Ash	2·6	2·7

The striking feature of the analytical results is the large amount of proteid contained in the rubber. The presence of this excessive quantity has probably arisen through the immediate coagulation of the latex as it issued from the tree, whereby the whole of the proteid matter in the latex was included in the rubber.

The rubber was submitted for valuation to brokers, who described it as rather stringy and perished scrap, and valued it at about 2*s.* 9*d.*, with fine hard Para quoted at 5*s.* 7*d.* per lb.

The investigation showed that this sample of Ceará rubber was unsatisfactory, both as regards physical properties and chemical composition, and that it would consequently fetch only a low price in the market.

2. From Olokemeji.

The sample was described as "Ceará rubber prepared by the Lewa method and afterwards smoked." It weighed 10 lb., and consisted of cakes of rubber formed of aggregated balls, which were rather moist internally, and contained a little vegetable impurity. The rubber was dark brown externally but white within, and it had a strong smoky odour ; it was rather deficient in strength.

The results of the examination were as follows :—

	Per cent.
Loss on washing (moisture and impurities)	21·7

Composition of dry washed rubber :—

	Per cent.
Caoutchouc	84·1
Resin	7·8
Proteid	6·5
Ash	1·6

The value of consignments of rubber similar to this sample is uncertain, but they would probably realise from 4*s.* to 4*s.* 6*d.* per lb. in London, with find hard Para quoted at 6*s.* 11*d.* per lb.

This rubber is only of fair quality on account of its deficient strength. The large loss on washing is due primarily to the moist condition of the rubber. The percentages of resin, proteid and ash are all rather high, especially the proteid.

If the latex flows sufficiently freely from the trees to be collected in bulk it would be advisable to prepare the rubber in the form of biscuits, by diluting the latex and allowing it to stand. This method would probably reduce the amount of proteid present in the rubber.

The appearance of this sample of rubber was greatly improved by conversion into crêpe.

TURPENTINE OIL FROM INDIA.

SAMPLES of turpentine oil were forwarded to the Imperial Institute by the Assistant Conservator of Forests at Naini Tal, United Provinces, in August 1910. The oil was stated to have been prepared at the Government turpentine oil distillery at Naini Tal, from the oleo-resin of the "chir" pine (*Pinus longifolia*), and it was desired to ascertain its value as compared with the turpentine oils of commerce.

Description of Samples.

The samples were two in number, marked "A" and "B." Each weighed 16 lb., and consisted of colourless turpentine oil.

Results of Examination.

The specific gravity and the rotatory power of the oils were as follows :—

	A.	B.
Specific gravity at 15°/15° C.	0·871	0·868
Optical rotation in 100-mm. tube	−0° 45′	−2° 10′

The samples were subjected to fractional distillation with the following results :—

	A.		B.	
	Percentage of total sample by volume	Optical rotation in 100-mm. tube	Percentage of total sample by volume	Optical rotation in 100-mm. tube
Fraction boiling at :—				
165° C. or below .	1	− 9° 45′	1	—
165° C. to 170° C. .	54	− 5° 15′	55	− 7° 15′
170° C. to 175° C. .	25	+ 2° 0′	28	+ 0° 20′
175° C. to 195° C. .	12	+ 6° 35′	9	+ 7° 5′
Residue . . .	7	+ 10° 45′	6	+ 17° 25′

The above figures show that the present samples, yielding practically no distillate below 165° C., are quite different from American turpentine oil, which should yield not less than 70 per cent. by volume between 155° and 160° C. They are of the same nature as a sample of turpentine oil from *Pinus longifolia* from the Jaunsar Division, United Provinces, previously examined at the Imperial Institute. One-third of the latter was lævo-pinene, boiling at 157° C., and having a rotatory power in a 100-mm. tube of −36° 30′, and two-thirds consisted of a mixture of sylvestrene and other high-boiling terpenes, with a boiling-point of 173° C. and a rotatory power in a 100-mm. tube of +13°.

This oil most nearly resembles Russian turpentine oil among those on the English market, but the Russian product is very variable in composition, and in this respect the Indian oil would have an advantage. The following figures have been recorded for two samples of commercial Russian oil :—

		I.	II.
Specific gravity at 15·5°/15·5° C. .		0·866	0·884
Optical rotation in 100-mm. tube		+ 14° 29′	+ 16° 20′
Fraction boiling at :—			
145° to 160° C.	per cent.	4	2
160° to 165° C.	,,	12	16
165° to 170° C.		43	36
170° to 175° C.		20	18
175° to 180° C.		11	7
180° to 185° C.	..	3	4
185° to 190° C.	,,	2	2

No. 1 was also found to contain some petroleum.

Commercial Valuation.

Samples of this Indian turpentine oil were submitted to a firm of importers and to a firm of varnish manufacturers. The importers stated that the odour of the oil differed from that of American turpentine oil, and that an expert to whom they submitted it without stating its origin considered it to be a mixture of French and Russian oils. They valued the product at £30 to £40 per ton in London (October 1910).

The manufacturers reported that the oil resembled Russian turpentine oil and would have a similar value, *i.e.* about half that of American oil. They added that the present value of American oil was about £55 per ton in London (November 1910), and they did not see any reason to anticipate any fall in prices.

Conclusions.

This Indian turpentine oil could be used in place of Russian oil, which is widely employed for the cheaper grades of varnishes, for black lacquers, and for making certain disinfectants. Information has been asked for from India as to the possibility of developing an export trade in this product at the prices quoted above. Detailed information regarding the present and possible sources of supply of turpentine oil are given in this *Bulletin* (1906, **4**. 215).

ROSIN FROM INDIA.

A SAMPLE of rosin (colophony) was forwarded to the Imperial Institute for examination in June 1910 by the Imperial Forest Chemist at Dehra Dun, with a request that it might be examined and valued.

The sample was labelled "colophony prepared at Naini Tal by using crystalline alum for its clarification." It consisted of masses of transparent, pale brownish-yellow rosin having the usual appearance and properties of rosin of good quality.

It gave the following results on analysis :—

Moisture	0·80 per cent.
Ash	0·15 per cent.
Melting-point	74° C.
Acid number*	174
Saponification number* .	184

The ash yielded by the rosin was a reddish-brown powder; the quantity obtained was insufficient for detailed examination.

The analytical results show that this rosin is of good quality.

Samples were submitted to merchants, who valued it at £14 to £15 per ton in the United Kingdom, and to a firm of soap-makers, who considered it to be worth £13 per ton. The current value of American rosin of similar colour and quality was £14 9*s.* per ton. The merchants stated that the present prices are abnormally high, and that £12 per ton could be regarded as a fair average price for this material.

This Indian colophony is of much better quality than a sample examined at the Imperial Institute in 1909 (see *Selected Reports from the Imperial Institute*, Part II., Gums and Resins [Cd. 4971], p. 196). As explained in that report, the value of rosin depends primarily on its colour, provided that the composition of the material, as indicated by the usual constants, is satisfactory. The present sample is not quite so pale as the best Bordeaux rosin, but it would be classed with the "water white" grades of American rosin. There is no doubt that Indian rosin of this quality would sell readily in the United Kingdom at good prices.

FLAX FROM THE EAST AFRICA PROTECTORATE.

A SAMPLE of flax, grown in the Highlands of East Africa, has been described in a previous number of this *Bulletin* (1908, **6**. 6). The fibre appeared to have been injured by over-retting, but it is probable that if the straw had been properly treated, flax of good quality would have been obtained. In any case, the result was regarded as sufficiently encouraging to justify further experiments.

Samples of flax of the Pskof variety, which had been grown in

* *Milligrams of potassium hydroxide required for 1 gram of rosin.*

the Limoru district of the Highlands of the Protectorate, were received at the Imperial Institute in 1908. They consisted of (1) retted flax straw, and (2) flax fibre.

The former was flax straw which had been retted but not broken and scutched. The straw was straight and generally not branched except towards the upper extremities; it was of brownish grey colour and much darker than ordinary Belgian flax.

The following measurements were obtained on comparing the specimen with a standard sample of flax straw grown in Belgium:—

	Flax straw from East Africa.	Flax straw from Belgium.
Length of straw . . .	30 to 40 in.	30 to 36 in.
Diameter, maximum . .	0·09 in.	0·064 in.
Diameter, minimum . .	0·04 in.	0·032 in.

It will be noticed that the straw from the East Africa Protectorate was longer and somewhat coarser than the standard sample used for comparison.

Sample (2) consisted of fairly well cleaned fibre from which most of the "shieve," or fragments of wood, had been removed. The clean fibre was of very good strength, and had an average diameter of 0·00073 inch, whilst the average diameter of a standard sample of Belgian flax fibre was 0·00086 inch. The specimen under examination was therefore generally finer than the Belgian flax.

These samples of flax from East Africa were on the whole well grown, but the retting operation appeared to have been imperfectly carried out, since the fibre was harsh, considerably stained, and much darker in colour than is usually the case with perfectly retted flax straw. The straw also lacked uniformity of diameter. This defect of the straw has a marked influence on the quality of the fibre produced from it, and it was therefore pointed out that it would be advisable to ensure a more even growth by planting the seed thickly. It is usual to sow about 3 bushels of seed per acre, but double this quantity is sometimes used, in which case the young plants require to be afterwards thinned out.

The commercial expert to whom a sample of the flax was submitted stated that the fibre was coarse and hard, and more

stated that the fibre was very dry, weak and towy, and of poor spinning quality. It was probably not worth more than £18 per ton.

The fibre was of good colour and satisfactory length, and its weakness and towy nature were probably due to the straw having been over-retted. In retting, considerable care is needed to stop the process at the right point, as otherwise the fibre is weakened and its value diminished.

The results of these experiments indicate that flax can be grown successfully in the Highlands of the East Africa Protectorate. In order to obtain a product of good quality, however, it is essential that considerable attention should be devoted to the processes involved in the preparation of the fibre, and particularly to the methods of retting.

COTTON FROM THE CAPE PROVINCE, SOUTH AFRICA.

THE trials which have been made in the Cape Province with cotton during the last few years have led to the conclusion that the most suitable districts for the cultivation of this product are the coast regions extending from Port St. John's to Port Elizabeth. Four samples of Egyptian Abassi cotton grown in this region have recently been submitted to the Imperial Institute for examination, and are described below.

Sample A was grown at Amalinda, ten miles from the coast in the district of East London. The product was fairly soft, lustrous, clean, of cream colour and free from stains, but rather weak. The length of staple was somewhat irregular, and varied from 1 to 1·6 inches, but was mostly from 1·2 to 1·5 inches. The diameter of the fibres ranged from 0·00055 to 0·00100 inch, with an average of 0·00074 inch. On microscopical examination, some immature fibres were noticed.

This sample was of fairly good quality, and such cotton would be readily saleable in the English market. It was valued by commercial experts at 11¾*d.* to 12*d.* per lb., with "good" Egyptian Abassi at 14½*d.* per lb.

Sample B was grown on the Lower Gonubie River in the district of East London. It consisted of fairly soft, lustrous, white to cream-coloured cotton bearing a few pale-brown stains. The fibre was of fairly good strength and from 1·2 to 1·6 inches long; its diameter was from 0·00050 to 0·00085 inch, with an average of 0·00071 inch. On microscopical examination, the presence of some immature fibres was noticed. This cotton was somewhat inferior to Sample A in colour, and was valued at 11½*d.* per lb., with "good" Egyptian Abassi at 14½*d.* per lb.

Sample C, grown on the same farm as Sample A, was fairly soft, lustrous, clean, of cream colour and practically free from stains. The strength of the fibre was generally good, but some portions were rather weak. The length of staple varied from 1·3 to 1·6 inches; but was mostly from 1·4 to 1·5 inches. The diameter of the fibres ranged from 0·0006 to 0·0010 inch, with an average of 0·00075 inch. On microscopical examination, the presence of some immature fibres was noticed.

This sample was of good quality, and such cotton would be readily saleable in the English market. It was valued at 12*d.* to 12½*d.* per lb., with "good" Egyptian Abassi at 14½*d.* per lb.

Sample D, grown at Willowvale, Transkei, Native Territories, consisted of fairly soft, very lustrous, white to cream-coloured cotton with a few brown and yellow stains. It was rather weak, 1 to 1·4 inches long, and 0·00055 to 0·00100 inch in diameter, with an average of 0·00073 inch. On microscopical examination, a good many immature fibres were noticed.

This sample was more silky than ordinary Abassi cotton from Egypt, and somewhat resembled "improved" American Upland cotton. It was valued at 11*d.* to 11½*d.* per lb., when "good" Egyptian Abassi was quoted at 14½*d.* per lb.

GRAPE FRUIT FROM THE EAST AFRICA PROTECTORATE.

A SMALL box of grape fruit grown at Nairobi was forwarded to the Imperial Institute by the Director of Agriculture in the East Africa Protectorate in July 1910, with a request for information as to the condition of the fruit on arrival, its quality, and as to whether there is a market for such fruit in London.

The box contained ten fruits of various sizes, which were submitted to experts immediately on arrival.

The condition of the fruit was stated to be practically perfect, and its quality to leave little to be desired. The only point to which attention was drawn was that these fruits from Nairobi contained more pith than the grape fruit received from Jamaica and California, and this fact might detract a little from their value when placed in competition with fruit from those countries. This slight defect will, however, probably not exist in fruit gathered from older trees.

The commercial value in the United Kingdom of grape fruit from the East Africa Protectorate will depend on (1) the time of year at which it can be placed on the market, and (2) the grading and packing of the fruit.

During the months of July and August there are practically no arrivals of grape fruit in Europe. If any quantity of the fruit could be landed in this country from the East Africa Protectorate during those two months (in the present case the fruit reached London on August 24) a very profitable business would result, and prices averaging from 15*s.* to 20*s.* per case could be obtained. During the other months of the year Jamaica and California send fair supplies of grape fruit which realise prices ranging from 10*s.* to 14*s.* per case.

The fruit is graded into several sizes. The largest size, which is larger than any of the fruits in the present sample from Nairobi, is packed in boxes, each containing 54 fruits. The "count" increases as the size diminishes, and the smaller grades comprise 64, 72, 80, 90, 96, and 112 fruits in a box. The small "counts," which consist of the larger fruits, are of course the more valuable. The boxes in which the fruits are packed measure 2 feet × 1 foot × 1 foot, and each box has a partition in the middle to strengthen it.

The fruits are wrapped in tissue paper and packed diagonally to avoid crushing, and it is essential that each box should be packed quite full, whatever grade of fruit it contains, so that the fruit does not get shaken about and bruised. The care taken in the packing will be well repaid by the superior condition of the fruit on arrival.

There is a steady increase in the demand in this country for grape fruit, which has been growing in popular favour for some years past, and a constant supply from the East Africa Protectorate would find a ready sale.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

THE CULTIVATION, PRODUCTION, PREPARATION AND UTILISATION OF CASTOR SEED.

THE castor plant, known botanically as *Ricinus communis*, Linn., is widely distributed throughout the tropics, but is generally believed to be native to North Africa and probably also to India. It belongs to the natural order Euphorbiaceæ, and is thus related to several other plants yielding oil seeds, such as *Jatropha Curcas*, *Croton Tiglium*, and *Hevea brasiliensis*, the latter yielding a valuable oil seed, in addition to Para rubber. (Compare this *Bulletin*, 1903, **1.** 156; 1904, **2.** 22; 1909, **7.** 95; this vol. p. 35.) There are numerous varieties of castor plants, some of which have been considered distinct species by botanists, but are now generally believed to be cultivated or geographical forms of one variable and widely distributed species.

The castor plant is largely grown in India, Java, Brazil, the United States and Italy, and occurs wild or in a state of semi-cultivation in most tropical and sub-tropical countries. The economic importance of the plant depends chiefly on the seeds, which yield a valuable oil that is used in medicine and for numerous industrial purposes. In India the leaves are also of value, being used as fodder for cattle, and in Assam and other countries as food for the Eri silkworm. (See this *Bulletin*, 1909, **7.** 202.)

In tropical countries the castor plant reaches the dimensions of a small tree, and may attain a height of from 20 to 30 feet, or more, with a stout trunk and branches. In cooler climates it becomes a shrub or bush, 8 to 12 feet high, and in localities where frosts occur it is a herbaceous perennial. Under cultivation in warm-temperate climates it is usually treated as an annual. Owing to its decorative value it is frequently cultivated under the name of "Palma Christi," solely for ornamental purposes. The leaves are large and handsome on long foot-stalks arranged alternately on the stem; palmate, glaucous, green or reddish in colour, divided deeply into 8 or 10 lobes, which have serrated margins. The flowers, of two sexes, are produced in panicled racemes, which terminate the branches; they are usually bluish-green in colour, but may assume a reddish hue, as in the variety know as "*lividus*." The short-stalked staminate flowers are produced at the base of the inflorescence and the pistillate ones on the upper part. The fruit is a dry, 3-celled, 3-seeded capsule, usually covered with sharp spiny prominences, rarely smooth. The seeds vary much in colour, size and shape; they are usually oval, flattened on one side, and of a mottled grey colour with a conspicuous white caruncle at the hilum end. When ripe, the capsules of some varieties dehisce and scatter the seeds a considerable distance. This peculiarity probably accounts for the wide distribution of the plant in countries, such as Brazil, to which it is not native. The method of seed-dispersal should be borne in mind by the cultivator, as seed is liable to be lost if the capsules are allowed to remain too long on the plants.

For practical purposes the numerous forms of the castor plant may be grouped into two classes, the large-seeded and the small-seeded kinds. The former are the more prolific in yield of seeds, and the oil obtained from them is suitable for lubricating and industrial purposes; the small-seeded varieties yield a finer oil, that is preferred for use in medicine.

Climate and Soil.

As a rough guide to the climatic conditions necessary for the production of castor seed it may be stated that where maize can be grown and ripened the castor plant may be expected to succeed. It is sensitive to frost, and is therefore only adapted to warm climates or to countries where the summers are sufficiently long to mature the seeds. The plant requires a fair amount of moisture, and rainfall after sowing is essential to ensure good germination; but after the root-system has developed, less moisture is needed, and in the tropics its cultivation seems to be restricted by excessive rainfall.

The soil best suited to the castor plant is a rich, well-drained, sandy or clayey loam, or any land that produces good wheat or maize. Very loose sandy soils or heavy clays are alike unsuitable. In India red soils situated at the foot of hills are specially chosen. These are poor in organic matter and require to be enriched with farmyard manure. The plant is also commonly grown in isolated patches on land surrounding dwellings, or along the tops of high mud banks that surround orchards and vegetable gardens.

Cultivation.

The land destined for a crop of castor seed requires good preparatory cultivation before sowing takes place. Owing to its well-developed root-system the castor plant demands a deep-rooting medium. Deep ploughing and harrowing are therefore essential. In India, where the plant is subject to attacks from insect pests, this preparation of the soil is recommended to be carried out in the cold weather in order to expose eggs, larvæ and grubs, which then become the prey of birds.

The castor plant soon exhausts the soil, and if virgin land is not available for the crop natural or artificial manures are necessary to keep up the supply of available nitrogen, potash and phosphoric acid. One of the most valuable manures for this purpose is the residual cake, left after the expression of oil from the seed. The empty capsules, shells, leaves and stems of the plant should also be returned to the soil. In India farmyard manure is commonly employed, or when this is not available silt is used. The castor plant is, however, seldom grown as a pure crop in India, but is generally used as a border to cotton or sugar fields or mixed with potatoes, cereals or some leguminous crop; hence soil exhaustion is less rapid than would otherwise be the case were pure crops grown. Pure crops should not be taken from the same land more than once in five to six years.

Before the seeds are sown it is advisable to pour warm water over them and allow them to steep, without further heating, for about 24 hours. This treatment softens the hard seed-coat and tends to ensure quick and uniform germination. The large-seeded kinds should be planted in rows from 5 to 6 feet apart, and at a similar distance in the rows. The small-seeded kinds may be planted closer; about 3 feet between the rows and 18 inches from plant to plant being the usual spacing in India. If planted too thickly the plants tend to develop tall stems and few branches, but if ample space is allowed so that air and light are admitted, free branching takes place and more flowers and seed are in consequence produced.

In order to secure a good "stand," it is advisable to place from 2 to 4 seeds in each little mound along the rows, the seeds being about 6 inches apart, or they may be dropped in the furrow made by the plough, and covered by the plough following, or dibbled in by hand. After germination has taken place and the seedling plants are from 6 to 8 inches high, they should be thinned out, the weakly plants in each mound being removed and the most vigorous specimen left to develop.

About 10 lb. of seed of the large-seeded varieties are required to plant an acre, and about 14 lb. in the case of the small-seeded kinds. The best time to sow the seeds is at the commencement of the rainy season. In India the large-seeded kinds are generally grown during the monsoon rainfall, and are usually confined to small patches in house gardens. The small-seeded kinds are generally grown as field crops at the end of the monsoon season and at the commencement of the cold weather.

After the plants have been thinned out, the land between the rows should be ploughed or hoed occasionally to keep down weeds and to conserve soil moisture. It is also advisable to slightly mould up the plants by drawing the soil up round the stems to prevent moisture collecting at the base. When the plants have attained a height of about 2 feet, further working of the soil is unnecessary, as the plants will then be of sufficient size to shade the ground and strong enough to outgrow weeds.

It sometimes happens that the plants grow too vigorously, and then long shoots are produced but few flowers are formed. When this takes place pruning should be resorted to; the long shoots should be topped to induce branching and the formation of flowers, and thereby increase the production of seed. The crop is also easier to collect from dwarf plants than from tall specimens.

Harvesting.

The capsules of the small-seeded varieties begin to ripen in from 4 to 5 months from the time of sowing, and those of the large-seeded kinds in from 7 to 10 months, according to

In countries where the castor plant is not systematically cultivated, but where it grows wild or semi-cultivated, and labour is cheap, the collection and preparation of seeds on the lines indicated above should be encouraged. The numerous uses to which castor oil is now applied ensures a ready sale for the castor seed, and the present market value of the latter provides, as a rule, ample remuneration for the labour involved.

In India, when grown as a mixed crop, the yield of seed per acre is about 250 lb., and when grown as a pure crop is from 500 to 900 lb. per acre. The yield of individual plants grown together as a single crop is much less than that of well-developed, freely-branched plants that have grown singly or in isolated clumps. As much as 20 lb. of seed per plant has been sometimes gathered from these. In the United States the yield is said to be from 900 to 1,350 lb. per acre when grown on suitable soil and with good cultivation. In Brazil it is calculated that in the castor plantations each plant yields from 4·5 to 11·25 lb. of seed.

Fungoid and Insect Pests.

Generally speaking, the castor plant is hardy, but it is liable to attacks from both fungi and insect pests. The leaves are sometimes attacked by *Melampsorella ricini*, De Toni, a fungus which appears as small yellow patches on the under surfaces, causing them to turn brown and decay. This may be destroyed by spraying with a solution of copper sulphate (1 in 1,000). In India there are a number of insects that live on the castor plant, but the most destructive are *Emproasca notata*, Mel., and *Pericallia ricini*, Fabr. The former lays its eggs in the soft tissues of the leaf midrib, and the bright green nymphs suck the juices of the leaves, causing curling and distortion. It seems to favour some varieties more than others, and is not usually destructive to castor plants grown as a field crop. The hairy caterpillar of *Pericallia ricini* is a great pest; it feeds on the leaves and is common all over India. Smoking with torches is sometimes resorted to in order to check its ravages. The caterpillar of *Ophiusa catella*, the "Fruit Moth," is stated to cause the destruction of castor plantations in the Transvaal by defoliating the plants. The remedies suggested are handpicking and destruction of the caterpillar, and spraying with "Paris green" or other compounds of arsenic. The moths may also be caught and destroyed by means of "light traps." The larvæ of another species of this genus known as *O. melicerte*, Dr., are also destructive in the Federated Malay States, India, and other countries. In the United States the castor crop is said to be free from insect pests.

Production of Castor Seed.

India is the principal producing country, and the bulk of the supply of castor seed that enters international trade is drawn from this source. The Indian exports of castor oil also exceed those of any other country. Although the actual production of this crop is not shown in the statistical returns for India, the following tables showing the amounts exported will indicate the magnitude of the trade in this commodity.

The quantities of castor seed exported from India to the principal consuming countries during the past five years for which figures are available have been as follows:—

	1904-5.	1905-6.	1906-7.	1907-8.	1908-9.
	cwts.	cwts.	cwts.	cwts.	cwts.
United Kingdom	452,358	479,348	649,874	1,121,035	806,789
France	266,845	286,848	277,002	267,383	333,959
Belgium	275,179	185,568	198,785	289,733	207,093
Italy	252,010	197,249	166,268	237,028	176,223
Germany	193,402	136,757	203,691	70,499	109,603
Total exports	1,460,908	1,298,624	1,505,059	1,993,717	1,650,466

The quantities of castor oil exported for the same period have been as follows:—

	1904-5.	1905-6.	1906-7.	1907-8.	1908-9.
	galls.	galls.	galls.	galls.	galls.
United Kingdom	256,975	191,034	129,102	233,583	131,308
Ceylon	72,041	61,994	65,818	81,233	63,980
Straits Settlements	242,672	201,169	185,019	186,686	176,824
Hongk	102,524	68,392	33,737	18,268	13,533
Cape Colony	110,344	92,070	172,802	81,495	9,069
Natal	212,269	255,528	231,358	215,137	73,690
Mauritius and Dependencies	92,582	105,867	96,602	92,415	82,414
New Zealand	89,841	111,748	132,380	129,640	166,718
Australian Commonwealth	428,520	293,677	363,723	439,445	352,841
* Foreign countries	14,342	45,837	21,921	23,114	23,275
Total exports	1,632,106	1,432,108	1,455,636	1,508,545	1,099,967

* *Principally Siam, Portuguese East Africa, Japan and Dutch Guiana.*

The imports of castor seed are not shown separately in the trade returns of the United Kingdom, but the imports of castor oil during the period 1905–9 have been as follows:—

Country of Origin.	1905.	1906.	1907.	1908.	1909.
	cwts.	cwts.	cwts.	cwts.	cwts.
Belgium . . .	21,881	18,967	17,802	9,632	9,847
France . . .	17,237	14,982	14,622	6,345	6,756
Italy	4,209	4,267	3,770	3,455	2,388
Other foreign countries	720	245	488	713	1,258
British India . .	17,140	11,868	13,709	11,590	12,494

After the United Kingdom, the United States is perhaps the largest consumer, part of the demand being met by the home produce, and part by imported material. The cultivation of castor seed in the United States is confined chiefly to a few districts in Oklahoma, Eastern Kansas, Western Missouri and South-West Illinois. The amount of the annual crop is not given in the returns, but it is estimated to be under 100,000 bushels. The imports of castor seed to the United States in the fiscal year 1908–9 amounted to 613,708 bushels, and of castor oil for the same period to 6,846 gallons. These were derived chiefly from India, but seed was also imported from Brazil.

Although not native to Brazil the castor plant finds in that country a suitable soil and climate, and has become naturalised to a large extent. The consumption of castor oil in Brazil is large, and there are a number of castor-oil factories, mainly in the State of Pernambuco. The following quantities of seed were exported during the years 1905–8:—

	Kilograms.		Kilograms.
1905 . .	2,645,775	1907 . .	1,221,308
1906 . .	3,126,047	1908 . .	150,101

RECENT EXPERIMENTS IN BRITISH TERRITORY.

It will be seen from the foregoing information that, whilst there is a very large demand for castor seed and castor oil, this demand is met from comparatively few sources, and that many of the importing countries are in a position, as regards climate, to produce all the castor seed they require. This aspect of the question has been seriously considered in recent years, in Australia and certain of the South African States, but, so far as is known at present, but little has been done to establish an industry in either of these countries. The manufacture of castor oil in the United Kingdom has been established comparatively recently, and this has given a further incentive to the production of castor seed in various British tropical and sub-tropical colonies. For these reasons a large number of inquiries has been received at the Imperial Institute in recent years, on the one hand from manufacturers desiring new sources of supply of castor seed, and on the other from planters in the colonies desirous of undertaking the production of this seed. In connection with these various inquiries, a considerable number of samples of castor seed, grown in various parts of the Empire, have been received and examined in the Scientific and Technical Department of the Imperial Institute, and it is of interest to place the results of these investigations on record, since they show that in many parts of the Empire the production of castor seed of good quality could be undertaken.

UGANDA.

Nine samples of castor seed were forwarded by the Officer-in-Charge of the Botanical, Forestry and Scientific Department at Entebbe in October 1910.

Description of Samples.

No. 1. Bright brown and grey mottled seeds varying in size from small to medium. A few damaged seeds were present.

No. 2. Medium-sized seeds, of grey colour with very dark brown mottling. A few damaged seeds were present.

No. 3. Large grey and black mottled seeds. A few damaged seeds were present.

No. 4. Fairly large, elongated greyish-white seeds, lightly mottled with black. A fair number of broken seeds were present.

No. 5. Fairly large brownish-grey seeds, mottled with very dark brown. A very few damaged seeds were present.

No. 6. Small, greyish seeds, mottled with dark brown or black. A few damaged seeds were present.

No. 7. Dark greyish-brown mottled seeds of small to medium size. Hardly any broken seeds were present.

No. 8. Fairly large, broad seeds, of coppery-brown colour lightly mottled with dark brown. Some broken seeds were present.

No. 9. Large, elongated white seeds, mottled with black or dark brown. Some broken seeds were present.

Results of Examination.

The yields of oil obtained from the samples by extraction were as follows :—

No. of Sample.	Yield of oil. *Per cent.*	No. of Sample.	Yield of oil. *Per cent.*
1	48·0	6	48·9
2	50·8	7	47·6
3	49·4	8	45·8
4	47·8	9	48·2
5	50·0		

Commercial Valuation.

These seeds would all be readily saleable in Europe. Their commercial value would approximate to that of Bombay castor seed, which is at present worth £12 5*s.* per ton in the United Kingdom (February 1911).

ANGLO-EGYPTIAN SUDAN.

The castor plant grows wild in the Anglo-Egyptian Sudan, and recently experimental plantations have been made on the Kassala farm with Indian and Java kinds, which have proved superior to the native plant. A variety with brilliant red seed spikes has also been introduced from Borgu in West Africa.

duce larger seeds. The following table gives the principal results obtained by the examination at the Imperial Institute of castor seed from the Sudan.

Date of Receipt.	Origin.	Description of Seed.	Percentage of Oil in Seed.	Valuation.*
November 1905	Berber Prov.	Small to medium, dull greyish-brown, marbled seeds	46·8	£11 to £12 per ton (April 1906).
,, ,,	Dongola .	Small, medium and large seeds, varying in colour from reddish brown to dark greyish-brown	47·9	
,, ,,	Upper Nile Prov.	Small greyish-brown, marbled seeds	45·2	
,, ,,	Halfa .	Medium dull greyish-brown, marbled seeds	47·7	
,, ,,	Rumbek, Bahr-el-Ghazal Prov.	Small, light brown seeds	44·2	Same as Bombay castor seed.
July 1906 .	Red Sea Prov.	Small grey seeds .	47·0	5*s.* per ton more than Bombay castor seed.
,, ,, .	,,	Small, dark grey seeds	41·1	Same as Bombay castor seed.
,, ,, .	,,	Small, blackish seeds, not in good condition	48·7	5*s.* per ton more than Bombay castor seed; if shipped in sound condition.
January 1907 .	Bahr-el-Ghazal	Small, dark brown seeds	44·0	Same as Bombay castor seed.
February 1907	Kassala Prov.	Small, grey seeds .	42·0	Same as Bombay castor seed.
April 1907 .	Not stated	Small, greyish-brown seed	47·0	About 5*s.* per ton more than Bombay castor seed.

EAST AFRICA PROTECTORATE.

Nine samples of castor seed grown in various parts of the East Africa Protectorate were forwarded for examination in December 1908 and July 1910.

Description of Samples.

No. 1. "Embu." Large seeds of mixed colour; some small seeds were also present.

No. 2. "Embu." Small, dark brown, mottled seeds.

No. 3. "Kisunia." Large elongated seeds, mostly brownish, not mottled; other castor seeds of dark brown colour also present.

No. 4. "Mjakiru." Large, mottled seeds, very dark brown to black in colour.

No. 5. "Mjbri." Small, mottled, dark brown seeds.

* *The present value of Bombay castor seed is £12 5s. per ton (February 1911).*

No. 6. "Nakinene." Small, dark brown, mottled seeds.

No. 7. "Njegegeg." Small, dark brown, mottled seeds.

No. 8. "Karungu." Very small, greyish-brown, mottled seeds.

No. 9. "Grown on the Uasin-Gishu plateau." Large, dark purple-brown seeds, not mottled.

Commercial Valuation.

The samples were too small for chemical examination, but specimens were submitted to commercial experts, who valued them as follows:—

Nos. 1, 3, 4 and 6 .	£9 17*s.* 6*d.*	per ton	(March 1909)
Nos. 5 and 7 . .	£9 10*s.* 0*d.*	"	"
No. 2 . . .	£9 0*s.* 0*d.*	"	
No. 8 . . .	£8 10*s.* 0*d.*	"	"
No. 9 . . .	£13 5*s.* 0*d.*	"	(October 1910)

net weight including bags, delivered free *ex ship* Hull, less 2½ per cent. discount.

The prices quoted for all the samples were based on the current market value of East Indian castor seed, which was quoted at £9 to £9 5*s.* per ton in March 1909, and at £13 5*s.* per ton in October 1910.

It will be seen that these valuations are very satisfactory, the prices quoted for the majority of the samples being in advance of the current value of East Indian castor seed. Very large quantities of castor seed are said to be available in the East Africa Protectorate.

RHODESIA.

Eight samples of castor seed grown near Salisbury, Southern Rhodesia, were forwarded for examination to the Imperial Institute in August 1906.

The following table gives a description of the samples and the yield of oil in each case:—

	Yield of oil. Per cent.
No. 1. Large clean seeds, almost black . .	47·7
No. 2. Large clean seeds, black and white striped	49·6
No. 3. Large clean seeds, light brown . .	50·0
No. 4. Smaller seeds, clean, mixed colour . .	46·8
No. 5. Large clean seeds, light grey or almost white	41·6

Specific gravity at 15·5°/15·5° C.	0·959
Acid value *	1·2
Acid value (*calculated as oleic acid*) per cent. .	0·6
Saponification value *	179·6
Iodine value per cent.	87·0

One part of the castor oil was found to dissolve in 5 parts of 90 per cent. alcohol to form a clear solution. These results indicated that the product was of good quality, although its value was diminished on account of its turbid condition. If rendered clear by filtration, its value in the opinion of commercial experts would be about £26 to £28 per ton (October 1905).

CEYLON.

In Ceylon the castor plant occurs as a weed in many places, and its cultivation is confined mainly to native compounds. Some experiments undertaken in the Royal Botanic Gardens, Peradeniya, have shown that its cultivation in that locality would be unremunerative although it might be made to pay in other parts of the Island. For these experiments seeds were obtained from Calcutta, Madras, Colombo and Hakgala. Samples of the seeds grown were forwarded to the Imperial Institute for examination and valuation, and were reported on as follows:—

No. 1. Madras variety, marked "4 *E.S.*"—The sample was of good quality but had a somewhat large proportion of small seeds. It was about equal in value to that imported from Bombay.

No. 2. Patna variety, marked "6 *E.S.*"—These seeds were rather larger than those of the preceding sample. The commercial experts reported that they were of good quality and worth 1*s.* 3*d.* to 2*s.* 6*d.* per ton more than Bombay seed.

No. 3. Calcutta variety, marked "2 *E.S.*"—This sample was of fair quality, but contained a large proportion of seeds which were discoloured and possessed withered kernels. It was valued at from 2*s.* 6*d.* to 5*s.* per ton more than Bombay seed.

No. 4. Major variety, marked "8 *E.S.*"—These seeds were of large size, but were considered by experts to be immature, since the kernels were soft and pulpy and did not fill the husks. The ripe seeds would no doubt contain a larger proportion of oil than the present sample, and if in good, sound condition would be worth 7*s.* 6*d.* per ton more than Bombay seed.

* *Milligrams of potash for 1 gram of oil.*

FIJI.

Samples of castor seed grown in Fiji have also been received at the Imperial Institute for examination. Information as to the yield of oil obtained from these samples, and their commercial valuation, was published in this *Bulletin* (1909, **7.** 272).

PREPARATION OF CASTOR OIL.

Large quantities of castor oil are prepared in India by crude native methods of expression as well as by modern machinery. In the United Kingdom the greater part of the castor seed imported is crushed at Hull, and in France at Marseilles, the methods of obtaining the oil being similar to those employed for other oil seeds (this *Bulletin*, 1910, **8.** 168).

For the finer grades of castor oil, such as that required for medicinal use, selected seed is taken, the husk, which is devoid of oil and comprises about 20 per cent. of the weight of the seed, is removed, and the soft kernels are expressed in the cold; by this means an almost colourless oil is obtained, which is free from the poisonous principle, ricin, present in the seeds. This is termed "cold drawn" oil. The remaining cake is then broken up and pressed a second, or even a third time, when it yields an inferior oil of yellowish or brownish colour unfit for medicinal use. The last traces of oil can be extracted by solvents, carbon disulphide or alcohol being used instead of light petroleum on account of the insolubility of castor oil in light petroleum.

Inferior seed is hot pressed directly or is extracted by solvents alone. After expression the oil is refined by steaming, which causes coagulation of albuminous matter and renders inert the fat-splitting enzyme which, if left in the oil, would cause it to rapidly turn rancid.

Castor seed of commerce contains from 46 to 53 per cent. of oil, and Lewkowitsch states that on a manufacturing scale about 40 per cent is obtained by expression, the first pressing yielding about 33 per cent.

CHARACTERS OF CASTOR OIL.

Refined castor oil is an almost colourless viscous liquid, which has the following constants (Lewkowitsch, *Oils, Fats and Waxes*, vol. ii., p. 327) :—

Specific gravity at 15·5°/15·5° C.	0·959–0·969
Saponification value	176·7–186·6
Iodine value, per cent.	81·4–90·6
Reichert-Meissl value	1·1
Acetyl value	150·0

It differs from all known vegetable oils in having a higher specific gravity, viscosity and acetyl value. It is readily soluble in alcohol and almost insoluble in light petroleum, the reverse being the case with the other vegetable oils. Castor oil consists principally of ricinolein, the glyceride of ricinoleic acid, of which about 82 per cent. must be present, as calculated from the acetyl value, together with small quantities of the glycerides of stearic and dihydroxystearic acids. The abnormal properties of the oil are due to the high percentage of ricinolein, which does not appear to occur in other oils to any considerable extent.

USES OF CASTOR OIL.

The pure "cold drawn" oil is largely employed in medicine as a purgative, its action being due to the ricinoleic acid. Numerous dry preparations are now made in which the taste of the oil is masked by various means. In one method (German Patent 150,554) the oil is mixed with milk and evaporated until a dry powder is obtained. In another (German Patent 152,596) it is mixed with casein salts and milk sugar; whilst another preparation is manufactured by emulsifying the oil with gum arabic and treating with magnesia and lecithin.

Castor oil is largely employed as a lubricant in India, but is rather too viscous to be used in this way in cold climates, although it is used for marine engines and for internal combustion (petrol) engines. It is employed for dressing leather belting, and for "fat liquoring" in the leather industry.

An important application is in the manufacture of "turkey red" oil, largely used in alizarin dyeing. This is prepared by treating the oil with concentrated sulphuric acid at a temperature below 35° C. This "sulphonated" oil is washed, and ammonia or soda added until a sample of the liquid gives a clear solution in water. The use of turkey-red oil improves the lustre of the dye, but the reason for this action is not clearly understood.

As stated above, castor oil is insoluble in light petroleum or hydrocarbon (mineral) oils, but by heating to about 300° C. for several hours, either at atmospheric pressure or under increased pressure, the oil polymerises and becomes soluble in hydrocarbon oils, and can then be used for making compound lubricating oils.

Castor oil is also employed in the manufacture of so-called "rubber substitutes." These are prepared by treating the oil with sulphur at an elevated temperature, or by treating a solution of the oil with sulphur chloride at ordinary temperatures. The "soda soap" of castor oil requires large quantities of brine for salting out, and consequently the oil is not employed alone for soapmaking to any extent; it has, however, the property of imparting transparency to soaps, and is consequently employed in the manufacture of transparent soaps.

A less important use of castor oil is the production of "cognac" oil. For this purpose castor oil is submitted to dry distillation, when a mixture of œnanthaldehyde and undecylenic acid, constituting the "cognac oil," pass over, a bulky rubber-like mass remaining in the retort.

UTILISATION OF CASTOR SEED CAKE OR MEAL.

Castor seed contains a remarkable ferment or enzyme, which has the property of splitting oils into glycerine and free fatty acid. The decomposition of oils into these two substances is strictly parallel with what occurs in the first stage of soap manufacture, and consequently the industrial application of the enzyme in soap manufacture has been tried. The first method of working experimented with, was to allow ground-up castor seed to act on the oil or fat, previously emulsified with water, containing a small amount of acetic acid or a neutral or acid salt. This method has, however, been abandoned, because of the difficulty of separating the fatty acids and glycerol, owing to the presence of vegetable tissue, etc., and the following method has now been adopted :—

A quantity of decorticated castor seed is ground up with water and the mixture strained. The white liquid so obtained is allowed to ferment spontaneously, when a thick emulsion rises to the top. This consists of about 38 per cent. of fatty acids, 58 per cent. of water and 4 per. cent. of albuminoid substance, the latter containing the fat-splitting enzyme. About 5 to 8 per cent. by weight of this cream-like emulsion is allowed to act on the oil, emulsified with 40 per cent. by weight of water, and 0·2 per cent. of manganese sulphate, for one or more days. When sufficient hydrolysis has taken place, the mixture is heated by steam to 80° or 85° and about 0·4 per cent. of sulphuric acid of 50 per cent. strength is added. On standing, the mixture separates into three layers: on the top fatty acids (which after separation are converted into soap by adding alkali); at the bottom, water and glycerine; in the middle, an emulsion of albuminoid matter, water, glycerine and oil. The middle layer is allowed to accumulate from several operations, and can then be separated into its constituents by further treatment. The ferment is destroyed if heated above 42° in contact with water, hence this method of hydrolysis is unsuitable for tallow or other fat of melting-point above 35° C.

The chief advantage of the "ferment" process of hydrolysis is that the fatty acids obtained are of pale colour.

Castor seed also contains a toxic albumose, named ricin, and consequently castor seed cake, which forms the residue left on expressing the oil, cannot be used for cattle feeding unless this substance is removed or rendered inert. Processes have been devised for removing the ricin, by dissolving it out of the castor cake with 10 per cent. salt solution, or of rendering it inert by steaming, which coagulates the albumose. Lewkowitsch states, however, that no castor cake is yet used for feeding cattle. A process has been reported (*Indian Trade Journal*, 1908, **9**, 309; 1909, **11**, 273) in which extraction of oil and destruction of the toxic substance are effected in one operation. The decorticated seed is ground up with water to a cream and poured into boiling water. By this means the albuminoid matter is coagulated, and separates together with the oil. The solid matter is strained off, dried on steam-heated plates, and part of the oil expressed in hydraulic presses; the remainder being then extracted with solvents, leaving a meal very rich in protein. The oil so obtained is said to be of good quality, pale in colour and free from fatty acid or proteid matter. The results of analysis of a sample of meal, prepared by this method, are included in the table of analyses given on next page (fifth column in table).

	Castor pomace.	Castor seed cake from		Castor seed meal	
		Whole seed.	Decorticated seed.	Extracted by solvents.	Special process.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture . .	12·31	9·85	10·38	—	9·2
Ash . . .	6·08	15·02	10·50	8·55	7·3
Oil . . .	24·32	5·25	8·75	1·17	2·6
Protein . .	21·91	20·44	46·37	34·00	71·7
Crude fibre and carbohydrates	35·38	49·44	24·00	41·00 / 15·27	5·0 / 4·2
Phosphoric acid .	—	1·62	2·26	—	—

It will be seen that the composition of the material varies very much, depending on (1) the extent to which extraction of the oil has been carried, (2) the use of (*a*) whole seeds, or (*b*) kernels (decorticated seed) for expression.

Castor cake or meal is largely employed as a manure, the large quantities produced in Marseilles being employed by growers of early vegetables.

In India the residue from the native method of preparing the oil, castor "pomace" (see table) contains a higher percentage of oil than that produced by expression in hydraulic machinery or by extraction with solvents, and is employed largely in India for manuring, and to a smaller extent for stuffing the soles of native-made shoes, for caulking timber, as fuel, and for making illuminating gas.

UTILISATION OF PARA RUBBER SEED.

REFERENCE has been made previously in this *Bulletin* to the fact that the kernels of these seeds contain about 42 per cent. of a liquid drying oil very similar in properties to linseed oil and capable like that oil of being used in the manufacture of paints and varnishes, rubber substitutes, oil cloth, soft soap and other important industrial products (this *Bulletin*, 1903, **1.** 156; 1904, **2.** 22; 1909, **7.** 95). Since these kernels were first investigated at the Imperial Institute in 1902–3, small consignments have been received from time to time in London and sold as oil seeds, but there has been no large development of this trade, mainly because the demand for seed for planting has been so large as to preclude the collection of seed for industrial use, and, further, the profits from sales of rubber on developed estates have been so large in recent years that little or no attention has been given to the utilisation of by-products. Now, however, when the area of productive Para rubber plantations is increasing rapidly every year, it seems likely that this indifference to the possibility of using these kernels will disappear, and already the expression of oil from the kernels has been undertaken at one or more mills in the East Indies.

It is opportune, therefore, to call attention to several practical difficulties which may occur in dealing with these kernels, and to methods of overcoming them.

Considerable difference of opinion exists as to the cost of collecting Para rubber seeds. The late Mr. Carruthers, in his report as Director of Agriculture for the Federated Malay States in 1908, estimated that 1,000 seeds could be collected there for 4 cents (1·1*d.*), and that 414,400 seeds would be needed to produce 1 ton of kernels. From these data he calculated that the cost of collecting and shelling 1 ton of kernels would be $21·14 ($1 = 2*s.* 4*d.*).

This estimate is considered far too low by Messrs. Macmillan and Petch (*Journ. d'Agric. Trop.*, 1910, **10**. 284, and *Circulars and Agr. Journ. Roy. Bot. Gard. Ceylon*, 1908, **4**. 90), who point out that in Ceylon the cost of collecting 1,000 seeds is 4*d.*, and that Mr. Carruthers' estimate of the number of seeds required to produce 1 ton of kernels is based on the weight of seeds from untapped trees. It has been shown in Ceylon that seeds from tapped trees are smaller and lighter than those from untapped trees, and Messrs. Macmillan and Petch estimate that from tapped trees, at least 700,000 seeds would be needed to produce 1 ton of kernels. Accepting their data, the cost of collecting sufficient seed to produce 1 ton of kernels would be £11 13*s.* 4*d.*, which is certainly a prohibitive price so far as the export of these kernels as an oil seed is concerned. It should be pointed out that Messrs. Macmillan and Petch's criticism of Mr. Carruthers' estimate is mainly directed to the question of the quantity of seeds required to produce 1 ton of kernels, whereas the principal difference between the two estimates lies in the cost of collection, which appears to be nearly four times as great in Ceylon as in the Federated Malay States. In this connection it may be

In determining the value of an oil seed the amount of oil present is the factor of prime importance, but much also depends on the nature of the cake left after expression of the oil. If this contains no deleterious ingredients and is rich in nutritive materials and poor in indigestible fibre, it can be used as a feeding-stuff for cattle, but if deleterious ingredients are present the material can, as a rule, only be employed as a manure. Unfortunately Para rubber seed kernels contain a cyanogenetic glucoside and an enzyme which decomposes this in presence of water, yielding prussic acid, as one product. This, however, is also true of linseed cake, perhaps the most popular feeding stuff with farmers in this country at the present time, so that, as has been pointed out already in this *Bulletin* (1905, **3**. 373; 1908, **6**. 210), the mere production of small quantities of prussic acid affords no ground for suggesting that cake from Para rubber seed kernels will be unsuitable for feeding cattle. It is, however, of the greatest importance to determine as soon as possible what the average maximum yield of prussic acid from cake made from these kernels under industrial conditions is, and if this proves to be no larger than that obtained from linseed cake on the average, it may be assumed that the cake is worth trial as a feeding-stuff. With all new feeding-stuffs it is desirable that extensive preliminary feeding trials should be made before the material is placed on the market, and even should Para rubber seed cake prove to yield less prussic acid than average linseed cake, it will still be indispensable that preliminary feeding trials should be made with it.

Recently a detailed examination of Para rubber seed oil has been made by Dr. S. S. Pickles in the Scientific and Technical Department of the Imperial Institute, and the results will be published shortly. The results show that the oil consists of a mixture of glycerides of linolenic, linoleic, oleic, and stearic acids, with possibly some palmitic acid.

The proportion of unsaturated acids present is lower than in linseed oil, as was to be expected from the slower "drying" character shown by Para rubber seed oil.

GUANO DEPOSITS OF ASSUMPTION ISLAND, SEYCHELLES.

AN important report on the guano deposits of the Island of Assumption was forwarded recently to the Colonial Office by the Governor of the Seychelles. The report was prepared by Mr. R. Dupont, Curator of the Botanic Station in the Seychelles, and as it contains much information of general interest, the following summary of its principal contents is now published with the permission of the Secretary of State for the Colonies.

Assumption is a coral island of the Aldabra group in the Seychelles. It is crescentic in shape, the convex side facing the south-east. Its total area amounts to about 2,700 acres. The island is higher on the west side than on the east, much of the eastern portion being nearly level with the sea at spring tide. It is largely covered with scrubby vegetation, but the monotonous effect is relieved to a considerable extent by coconut and mapon (*Pisonia macrophylla*) trees and bushes of bois d'amande (*Pemphis acidula*).

The surface is undulating in form, the ridges running along the length of the island. Natural pits and crevices abound, as is usually the case on coral islands, due in large part to the irregular growth of the coral masses of which the island is built up. Old pits are, however, being gradually enlarged, and new ones arising, by the solvent action of rain-water.

THE GUANO DEPOSITS.

As in the case of many other islands in this archipelago, and indeed in those of the Indian and Pacific oceans generally, the Island of Assumption contains extensive deposits of guano, which have accumulated as a product of bird-life on the island during many centuries prior to human occupation. Birds are, in fact, still numerous, in spite of disturbances due to human activity.

Originally deposited, for the most part, on the general surface of the island, the guano tends to accumulate in the pits and hollows, into which it is washed by the rain water. In this way the pits become gradually filled with guano. Further, the action of percolating water on the guano in the pits concentrates it, by removing much of the organic matter, and increasing the proportion of phosphate of lime. In consequence of this the pit-guano is usually of much richer quality than the ordinary surface-guano.

During rainy weather, carbonate of lime with a little phosphate circulates in solution, cementing the coral fragments which lie on the surface. The solutions circulating in the pits are rich in phosphatic matter, and tend to phosphatise the lumps of coral which fall into the pits. This process of phosphatisation of the coral limestone is slow and gradual, but ultimately complete. Lumps of coral showing natural shapes can be collected from the pits in all stages of phosphatisation.

Extent.

In estimating the extent of the deposits, two chief modes of occurrence have to be recognised: (1) in pits, (2) a shallower formation on the general surface. In addition to these, however, there are a number of hollows on the surface, in which the guano can be classed as intermediate in character between the pit-guano and the surface-guano.

The pits are very unevenly distributed, and are variable in shape and depth. In some of them water occurs at a depth of 2 feet, in others at 12 feet. The nature of the ground gives an indication of the probable depth of the pit, as the undulations of the surface can be readily followed. The pits found on the highest ridges are the deepest.

The quantity of guano found in any particular pit may be as much as 500 tons, whilst the same quantity of surface-guano is spread over an area of from 1 to 10 acres, according to the presence or absence of hollows. The whole island has been examined to ascertain the extent of the deposits. For this purpose the area was divided into sections varying in extent from half an acre to 10 acres, according to the importance of the deposits. The capacity of the pits was measured by digging a hole through the centre down to the water-level, and multiplying this distance by the surface length and breadth of the pit in each case. In this way it has been estimated that the total amount of pit-guano available is about 106,000 tons.

The amount of surface-guano available was estimated at 100 tons per acre, *i.e.* 270,000 tons for the whole island. This surface-guano is still in course of formation by birds, which are very abundant during the breeding season.

Nature and Composition of the Pit-Guano.

The pit-guano of the island is stated to be of the best quality. It is fairly uniform in composition, carrying a high percentage of calcium phosphate, and only small amounts of iron oxide, alumina, and limestone impurity. Its density averages about 1·15 in the bulk, and a ton occupies a volume of about 31 cubic feet.

Seven analyses of the guano found at one locality in seven different pits gave the following average result; the large amount of water present is attributed to the fact that the samples were collected and analysed after a shower of rain:—

	Per cent.
Calcium phosphate	61·04
Moisture	19·57
Iron oxide and alumina . . .	3·67

The average percentage of iron oxide and alumina together, found in the course of 125 analyses of pit-guano, was 3·5. In many pits there is less than 1 per cent. of iron oxide and alumina; and though in some others the amount exceeds 3 per cent., the above average indicates that, by mixing the best guanos with those containing more than 3 per cent., the mixtures obtained are likely to contain not more than about 3 per cent., which is the maximum allowed by European trade conventions.

It is found that the presence of iron cannot be positively ascertained from the colour of the guano, as in some cases the guano may be at the same time whitish in appearance and very ferruginous.

The amount of carbonate of lime in pit-guano seldom exceeds 4 per cent., which is well below the 10 per cent. allowed in trade.

The presence of iron oxide and alumina is an objectionable feature when the amount reaches 8 or 10 per cent., as is the case in some of the Aldabra guano, owing to the fact that, in the manufacture of superphosphate, the soluble phosphate formed by addition of sulphuric acid assumes an insoluble form in the presence of iron and alumina.

If, however, as seems not unlikely, much of the Assumption guano proved to carry rather more iron oxide and alumina than strict trade conventions permit for making superphosphate, there is no reason why it should not be exported for use as manure without conversion into superphosphate, since it is rich in phosphates. Moreover, the phosphate in its natural state is in a form in which it is largely available for plant nutrition, and it is therefore not always converted into superphosphate, but is often used for the manufacture of "soluble guano," or is used in its natural state, after grinding, as a soil fertiliser. Hence the ordinary restrictions of the market with regard to the percentage of iron oxide and alumina are now less prohibitive than they were formerly when the manufacturers of superphosphates were the sole buyers of this type of guano.

Nature and Composition of the Surface-Guano.

The surface-guano is much more variable in composition than the pit-guano. The percentage of iron oxide and alumina in the surface material is much the same as that found in the guano of adjacent pits, but it is otherwise as regards the amount of calcium carbonate, which is frequently present in excess in the surface guano.

The nature of the rocky substratum has naturally an important bearing on the composition of the surface-guano. If the substratum is compact, the guano is kept *in situ*, and ultimately becomes concentrated to such an extent that it is equal in quality to the best pit-guano. On the other hand, when the substratum of rock is friable, or is formed of coral sand, which is easily dug up by the birds when in search of food, the surface-guano may contain a large amount of calcium carbonate.

In the northern portion of the island there is a flat, about 35 acres in extent, on which guano has accumulated in layers to the extent of about 10,000 tons. In some places, calcareous sand has been washed up by the sea in heavy gales and mingled with the surface-guano. In the older beds of this mingled coral sand and guano, the calcareous matter has become transformed into phosphate, yielding a rich deposit. In other places, where the mingled sand and guano is of recent formation, the deposit contains too much calcium carbonate to be worth exploiting.

The following analyses of two samples, one taken from an old deposit and the other from one of recent formation, on the northern flat referred to above, show the variability in the amount of calcium carbonate to which these surface-guanos are liable:—

	Older bed. *Per cent.*	Newer bed. *Per cent.*
Calcium phosphate	72·83	8·94
Iron oxide and alumina	0·60	0·50
Calcium carbonate	1·20	60·00
Moisture	8·70	10·00

Utilisation of the Deposits.

Mr. Dupont recommends that the pit-guano alone should be utilised at present, in view of its generally better quality, though the surface-guano might also be worked at a few points where the substratum is hard and is not likely to be mixed with the guano.

There is a convenient anchorage at the northern end of the island, where ships can lie within 300 yards of the shore without risk, but at this place the sea is too rough to permit of loading during the north-west monsoon; so that export of guano will probably only be feasible from May to December, when south-east winds prevail. Secure anchorage can also be obtained on the west coast. There would appear to be no difficulty therefore in dealing with the most important deposits of guano, which are located at the extreme north and in the south-south-west of the island. For the exploitation of the remaining deposits it is considered likely that a movable railway will have to be laid down to reach these in succession; and the working will have to be arranged as already indicated, so that the guano extracted may be mixed to contain on the average not more than 3 per cent. of iron oxide and alumina.

It is estimated that 46,000 tons of this high-grade guano suitable for export to Europe could be obtained; and about 50,000 tons of low-grade guano, which could not be exported to Europe at a profit under present conditions. The deposits at the north end of the island are already being worked; and up to August 1, 1910, about 7,500 tons of high-grade phosphate, not included in the estimate given above, had been exported. The right to collect guano in Assumption Island and in the other islands of the Aldabra group is held by a lessee under a lease which expires in 1931.

PREPARATION OF CALCIUM CYANAMIDE AND ITS USES AS A MANURIAL AGENT.

PART I.

IN almost every part of the world where agriculture is an important industry, attention is at present being given to the question of obtaining increased yields of agricultural products. For this purpose researches are being made in several different directions. In the first place, investigation is being vigorously prosecuted towards the breeding of strains of plants, which will give higher yields of staple products than are obtainable from existing varieties, and such work has already given excellent results in the production of more prolific strains of wheat, cotton, and other agricultural products. In this branch of work may also be included the experiments designed to produce disease-resistant crops, since the ultimate object is to avoid loss of produce as the result of disease. In this category also must be included the attempts now being made, often with marked success, to breed plants which will ripen and bear crops under adverse climatic conditions, since in this way it is possible to bring into cultivation land formerly regarded as useless for this purpose.

Concurrently with these important investigations attention is being given to the question of how to prevent the fall in productivity of land which has been long under cultivation. This is

	Annual capacity. *Tons.*		Annual capacity. *Tons.*
Piano d'Orta	5,000	Notre Dame de Briançon	3,750
Westeregeln	5,000	Ontario	5,000
Odda	12,000	Kinru	4,000
Knapsack	5,000	Terni	4,000
Bromberg	3,000	Sebenico	4,000
Martigny	3,750	Total	54,500

The works to be completed early in 1911 include those at Trosberg (12,500 tons) and St. Marcel (3,000 tons), whilst by the end of that year those at Almissa (4,000 tons) and at Marble-rocks near Nerbudda, Central Provinces, India (4,000 tons), are to be ready.

Manufacture of Calcium Cyanamide.

This is usually accomplished in two stages, (1) the production of calcium carbide by the interaction, in the electric furnace, of anthracite and lime, (2) the formation of calcium cyanamide from the carbide by heating the finely-powdered material in a current of pure nitrogen. The manufacture of calcium carbide is too well known to need any description. The carbide, after cooling during 8 to 12 hours, is ground to a fine powder in ball mills, and then charged into retorts, which can be uniformly heated electrically, by means of central carbon resistances, to a temperature of 800° to 1000° C. The carbide powder is charged into each retort to the extent of about 300 kilograms. The lids of the retorts are made air-tight, nitrogen under pressure is admitted and the retorts maintained at the required temperature for about 45 hours, the pressure of nitrogen being maintained throughout the operation. The cyanamide thus produced, after being allowed to cool in an inactive atmosphere, is finally ground and is then ready for sale. According to recent investigations the absorption of nitrogen by the carbide is much facilitated by the presence of some salt of calcium not containing oxygen. Thus a mixture of 77 per cent. of calcium carbide with 23 per cent. of calcium chloride absorbs nitrogen at 700° to 750° C., and such a mixture is in use. The objection to this addition is the fact that the final product containing calcium chloride is hygroscopic. It is necessary that the nitrogen employed should be of a high degree of purity, and to attain this, atmospheric air is subjected to either the "Linde" or the "copper" process for the removal of oxygen. The "Linde" process depends upon the fact that liquid nitrogen boils at $-196°$ C. and liquid oxygen at $-185°$ C. The air is drawn through two towers, down which soda liquor is allowed to trickle in order to remove the carbonic acid, and is next compressed under 4 atmospheres pressure (57 lb. per square inch) and cooled by passing through pipes, around which flows cold oxygen from later stages in the process. The compressed cooled air passes to an ammonia cooler where its temperature is further reduced to $-20°$ C., whereby the remainder of the moisture is removed, then through coils cooled by gas slightly above the boiling-point of liquid nitrogen, and finally through coils in a tank of liquid oxygen, which liquefies the air, as it is still under pressure. The liquefied air is next allowed to expand through a throttle valve to atmospheric pressure, and the liquid thus produced is led into the top of a rectifying column where the oxygen is condensed and practically pure nitrogen gas passes over to the compressors. The alternative, "copper" method consists in passing air over heated metallic copper, which combines with the oxygen, leaving the nitrogen free. The copper oxide produced can be reconverted to the metal by heating in coal gas.

Processes have been patented and tried for the production of calcium cyanamide from lime, coke and nitrogen in one stage, thus omitting the cooling and grinding of the calcium carbide. It has been found, however, that the conversion of the calcium carbide to calcium cyanamide is more efficient and rapid if the calcium carbide is finely ground before being submitted to the action of nitrogen. It is stated that some of the works producing calcium cyanamide are installing plant for the conversion of part of their product into sulphate of ammonia by treating it with superheated steam and then absorbing the ammonia thus produced in sulphuric acid. (*Met. and Chem. Eng.*, 1910, 8. 287.)

An American estimate of the cost of plant necessary for the production of 10,000 tons of cyanamide per annum is £92,500. This estimate assumes that the necessary power is obtained from a subsidiary company. If power can be obtained at about 2*s.* 7*d.* per H.P. per annum, the cost of production is, including interest on the capital outlay, estimated at £9 per metric ton. From the above details it is evident that in order to manufacture calcium cyanamide to compete with other nitrogenous manures, cheap water power for the production of electricity is an essential factor, as in the fixation of 1 ton of nitrogen 2 kilo-watt-years of power are consumed.

Composition of Calcium Cyanamide.

The product offered for sale in Europe contains from 57 to 63 per cent. of cyanamide and a large quantity of free lime. A sample examined by Voelcker in this country gave the following percentage results (*Mark Lane Express*, 1909, p. 59):—

	Per cent.		*Per cent.*
Calcium cyanamide	58·91*	Ferric oxide and alumina	2·44
Free lime	23·55	Silica	2·19
Magnesia	0·05	Free carbon	12·86

The products now on the market are stated to be free from carbide, which was not the case with the earlier products. In the United States calcium cyanamide is met with in several forms. Usually the product of the composition shown above is known as "nitrolime"; whilst a material obtained by subjecting this to special treatment, which includes hydration of the caustic lime, is sold as "improved cyanamide"; it has the following composition:—

	Per cent.		*Per cent.*
Calcium cyanamide	29·26	Alumina	1·37
Calcium carbonate	0·21	Ferric oxide	0·69
Calcium nitrate	20·06	Free carbon	7·89
Calcium hydroxide	28·78	Silica	1·03
Sodium cyanamide	10·38	Total nitrogen	17·01

Another form, which finds employment in the United States, is a product having the composition given above mixed with peat in order to reduce the "total nitrogen" to 10 per cent. This is used for compounding with wet manures, such as wet

* *Equivalent to* 20·62 *per cent. of nitrogen.*

acid phosphate, tankage, etc., and is known as "complete ammonia dryer."

It should be understood that these products are only in use in the United States to any extent, and the results of experimental trials given in this article refer to the use of raw cyanamide.

USE OF CALCIUM CYANAMIDE IN COMPLETE OR COMPOUNDED MANURES.

This is an important matter for farmers, as it is frequently necessary to use a phosphatic as well as a nitrogenous manure. When calcium cyanamide was first introduced it was frequently stated that it could not be mixed with superphosphate owing to its causing "reversion" of the phosphate and losing nitrogen; but experiments have shown that the quantity of nitrogen lost is of little importance provided that the weight of cyanamide present in the mixture is less than half the weight of superphosphate (*Journ. Board Agr.*, 1908, **14**. 652). Admixture of 1 part of calcium cyanamide with 10 parts of superphosphate results in the conversion of all the "water-soluble phosphoric acid" into "citrate-soluble," and of 1 part with 5 parts of superphosphate leads to the change of the whole of the phosphoric acid into dicalcium phosphate, which is soluble in citric acid. Experiments carried out with *Brassica chinensis*, at the Imperial College of Agriculture, Tokyo, indicate that calcium cyanamide is more effective when mixed with superphosphate than with a neutral phosphate, as the acid phosphate neutralises the ammonium carbonate produced in the soil.

A mixture of 1 part of cyanamide with 5 or 10 parts of superphosphate forms a good fertiliser for barley or turnips and can easily be made, if water is judiciously added at the time of mixing, in just sufficient quantity to slake the lime (Hall, *Fertilisers*, p. 41). Such a mixture with superphosphate does not cake, but remains quite loose and friable. In general, calcium cyanamide can be mixed with any manure with which it is customary to mix nitrogenous manures, *e.g.* potash salts, basic slag, superphosphate, etc.

It is also stated that mixtures, within certain limits, of this manure with nitrate of soda and acid phosphate do not lose nitrogen from the nitrate as would be the case in the absence of calcium cyanamide. This is accounted for by the fact that any nitric acid liberated from the nitrate of soda is immediately fixed by the free lime of the calcium cyanamide forming nitrate of lime.

With regard to the storage of this manure, experiments made at the Rothamsted Experimental Station have shown that, as it is now sent out, packed in double paper or jute sacks there is little loss of nitrogen due to the action of atmospheric moisture (*Journ. Board Agr.*, 1906, **13**. 216). Experiments carried out over a period of 10 weeks showed that, when stored in a shed in bags the gain in weight amounted to only 5 per cent. The quantity of calcium carbide found in the samples examined was below 0·1 per cent., showing that there was no danger of fire from the production of acetylene by the action of moisture on the unaltered carbide.

EFFECT OF CALCIUM CYANAMIDE ON SEED GERMINATION.

Numerous experiments have been carried out to test the effect of calcium cyanamide on seed germination. Those of Dr. Haselhoff of the Marburg Agricultural Experimental Station (*Landw. Jahrbuch*, vol. 34) showed that, as a general rule, seeds were injured by direct contact with calcium cyanamide, the effect varying with the time which had elapsed between the application of the manure and the sowing of the seed.

In a series of experiments carried out at the Aberdeen and North of Scotland College of Agriculture (*Bulletin*, No. **13**. p. 25) on turnips, the calcium cyanamide was applied at the time of sowing like sulphate of ammonia, and in no case was it observed to have any injurious effect on the young plants. As the turnip plant is easily injured during the early stages of growth the result seems to indicate that up to 1 cwt. per acre (the quantity applied in the case mentioned) no injury is likely to result from application of the manure at the time of sowing. In the case of grain there was no marked difference between the crops obtained when the cyanamide was applied with the seed or later on. It is also important to note that no injury to the young shoots could be detected on the plots that received cyanamide at the time of sowing.

It is possible that in some of the earlier pot cultures made to test the action of calcium cyanamide on seed, and which seemed to indicate that injury was caused, too large a quantity of the manure in proportion to the soil used was applied, as it has been found in the case of certain other fertilisers that too large a proportion is injurious to seed.

UTILISATION OF CALCIUM CYANAMIDE AS A MANURE.

The first change which takes place when cyanamide is placed in the soil is the slaking of the free lime and the formation of calcium carbonate by its combination with the carbon dioxide of the air. Various theories have been advanced as to the mode of decomposition of cyanamide in soil. It has been shown (F. Löhnis, *Centbl. Bakt.*, 1908, p. 323) that water converts calcium cyanamide into dicyanamide $(CN.NH_2)_2$, and that under favourable conditions the nitrogen is completely changed, by certain bacteria occurring in the soil, into ammonia. In sterile soils, however, this reaction does not occur to any appreciable extent (*Fühlings Landw. Ztg.*, 1908, **57**. 15).

A long series of experiments carried out by Olpiani (*C.R. Soc. Chim. Ital.*, 1910, p. 84) showed that urea is produced by the action of soil on cyanamide, and that in the second stage carbonate of ammonia is formed. That the absorptive power of the soil for moisture has an important bearing on the rapidity with which the calcium cyanamide becomes available for plant nutrition, has been shown by numerous experiments (*Landw. Vers. Stat.*, 1908, **68**. 301), soils of high absorptive power being the more active. The ammonia eventually liberated is fixed by the organic constituents of the soil, and is then slowly converted by nitrifying bacteria into nitrates.

(*To be continued.*)

GENERAL NOTES.

Chromite from Baluchistan.—In an article published in a recent number of this *Bulletin* (1910, **8**. 281) reference was made to the chromite mines in the Quetta-Pishin and Zhob districts of Baluchistan, whence much of the chromite exported from India is obtained. An analysis of a representative sample from a cargo of chromite from deposits near Hindubagh, in the Zhob district, has been supplied recently to the Imperial Institute, and is now published with a view to rendering more complete the account already given of these deposits. The analysis is as follows :—

		Per cent.
Chromium sesquioxide	Cr_2O_3	57·00
Ferrous oxide	FeO	13·20
Ferric oxide	Fe_2O_3	0·36
Manganese oxide	MnO	0·40
Alumina	Al_2O_3	9·80
Magnesia	MgO	16·57
Lime	CaO	*trace*
Phosphoric acid	P_2O_5	0·01
Sulphur	S	0·01
Silica	SiO_2	1·90
Water and carbon dioxide	H_2O and CO_2	0·30
Undetermined and loss		0·45

The mineral was free from copper, arsenic, zinc and nickel. Analyses of chromium ores from other localities have been given already (*loc. cit.*, p. 397).

Valuation of Natural Phosphates for Industrial Purposes.—A paper of considerable practical importance on this subject has been communicated recently to the Belgian Chemical Society by MM. Hardy and Vandormael, and is printed in the Society's *Bulletin* (1911, **25**. 43) for January of this year. Deposits of natural phosphates are now principally of importance as sources of raw material for the preparation of superphosphates to be used as manure. The constituent to which such natural phosphates owe their value is tricalcic phosphate, but other constituents are almost invariably present, and these may be merely diluents or actively disadvantageous, either in interfering with the preparation of superphosphates or in lowering the value of the product obtained by their deleterious qualities. The chief of these subsidiary constituents are water, calcium sulphate, silica (forming group 1), calcium carbonate, calcium fluoride magnesium carbonate (forming group 2), aluminium silicate, iron phosphate (forming group 3). The conversion of natural phosphates into superphosphates is brought about by heating the former with sulphuric acid, and theoretically the quantity of acid necessary should be merely that needed to convert tricalcic phosphate into calcium acid phosphate (superphosphate). In practice, however, it is found that this theoretical quantity of acid is never sufficient, and this is due, apart from inevitable losses in manufacture, to the presence of the impurities of groups 2 and 3, referred to above, these being all converted into the corresponding sulphates by the action of the sulphuric acid. The importance of MM. Hardy and Vandormael's paper lies in the fact that they show as the result of an elaborate

to 12*d.* per lb., when "good" rough Peruvian was quoted at 11·15*d.*, and "good" Egyptian Abassi at $14\frac{3}{8}$*d.* per lb.

Cascarilla Bark from the Bahamas.—Two small supplies of cascarilla bark were forwarded for examination to the Imperial Institute by the Governor of the Bahamas in June 1909. The samples were stated to have been collected on Acklin's Island.

No. 1 consisted of quills $\frac{3}{16}$ to $\frac{1}{4}$ inch in width, and from 2 to 3 inches in length, with a considerable quantity of smaller fragments. Most of the quills still showed the thin greyish outer layer, but in some cases it had wholly or partially disappeared. The inner surface of the bark was dark brown.

No. 2 closely resembled the first sample, but the quills were thinner and smaller, in some cases almost fibrous. Some very thin branches were also included.

On burning, both barks gave off the characteristic fragrant aroma of cascarilla.

The bark was submitted to commercial experts, who reported that the first sample was exceptionally clean, and would be worth 65*s.* or 66*s.* per cwt., while the second sample would be worth from 55*s.* to 57*s.* 6*d.* per cwt. (September, 1909). They pointed out, however, that in consequence of more plentiful supplies of cascarilla bark in the London market, these prices might not be quite realised at public sales.

In collecting cascarilla bark for export, great care should be taken to include only the bark of the true cascarilla tree (*Croton Eluteria*), and to avoid the inclusion of material from allied species of Croton.

The best prices are obtained for fairly large quills of bark from 2 to 4 inches long and $\frac{1}{3}$ to $\frac{1}{2}$ inch wide. The material should be as free as possible from pieces of twig.

The bark should be allowed to dry thoroughly before being packed for export. It is usually packed in bales containing about 1 to $1\frac{1}{2}$ cwt. each.

The Leather Industries of the Bombay Presidency.—A report on this subject has been made recently to the Bombay Government by Mr. A. Guthrie, as the result of a six months' investigation of leather manufactures in that Presidency. From this report the following particulars are taken :—

The raw material available for leather production in Bombay, as in the rest of India, consists chiefly of buffalo and cow hides, and the skins of sheep and goats with small quantities of camel, sámbhur and neilghai skins.

Lime is available in abundance in most parts of the Presidency, and the oils used for leather dressing are sesame, ground-nut or safflower, all of local origin.

The tanning materials used are *Acacia arabica* bark (babul), *Cassia* *auriculata* bark (turwar), myrobalans, *Zizyphus xylopyrus* fruits, *Terminalia tomentosa* bark, *Eugenia jambolana* bark, *Phyllanthus emblica* leaves, *Xylia dolabriformis* wood and bark, fruits of *Terminalia belerica*, pomegranate rind and flowers, mangrove bark (imported from Zanzibar).

The first three only of these materials are in common use throughout the Presidency, the others being used only in localities where the better materials are not readily available. *Cassia auriculata* bark is largely used for skins intended for export, since it furnishes a pale-coloured leather. The tendency of leather tanned with this material to darken in colour and deteriorate on keeping is partially counteracted by a final bath in myrobalans liquors before finishing off.

The methods in use by Bombay tanners for unhairing, tanning and finishing do not differ in the main from those in use elsewhere, except as regards the use of saline acid baths for unhairing skins and in some cases hides also. In this process the skins are put into a solution of brine along with materials which will produce acids by fermentation, such as the latex of *Calotropis gigantea* and flour made from durra grain.

The report gives detailed descriptions of the local variations of the general methods in use.

A good deal of the leather made is manufactured locally into footwear, môts (used for drawing water from wells for irrigation purposes), rollers for cotton gins, water bags and buckets, saddlery and harness, account book covers and miscellaneous articles.

A special chapter is devoted to discussing the social condition of the various classes of leather workers.

Among the recommendations made are the following:—

(1) An investigation of Indian tanning materials with a view to discovering materials more suitable for tanning leather for export than those now in use; (2) experiments in the cultivation of exotic tanning materials, such as sumac, valonia and quebracho; (3) rearrangement of octroi duties on hides and skins in Karachi; (4) formation of co-operative credit societies to assist needy leather workers; and (5) the teaching of the principles of leather manufacture in schools in the chief leather working districts. The report is illustrated with a number of reproductions of photographs of typical scenes connected with native leather industries.

RECENT PROGRESS IN AGRICULTURE AND THE DEVELOPMENT OF NATURAL RESOURCES.

In this Section of the Bulletin a Summary is given of the contents of the more important papers and reports, published during the preceding quarter, in so far as these relate to tropical agriculture and the utilisation of the natural resources of the Colonies, India and the Tropics generally.

AGRICULTURE.

GENERAL.

Leguminous Plants.—The question of the agricultural value of leguminous plants is discussed in *Bulletin* No. 24, *de la Station Agronomique, Mauritius.* A short description is first given of the tribes, Mimoseæ, Cæsalpineæ and Papilionaceæ and the principal species included in them, followed by a short historical account of the investigations on the fixation of atmospheric nitrogen, which culminated in the discovery by Hellriegel and Wilfarth that the nodules formed on the roots of leguminous plants are the means by which atmospheric nitrogen is fixed by species of this order. The information available on the mode of assimilation of atmospheric nitrogen and methods for the inoculation of sterile soils with the bacteria associated with leguminous plants is then summarised. Apart from their value in improving the fertility of soil and affording foodstuffs and fodders rich in proteins, many of the Leguminosæ yield economic products of value, including gums, tanning materials, dyewoods, timbers, oil seeds, etc., and the importance of this side of the matter is duly insisted on in the pamphlet. A detailed account is then given of the chief leguminous plants grown in Mauritius, with, in most cases, information as to the yield of seeds, fodder, etc., obtained from them with analyses of the various products. Among these plants are *Phaseolus lunatus*, ground-nut, *Pachyrhizus angulatus*, which furnishes starchy roots, hence its name of "Manioc pea," *Dolichos lablab*, sword bean, pigeon pea, indigo, haricot bean, *Crotalaria* spp., lentils, etc. Finally the relationship of all these plants to the soil and the feeding value of their seeds and hay where these are comestible, is discussed, and the pamphlet concludes with a short account of the chief insect pests attacking the Leguminosæ.

Permanent Pastures.—A summary of the principal results of agricultural work carried on in India during the year is given in *The Report of the Agricultural Research Institute and College, Pusa*, for 1909–10.

The permanent pasture experiments started in 1907 have been continued, the object being to determine the effect of different manurial dressings on the yield, quality and botanical composition of the herbage. The experiment has not been continued long enough to afford useful results, but, at present, the crop consists in the cold weather mainly of *Andropogon annulatus* with some *Cynodon Dactylon*, and in the rains some *Digitaria* (*Panicum*) and *Rottbœlia*. At the end of the rains the whole area is overgrown by *Saccharum spontaneum* and *Imperata arundinacea*, which in turn disappear entirely in the cold weather. Practically the only leguminous plants are *Medicago lupulina* and *Indigofera linifolia*, which are useless for haymaking. "Weeds" are a negligible quantity. Much attention is given to the subject of fodder production, and the manufacture of ensilage in silos of the American type is invariably successful, maize giving the most nutritious fodder when so prepared, though sorghum gives better yields.

Cross-fertilisation.—In "The Economic Significance of Natural Cross-fertilisation in India" (*Memoirs, Dept. Agric. Ind., Bot. Series*, 1910, **3**. No. 6), by Mr. A. Howard, Mrs. Howard and Mr. Abdur Rahman Khan, the extent to which cross-fertilisation occurs in some of the more important crops of India is discussed. The matter has been investigated by means of line cultures for crops of the three types, (*a*) with closed flowers (in which self-pollination is usual), (*b*) with open flowers, and (*c*) monœcious and diœcious crops. As regards wheat it is concluded that cross-pollination is rare in India except in hot, dry localities, such as the canal colonies of the Punjab. Cross-fertilisation was not observed in these experiments with barley, lentils, grain, or san hemp, but one case of a cross between purple and white-flowered peas was observed, and evidence of a considerable amount of crossing between varieties of *Lathyrus sativus* was obtained. All these plants belong to group (*a*).

From the method of cultivation adopted with tobacco, it is improbable that much cross-fertilisation occurs, but it has been found in these experiments that such natural crossing is the chief cause of the deterioration of desirable types, and it is pointed out that exotic tobacco seed is usually mixed, and that such seed should not be distributed to cultivators until the various types have been sorted out, and the best types isolated. When many varieties of tobacco are grown on an experimental farm the greatest care must be exercised to prevent intercrossing, if trustworthy data regarding the various types are to be obtained. A similar warning is given as regards cotton, linseed, and other crops with which experiments are now being carried on in India, and a summary of Fruwirth's results with the Indian opium poppy is given.

In the last section of the pamphlet the bearing of natural cross-fertilisation on the improvement of Indian crops is discussed, and it is pointed out that "line-breeding" (strains descended from single individuals obtained without interbreeding with other lines of descent), is especially applicable to plants with closed flowers, such as wheat and the pulses, and also to tobacco where uniformity in type is the foremost consideration. "Broad-breeding," *i. e.* the condition of descen found in natural species, it is considered is applicable to such crops as maize where vigour and yield are more important than uniformity. "Narrow-breeding" is defined as the "condition of descent found in carefully selected varieties, consisting of relatively small numbers of closely similar individuals interbreeding with each other to form a narrow network of descent," and it is considered that for such crops as cotton and the Brassica oil seeds the choice must be between broad and narrow breeding, since line-breeding might lead to loss of vigour, but to determine this, long-continued careful experiment is necessary.

Deterioration in a crop raised from exotic seed is frequently ascribed to climatic effects when it is really due to the splitting up of exotic hybrids into undesirable forms, or to crossing with local varieties, and it is suggested that failure to recognise this was the chief cause of the lack of success which attended the attempt to introduce Egyptian cotton into Texas.

Soils.—The *Report of the Agricultural Research Institute and College, Pusa*, for 1909–10, mentions that an investigation is in progress, into the cause of sterility in certain land in the Mainpuri District of the Central Provinces, India. The land is of the "black alkali" type, and in addition is highly impervious to water; moreover, the level of sub-soil water has risen considerably in recent years, and the first and second of these factors are at present being investigated.

According to the same report the Imperial Bacteriologist for India is investigating the occurrence and activity of bacteria at varying depths in soil, both as regards different species and their relationship to soil chemistry. Salts of magnesia have been found to inhibit nitrification entirely in Pusa soils when the latter are seeded into liquid media.

The chemical and mechanical analyses of 154 soils from numerous localities in New Zealand are given in the *Report of the Dominion Laboratory* for 1909. In cases where deficiency of plant food is commented upon, it is usually phosphoric acid that is lacking.

FOOD STUFFS.

Wheat.—For the decennial period ending in 1902 the average imports of wheat from India to the United Kingdom were 5 million cwt., whereas for the seven years ending 1909 they were 14 million cwt., and there is every reason to suppose they will go on increasing. In order that this trade should develop in a satisfactory manner it is essential that Indian producers should meet the requirements of British millers, which, briefly, are that the wheat exported should be free from dirt, other grains, immature and weevilled wheat, and that it should be uniform, dry, and free-milling. Further, it should produce a strong, stable flour of good colour. The whole process of milling has been so improved in recent years, and the United Kingdom is able to draw on so many countries for wheat supplies that there is a market here for almost any variety of wheat, but in spite of this there is a tendency to demand hard wheats yielding strong flours, and in most wheat-growing countries an effort is being made to breed wheats of this description, and attention is also being given to this subject in India (see this *Bulletin*, 1909, **7**. 419). In view of all these facts the publication of Sir J. Wilson's "Memorandum on Indian Wheat for the British Market" (*Bulletin* No. 20, *Agricultural Research Institute*, *Pusa*) is opportune. It gives a summary of the present position of this trade in its statistical, financial and technical aspects, and makes a number of suggestions to Indian producers and British millers as to steps which can be taken to encourage the use of Indian wheat in the United Kingdom.

The *Bulletin of Agricultural Statistics*, published by the International Institute of Agriculture at Rome, gives carefully compiled statistics of the various cereal crops of the world. On an average of five years (1904–1908) as regards yield of wheat, the United Kingdom and New Zealand produced 21 quintals per hectare, being surpassed only by Denmark with 27·8, Belgium with 23·7, and the Netherlands with 23·8.

The plan of having a small plot of clean ground set apart for seed production is recommended (*Milling*, 1911, **36**. 48), so that when well matured the farmer can select the best heads from the best plants in the plot for seed. Most of the grain in Canada is cut slightly on the green side of maturity, hence the advantage of this plan. The use of acid phosphate of calcium blended with flour in the form of a spray or powder in order to make it "stronger" is discussed in *Milling* (1911, **36**. 28), and also the various "flour improvers" that are in use.

Yeheb Nuts.—An account of these nuts was given in this *Bulletin* (1907, **5**. 19, and 1908, **6**. 207). Their composition points to their containing a remarkably perfect combination of food constituents. Two samples of the soil in which they grew have been analysed by Dr. Voelcker (*Kew Bulletin*, 1910, p. 398), and were found to be extremely poor sandy soils markedly deficient in humus and nitrogen. Seeds have been distributed to stations in the dry regions of India and elsewhere, in the hope that it may be possible to establish the plant in places where the nuts might form a source of food as they do among the Somalis.

Honey and Beeswax.—Lt.-Col. Moll gives an account in *Renseignements Coloniaux*, p. 395 (Supplement to *L'Afrique Française*, December 1910), of the methods of exploiting both wild and domestic honey and wax, practised by the natives in the neighbourhood of Lake Chad.

Sugar-cane.—The results of a long series of manurial trials carried out with sugar-cane are given in *Bulletin* No. 23, *de la Station Agronomique*, *Mauritius*. Details of the manures applied in each plot, and of the varieties of cane planted and the yields of sugars obtained are recorded in a series of tables, and in the last chapter the general conclusions which may be deduced from the results of the trials are summarised.

The best yields of cane were obtained with a complete manure composed of dried blood, sulphate of ammonia, sodium nitrate, superphosphate, phosphatised guano, and sulphate of potash; the next best with the same manure minus the first three constituents; the third best with the complete manure minus potash; the fourth when all the ingredients of the complete manure except superphosphate were applied, and the poorest on the unmanured plot. When richness of cane harvested is considered, the results are far less decisive, and do not permit of general conclusions being drawn with regard to the relative values of the different manures applied.

Cocoa.—An account of a series of experiments on the manuring of cocoa in Dominica is given in *Reports on the Botanic Station Experimental Plots and Agricultural School*, 1909–10. The plots have received the same treatment since 1902–3. On the average of 8 years all the manured plots did better than the unmanured, and the best results were obtained by mulching with grass and leaves. The same advantages are also shown in the average monetary gains from manuring the plots. It is stated that the results tend to show that the best returns are obtained by applications of plant food in a slowly available form, supplemented by liberal supplies of humus. The results of experiments on other plots are also recorded.

A well-illustrated paper by Rorer on "pod-rot," "canker" and "chupon-wilt" of cocoa caused by *Phytophthora* species is published in the *Bulletin of the Department of Agriculture, Trinidad* (1910, **9**. 79). Spraying and the cutting out of canker are recommended. It is considered unremunerative to attempt to gather and destroy all diseased pods as soon as disease is noticed.

Fodders.—A detailed table comparing the composition, digestibility, and feeding value of bran and tailings with that of seven other common cattle foods is given in *Milling* (1911, **36**. 136); it shows the economy of the use of bran when the cost per digested food unit is calculated. The need of selling bran by standards of quality is discussed in the same journal (1911, **36**. 2).

OIL-SEEDS, OILS, FATS AND WAXES.

Palm Oil.—Fickendey discusses (*Der Tropenpflanzer*, 1910, **14**. 566) the utilisation of palm oil as an edible fat. Freshly prepared palm oil is eaten by natives and by Europeans in West Africa, but although the orange colour can be removed by air-bleaching (see this *Bulletin*, 1909, **7**. 389) the high acidity of the oil when it reaches Europe renders it unsuitable for the preparation of edible fats for the European market.

Fickendey's experiments show that the acidity is principally due to the presence of a fat-splitting enzyme (lipase) in the fruit pulp, which causes production of fatty acids immediately the pulp is crushed for the preparation of oil. This enzyme can be rendered inactive by heating

preparation of olive oil). This oil contains much free fatty acid, which is neutralised and removed, the neutral oil being then employed in the preparation of lubricants. The oil differs from olive oil in containing olive kernel oil derived from the seed.

Soy Beans.—Owing to the increased demand for soy beans, and the occurrence of plague in China, which is likely to tend to a diminution of the export, attempts are being made to cultivate these beans in many countries. In Central Russia the districts of the Don and the south-west are said to be specially suited to their cultivation, which is extending there (*Les Matières Grasses*, 1911, **4.** 2093). Java seed planted in Ceylon is stated to be growing well, and further supplies for planting have been obtained from Japan (*Ceylon Observer*, 1911, **51.** 24). *Der Tropenpflanzer* (1910, **14.** 613) contains an article by Honcamp on the soy bean plant; this deals with the varieties, composition, and uses of soy beans, and also gives information on the composition and uses of soy bean oil, cake and hay.

Sugar-Cane Wax.—This wax occurs on the surface of the cane and can be recovered from the "filter dirt"—a waste product of sugar manufacture—by extraction of the fermented waste with light petroleum. The wax can be refined by means of fuller's earth, and could probably be used as a substitute for Carnauba wax, which it resembles. Wijnberg ("*The wax of the Sugar-cane and the Possibility of its Technical Production*") estimates the cost of production of refined wax at 2*d.* to 3*d.* per lb. Extraction of the wax is being commenced in Java, where it is calculated that more than 4,000 tons should be obtainable per annum. It is hoped that the value of the wax will be about that of Carnauba wax, which is at present worth from £6 15*s.* to £11 10*s.* per cwt. in London, according to quality.

Miscellaneous.—Menon has published analyses of oils derived from a number of Indian seeds, together with notes on the occurrence of the seeds, and the preparation and uses of the oil. The species dealt with are *Bassia* spp., *Payena oleifera*, *Jatropha glandulifera*, *Luffa acutangula*, *Mimusops Elengi*, *Pithecolobium dulce*, *Psoralea corylifolia* (the seeds of which are said to have been imported to the United Kingdom as "Bawchan" seed), *Sapindus trifoliatus*, *Thespesia populnea* and *Vernonia anthelmintica* (*Journ. Soc. Chem. Ind.*, 1910, **29.** 1428).

Lewkowitsch (*Les Matières Grasses*, 1910, **3.** 2028) publishes an analysis of "Apeiba" oil derived from the seeds of *Apeiba Timbourbou*, a tree somewhat resembling the horse-chestnut and known in Nicaragua as "Burillo." The oil differs in its chemical constants from all known oils, but appears to resemble coconut oil in some respects, although it has a higher iodine value.

The occurrence in Madagascar of a species of *Jatropha*, yielding an oil used by the natives, is noted by Jumelle and Perrier de la Bathie (*loc. cit.* 2033). The species appears to be a new one and is provisionally named *J. mahafalensis.*

The *Chem. Rev. Fett. u. Harz. Ind.* (1910, **17**. 233) gives the results of examination by Grimme of several new oils, among which may be mentioned these derived from seeds of *Virola guatemalensis*, *V. venezuelensis* and *Attalea* sp.

Cases of poisoning are stated to have occurred recently in Germany through the consumption of a vegetable butter. The cause of poisoning is alleged to be the presence of a fat sold to the manufacturers as "cardamom" fat, but which appears to have been derived from "Marotti" seed, probably obtained from a species of *Hydnocarpus*, certain species of which are known to yield poisonous fat (*Les Matières Grasses*, 1911, **4**. 2111).

"Senat" seed, derived from *Cucumis melo*, var. *agrestis*, is a new oil seed, the export of which from the Sudan amounted in 1910 to 110 tons. It is fairly abundant in Kordofan, but the natives are as yet unaware how to utilise it. A sample of the seed is now under investigation in the Scientific and Technical Department of the Imperial Institute (*Report of Sudan Central Economic Board*, December, 1910).

RUBBER.

Para Rubber.—The variability in the quality of plantation Para rubber (*Hevea brasiliensis*) has frequently been observed, and attention is drawn to the seriousness of the question, as affecting the reputation of this class of rubber, in an article in the *India Rubber Journal* (1910, **40**. 897). An instance is quoted by A. D. Thornton of two samples of plantation biscuit rubber taken from the same consignment, which differed in colour and also in physical properties; the latter difference persisted throughout the whole process of manufacture. It is suggested that a more careful grading of the rubber by planters might obviate, to some extent, this serious variation in quality. The question of the compulsory grading of rubber is discussed from the planters' standpoint in the *Ceylon Observer* (1911, **51**. 4). The causes contributing to the variability of plantation rubbers also form the subject of an article by F. Kaye (*India Rubber Journal*, 1911, **41**. 17), who groups them under two heads: (1) variations in the composition of the latex, and (2) variations in the conditions of preparation. A classification of the trees according to age and local conditions is proposed as a means of securing uniformity of latex, and a standardisation of the physical and chemical methods of coagulation and preparation is also advocated.

Messrs. Beadle and Stevens (*Analyst*, 1911, **36**. 6) describe the results of their experiments on latices of *Hevea brasiliensis*. It was found that the percentages of rubber and of total solids present in the latex depend on the manner and frequency of tapping. For trees 7–8 years old tapped lightly every other day the total solids, including rubber, amounted to about 40 per cent. of the latex. The same trees tapped more heavily gave latex containing only 30 per cent. total solids. The experimental results also show that the percentage of rubber in the latex of young trees is lower than in that of older trees under similar conditions of tapping. Analyses were also made of the dried latices from (1) stems of leaves, (2) trees four years old, and (3) trees ten years old. Nos. (2) and (3) do not differ appreciably in composition from one another, but the dried latex from the leaf stem contains more protein and resin than Nos. (2) and (3).

Manihot Rubbers.—J. Medley Wood states, in the *Report on the Natal Botanic Gardens* for 1909–10, that experiments have been made there on the cultivation of two of the new Manihots, *M. dichotoma* and *M. piauhyensis*, the seeds of which were sent from Kew. It was found that the seeds of *M. dichotoma* germinate more rapidly and the plants grow much faster than those of *M. piauhyensis*.

F. A. G. Pape has recently patented a new tool for the tapping of Ceará rubber trees. It is of the pricker type, and consists essentially of a steel plate carrying 70 or more chisel-like projections. A sketch and description are given in the *India Rubber Journal* (1911, **41**. 27).

Sapium sp.—In an article on "A Sapium Plantation in Columbia" in *Le Caoutchouc et la Gutta Percha* (1910, **82**. 4662), M. H. Jumelle expresses the opinion that the *Sapium* tree of Columbia is identical with *Sapium utile*, Preuss. The rubber from the Sapium of Columbia is known as "caucho blanco," and obtains locally a higher price than the product of *Castilloa elastica* ("caucho negro"). The yield of rubber is said to be from ½ to 2 lb. per tree (2 tappings per annum), and the export of "caucho blanco" is estimated at 120,000 kilograms per annum. Jumelle advocates the use of more rational tapping methods, and the cultivation of the tree in plantations. Experiments in the latter direction have been already commenced.

Castilloa Rubber.—Dr. Olssen-Seffer. in a recent contribution to the *American Review of Tropical Agriculture*, deals with the plantation requirements of Castilloa trees (*Castilloa elastica*). He considers that the chemical composition or relative richness of the soil is of comparatively little importance, but that the tree needs a porous soil, well drained, with a sufficient underground water supply. Stagnant water and acid soil are detrimental, and unsatisfactory results are obtained when the tree is planted in a thin soil, with hard impermeable subsoil. Dr. Olssen-Seffer also deals with the questions of shade in the plantation, distances of planting, thinning out and methods of increasing the girth of the trees.

F. Kaye (*India Rubber Journal*, 1910, **40**. 831) has published an account of his experiments on Castilloa latex. Various coagulation methods have been investigated principally with the view of obtaining a light coloured rubber with a low percentage of resins. His experiments apparently lead him to the conclusion that the best way to remove resins and also to prevent the subsequent development of dark colour is to coagulate the latex with boiling water.

The *India Rubber Journal* (1910, **40.** 828) contains a short article on the cultivation of Castilloa rubber in Trinidad and Tobago. Recent returns indicate the number of rubber trees in these islands to be:—*Castilloa elastica*, 600,000; *Hevea brasiliensis*, 30,000, and *Funtumia elastica*, 25,000. Reference is made to the centrifugal machine, patented recently by H. S. Smith, for the coagulation and washing of Castilloa rubber. It is stated that, by its use, dry clean rubber can be obtained from the latex in 15 minutes, and the tendency to subsequent discoloration is overcome (cf. this *Bulletin*, 1910, **8.** 136). The results of analyses of a number of samples of Castilloa rubber are quoted.

Rubber from Gutta Jelutong.—The extraction of rubber from Gutta Jelutong (derived principally from *Dyera costulata*) is now conducted on a large scale in Borneo. Schidrowitz has described the works at Goebilt recently erected for the purpose (*India Rubber World*, 1911, **43.** 130). Particulars are also given of the methods of tapping the trees and the yield of latex. The latex of *D. costulata* furnishes on an average 60–70 per cent. of solid (wet) jelutong, containing 10 per cent. of rubber, and the yield of pure rubber per tree per annum is stated to be 6 to 7 lb. Special treatment is, of course, necessary for the separation, of the rubber from the resins.

Plumeria spp. from Mexico.—In this *Bulletin* (1910, **8.** 47), under the title of "New Mexican Rubber Plants," mention is made of three species of Plumeria, *P. rubra*, *P. acutifolia* and *P. mexicana*, which are known in Mexico as "cacaloxuchitl." F. Kaye has recently (*India Rubber Journal*, 1910, **40.** 903) given an account of some experiments made on the latex of cacaloxuchitl. He concludes that although it is possible to prepare a remarkably clean and almost colourless rubber from this latex, the product cannot compete with many rubbers from other sources as regards strength and elasticity.

Funtumia elastica.—Dr. Gruner contributes to *Der Tropenpflanzer* (1911, **15.** 36) an account of recent experiments on the tapping of Funtumia trees at Misahöhe, Togoland, and also reviews the results obtained elsewhere.

According to Prof. Weberbauer, it is not advisable to tap trees of less than 52 cm. circumference, and he considers that 8-year-old trees will yield on the average not more than 100 grams of rubber per annum. W. H. Johnson also states that Funtumia trees should not be tapped under 9 years of age. At Misahöhe, however, one tree 4½ years old and 22 cm. in girth gave 12½ grams of dry rubber at one tapping, another (20 cm.) gave 8·8 grams, the wounds in the bark healing quickly and well—whilst at Moliwe two trees, 5½ years old, yielded respectively 159 grams of dry rubber (in 3 tappings) and 150 grams (in 2 tappings) in the year. The yield of rubber apparently varies very much according to the locality, and to the methods of tapping employed. The herring-bone system of tapping is not recommended for young Funtumia trees, as the bark in trees up to ten years old is too thin. For this reason also, the use of wedge-shaped knives is to be condemned. Weberbauer recommends making, with a pocket knife, vertical cuts, 2 metres long, at distances of 10 cm. apart, around the stem. A cup is placed at the foot of each incision, and the latex is directed into it by means of a leaf. The spiral system of tapping may be applied with older trees.

From measurements taken at Misahöhe it appears that the girth of the trees increases at the rate of 7 cm. per annum between 4 and 6 years of age.

The report of the work of the Berlin *Kautschuk Zentralstelle für die Kolonien* for the half-year April–October 1910 contains an account of the researches which have been conducted there on problems of general interest to rubber cultivators (*Gummi Zeitung*, 1911, **25**. 675). Of special interest are the results of the experiments on the different methods of coagulating Funtumia latex. The latex used was obtained from the Agricultural Station at Victoria. The following methods of preparation were applied:—(*a*) by allowing the latex to drain on wooden plates, (*b*) by the use of "Puruh" (hydrofluoric acid), (*c*) by adding dilute hydrochloric acid and formalin and heating, (*d*) by treatment in the cold with 1½ per cent. metaphosphoric acid, (*e*) by treatment in the cold with 2 per cent. mangrove sap, (*f*) by treatment in the cold with formalin, (*g*) by dialysis of the latex (cold) through parchment tubes, (*h*) by dialysis through parchment tubes in hot water.

The rubbers obtained were afterwards analysed. They were also vulcanised and the physical properties, strength and elasticity of the vulcanised specimens were tested on the "Schopper" machine. As the result of these tests, the rubbers are arranged in the following order of quality:—*c* (best quality), *h*, *a*, *e*, *f*, *g*, *d*, *b* (poorest).

Determinations were also made of the viscosities of the unvulcanised rubbers in solution in xylene, and it was found that, broadly speaking, the values were in the same order as the results of the physical tests of the vulcanised rubbers.

FIBRES.

Cotton.

Sudan.—References to the progress of cotton cultivation in the Sudan have been made in recent *Reports of the Central Economic Board, Khartum*. In the Red Sea Province cotton can be grown very successfully on that part of the Baraka delta which is inundated by the annual overflow (compare this *Bulletin*, 1904, **2**. 247). The prospects of the crop for 1911 are very favourable. In August 1910 about 30,000 acres were flooded, and the whole of this area has been planted. Good "Mitafifi" seed provided by the Government was sown, and it is therefore anticipated that the crop will surpass that of 1910 in quality. In December the plants were in excellent condition, and a large yield is expected.

The reports received from the Berber Province in November and December 1910 were rather discouraging, but the prospects have now improved and a good crop will probably be obtained. It is stated that the natives do not give the plants sufficient water.

Egyptian cotton was grown with considerable success in the White Nile Province in 1910. Enormous areas are flooded every year which would be available for cotton.

In the Upper Nile Province, the plant is grown chiefly on non-irrigated land. The crop in 1910 was unsatisfactory at Renk, owing to lack of rain, but at Kodok fairly good results were obtained, in spite of the fact that the land had not been ploughed.

In the Kassala Province, the cotton plants growing on irrigated land at Debeloweid were stated in December to be making excellent progress, and the crop is expected to surpass all previous records. At Gallabat, the native "Beladi" cotton, which is sold to the Abyssinians, has not given a very satisfactory result.

East Africa Protectorate.—Cotton cultivation has not proved very successful in the East Africa Protectorate hitherto, but it is stated in the *Colonial Report*, No. 669, for 1909–10 [Cd. 5467–5], that it is expected that the industry will make more progress when the land in the vicinity of the Tana and Juba rivers can be opened up.

Uganda Protectorate.—Reports on the cotton industry have appeared in recent numbers of the *Uganda Official Gazette*. Very encouraging accounts have been received from the district to the north of the Eastern Province, in the vicinity of Kumi, Bululu, and the shores of Lakes Kwania and Kioga. In Bululu, the land is generally sandy, but in some places there is a rich cotton soil; the area under cultivation has increased fourfold and the plants are being well tended. A good many cotton plantations have been visited in the Kuman country, and the plants have been found to be in excellent condition and free from pests. The Uganda cotton crop, as a whole, has not proved so satisfactory as was anticipated, and this is considered to be probably due to late sowing. Very good results have been obtained in the Bukedi District, however, and no less than 250 tons of unginned cotton of excellent quality were brought in during December and met with a ready sale.

British West Africa.—It is stated in the *Annual Report on the Forestry and Agricultural Departments of Southern Nigeria for* 1909 that the farmers in the Ifon and Ishan Districts of the Central Province appear to have undertaken cotton cultivation in a satisfactory manner. The area planted has more than doubled in 1910, and it is estimated that there are 200 cotton plantations amounting in all to 2,100 acres. The exports of cotton from the Western Province in 1909 amounted to 4,775,947 lb. of value £97,250, as compared with 2,162,754 lb. of value £50,307 in 1908.

It is reported in the *Official Gazette of Northern Nigeria* (No. 10 of 1910) that cotton seed has been distributed to the natives of the Abinsi District and also to the people of Katsena Allah, and has been eagerly accepted. Cotton is being extensively grown in the Hill Division of the Bauchi Province, but very little will be exported owing to the lack of transport facilities.

India.—The report of Mr. G. A. Gammie, Imperial Cotton Specialist, has been published in the *Report of the Agricultural Research Institute and College, Pusa*, 1909–10. A study of the cottons of the Garo Hills and Chittagong Hill tracts, Eastern Bengal and Assam, has shown that the best variety is a plant bearing very large bolls which grows in the Garo Hills and has a staple sometimes attaining a length of $\frac{3}{4}$ to 1 inch. It is recommended (1) that no alteration should be made in the type of cotton grown in this region, as experience has proved that it is the only kind capable of growth under the excessive rainfall and primitive agricultural methods of the Hill tracts; (2) that selection experiments should aim only at increasing the length of staple and the percentage of cotton to seed without modifying the special characteristics of the plant; and (3) that this cotton should be introduced into all the tracts.

It is suggested that attempts should be made to improve the forms of *Gossypium intermedium* of Bengal by selection, and that similar experiments should be made with *G. hirsutum*, preferably with the two forms known as "Buri" and "Cambodia."

Recommendations are made that "Buri" cotton should be introduced into the Central Provinces, and that efforts should be made to improve the "Bani" variety, especially with regard to its yield and ginning percentage. The different types of "Jari" cotton have been isolated, and these should now be studied in order to determine their comparative value to growers.

Seed of a hybrid cotton, produced at the Surat Farm, has been distributed to cultivators in Bombay, and the crop has realised a considerably higher price than that of the local Surat cotton.

West Indies.—In Barbados, the cotton seed, obtained from the Sea Islands in 1903, at first gave a crop which was entirely satisfactory as regards both yield and quality. After a few years, however, the plants became susceptible to the attack of insect and fungoid pests, and as a result the output was seriously diminished and the area under cultivation was consequently reduced. The extent of the decrease is shown by the fact that whereas 7,194 acres were planted in 1907–8, only 5,768 acres were sown in 1908–9, and 4,121 acres in 1909–10. In order to save the industry from extinction, a series of experiments, described in the *Report of the Local Department of Agriculture at Barbados*, 1909–10, was undertaken with a view to obtaining, by selection and hybridisation, varieties resistant to the various pests, and also giving large yields of cotton of good quality. These experiments are being carried out on a special plantation, and also, with the co-operation of planters, on

£2,500, in 1909. There are a large number of plants of an inferior type in existence in the Virgin Islands, and planters are therefore advised to sow freshly imported seed in preference to that of local origin.

German Colonies.—A discussion of the position of cotton-growing in some of the German Colonies is given in the *Verhandlungen der Baumwollbau-Kommission des kolonial-wirtschaftlichen Komitees*, 1910, No. 2. The production of cotton in these Colonies shows a steady increase. The exports from Togo in 1909 amounted to 2,043 bales of 500 lb. of value £20,800, as compared with 1,667 bales of value £18, 300 in 1908. In German East Africa the exports in 1909 were nearly double those of 1908. In the former year they amounted to 2,077 bales of value £22,020, whilst in the latter year they were only 1,081 bales of value £12,470. During the six months, May–October, 1910, the average price realised for Central Togo cotton was 7·2*d.* per lb. with a maximum of 7½*d.*, and for German East Africa cotton 8·95*d.*, with a maximum of 12*d.* per lb.

It has been stated by a representative of the Bremen Cotton Exchange that the quality of Togo cotton has undergone serious deterioration. In the years 1904–8 Togo cotton was sold at an average price which was slightly in advance of "middling" American, whilst in 1909 the value fell just below that of this standard, and in 1910 declined to ½*d.* per lb. less. Some of the arrivals of cotton during 1910 were so inferior that considerable difficulty was experienced in selling them, and it is considered that unless a change is effected very soon, the trade in Togo cotton will be ruined. Since in the earliest experiments the cotton grown from native seed gave the best product, it is recommended that such seed should be at once separated from all other kinds and the latter destroyed. The germinating power of the native seed should then be carefully tested and only the best distributed to the natives, since it is considered that in this way alone can the necessary change be effected and confidence restored.

The opinion has also been expressed that the deterioration is due to the practice of allowing the plants to remain in the ground from year to year instead of planting fresh seed for each crop. Another view is that the depreciation is partly due to the Nuatjä plantation having been taken over by the Government and converted into a general agricultural station instead of being devoted entirely to cotton. It has been decided to send an expert to Togo for the purpose of investigating the causes of the deterioration of the crop.

Flosses or Silk-cottons.

An account of "kapok," which consists of the fine silky hairs contained in the capsule of *Eriodendron anfractuosum*, and of certain other flosses, was given in this *Bulletin* (1905, **3**. 221), and it was stated that at that time no process had been devised whereby these fibres could be spun on a commercial scale. The difficulty of spinning is chiefly due to the fact that the fibres have a smooth, slippery surface, and therefore lack cohesive force. Discoveries which are said to enable this difficulty to be surmounted have been made recently by Herr Stark, of the Chemnitzer Aktien-Spinnerei, and are described in the *Verhandlungen der Baumwollbaü-Kommission des kolonial-wirtschaftlichen Komitees* (1910, No. 2). The surface of the fibre is rendered rough by chemical treatment, and is thus enabled to exert the necessary grip. By a special arrangement and adaptation of the spinning machinery, the roughened fibres can be spun either alone or in admixture with cotton. These processes are applicable to kapok and many other flosses, of which the most important are those of *Calotropis procera* and *C. gigantea*. The yarns so produced cannot be satisfactorily bleached, but are readily dyed and possess an excellent lustre and a woolly character, and are said to be suitable for the manufacture of plushes, laces, and other materials. The chief importance of the discovery, however, lies in the possibility of using the flosses as substitutes for cotton, and thus rendering the textile industry less dependent on the United States for its raw material. Specimens of the yarns and other products manufactured by this method have been received by the Imperial Institute, and may be inspected on application.

Sisal Hemp.

It is stated in the *Colonial Report, No.* 669, *for the East Africa Protectorate for* 1909–10 [Cd. 5467–5] that the Sisal plantations, which now cover a large area, are rapidly approaching the producing stage, and that from the present year onwards several hundred tons of the fibre will appear among the annual exports.

In the *Government Resident's Report on the Northern Territory, South Australia*, 1909, a report is given of experiments which have been carried out in the Botanic Garden at Palmerston on the extraction of Sisal hemp by means of a Death and Ellwood machine. Fibre of excellent quality has been obtained, and it has been found that the Sisal leaves grown in the Garden contain a larger percentage of fibre than has been obtained in Queensland. During 1909, 80,000 bulbils were distributed to planters, and it is evident that interest is being aroused in the cultivation of this product.

Silk.

The Report of Mr. H. Maxwell-Lefroy, Imperial Entomologist to the Government of India, which has been published in the *Report of the Agricultural Research Institute and College, Pusa*, 1909–10, gives an account of efforts which are being made in connection with sericiculture. Special attention has been devoted to *Attacus ricini*, the Eri silkworm. The industry is most extensive at present in Tirhoot, Bhagalpur, and Patna, the three divisions nearest to Pusa, but is also being tried in Malabar, Dharwar, West Coast, Gujerat, Kathiawar, Sind, Patiala, Rohilkhand, Betul, Chanda and Murshidabad. The Salvation Army are endeavouring to establish it at Bangalore and other places. The successful development of the industry demands some organisation for the collection and sale of large quantities of cocoons. Trials are being made at Pusa with hybrids between *Attacus ricini* and the wild form, *A. cynthia*, which it is hoped may result in the production of a more robust race. The diseases of the Eri silkworm occasionally cause serious difficulty, and are being investigated with the aid of the Imperial Agricultural Bacteriologist.

A study is also being made of the cultivation of the mulberry silkworm, and the experimental work in this direction has so far proved very satisfactory.

MISCELLANEOUS PRODUCTS.

Cinchona.—According to the *Jaarboek van het Departement van Landbouw Ned. Ind.* for 1909, the total number of cinchona plants in the open ground in the Government plantations at the end of 1909 was 5,549,000, a decrease of 85,000 due mainly to unfavourable weather conditions. In the nurseries the number has decreased from 3,416,000 to about 3,211,000. The seven plantations comprising the Government undertaking include an area of slightly over 1,513 bouws (one bouw is equal to about 1·75 acres), on which are planted 4,000,000 *C. Ledgeriana*, 279,000 hybrids, 300,000 *C. succirubra* and 970,000 *C. robusta*. The bark of *C. succirubra* is mainly used for galenical purposes, and as that grown at the Kawah-Tjiwidei and Tjibitoeng plantations is much superior in colour to that obtained at the other plantations, it has been decided to confine its cultivation to those establishments. Originally 150 bouws were planted with the hybrid 23^3 and these are now being gradually cleared, since, although this variety has the great advantage of being fairly resistant to drought, its production of bark is so small and the alkaloidal content of that bark so low, especially as the age of the plant increases, that its cultivation is not sufficiently remunerative. It is to be replaced by "*ledgeriana*" seedlings or "*ledgeriana* grafts" on "hybrid" or "*succirubra*" stems.

At Poentjak Gedeh experiments were commenced in 1904 on planting at various distances, and from these trees, bark was harvested in 1907, 1908, and 1909. The results show that the total yield of quinine sulphate obtained per bouw during the period has been 91·9, 62·2 and 45·13 kilograms for equal areas planted 3 × 3, 3 × 4, and 4 x 4 feet respectively. Close planting has the additional advantage of reducing working expenses by lessening the growth of weeds.

The total crop of bark for 1909 was 1,787,809 half kilos, being a slight decrease on that for 1908. The bark shipped to Amsterdam gave an average yield of 7·54 per cent. of quinine sulphate, comparing favourably with that of 7·29 per cent. in the previous year, while that supplied to the Bandoeng quinine factory gave on the average 6·34 per cent. as against 6·08 per cent in 1908.

Recent researches on the alkaloidal content of cinchona leaves subjected to various conditions as regards light and shade tend to show that, contrary to Dr. Lotsy's opinion, this factor has little influence on the amount of alkaloid formed. In another series of experiments rings of bark were removed from trees and precautions taken to prevent its renewal. After various intervals other strips were removed both above and below the original rings, and from the results of examination of the three sets of bark so obtained it has been concluded that alkaloid is not produced in the leaf and carried thence to the stem.

Further researches on diseases, especially *Corticium javanicum* (compare this *Bulletin*, 1909, **7.** 333), affecting cinchona have been carried out, but no new results of importance have yet been arrived at.

In *Teysmannia* (1910, **21.** 777), Dr. Rant describes what he believes is a new fungoid disease of cinchona. It is only found on trees grown in damp and shady places, and occurs mostly as a thin, dark brown band composed of mould threads, on the stem and branches. It appears to do no harm on the stem or branches, but where it reaches the leaves the latter decay and drop off. Only a few cases have been found so far.

The *Report of the Government Cinchona Plantations and Factory, Bengal*, for 1909–10 shows that the total number of plants in permanent plantations on March 31, 1910, was 2,654,900, made up as follows:—Hybrid No. 1, 183,600; Hybrid No. 2, 83,000; *C. succirubra*, 163,674; *C. calisaya-ledgeriana*, 2,172,926, and *C. officinalis*, 51,700; whilst the nurseries contained 5,524 Hybrid No. 2. The bark collected amounted to 326,560 lb. Out of 66 samples of Hybrid No. 2 bark from the Munsong plantation over half showed more than 5 per cent. of quinine, some being over 9 per cent.

The quantity of bark worked up at the factory was 468,461 lb., of which 232,461 lb. was "ledgeriana" bark from Java which gave on the average 6·28 per cent. of quinine sulphate, whilst the 236,000 lb. of Bengal bark utilised gave 3·67 per cent. of quinine sulphate as compared with 3·59 per cent. obtained in the previous year.

Tobacco.—The experimental work carried out in 1909 on the Crown Lands in Java in connection with the cultivation and fermentation of tobacco is described in the *Jaarboek van het Departement van Landbouw in Nederlandsch-Indie* for 1909.

Experiments on manuring were attempted, but the experimental plots were so badly attacked by fungoid disease that no conclusive results could be drawn. Formaldehyde, carbon disulphide, and potassium permanganate were tried as remedies; the two latter proved successful without damage to the leaves.

Steam-fermentation experiments have been carried out, using apparatus capable of fermenting one cubic metre of tobacco at once. The preliminary trials have shown that much shorter times are required for fermentation in this way, and it was found impossible to infect the partially steam-fermented tobacco with bacteria capable of producing further fermentation.

Experiments on various methods of shading young tobacco plants were carried out. New types of apparatus for the selection of seed by weight, and for the destruction of tobacco-plant refuse have been devised.

FORESTRY.

GENERAL.

Forest Fires.—In view of the number of forest fires and the enormous amount of damage caused thereby it is not a little remarkable that so few works exist dealing with this important subject. To meet the need for such a book in English a translation of M. Jacquot's *Incendies en Forêt* has been prepared by C. E. C. Fischer and published by the Indian Forest Department. The work treats the subject in a comprehensive manner, of course from a French point of view, but it contains much that is of value and interest to foresters in general. The primary object the writer had in mind was to assist private owners, rather than professional foresters, in calculating the extent of the damage done by fire and in supporting their claims in a court of law. The appraisement of damage done by fires involves much more than the calculation of the actual loss of timber. The disorganisation of management, the damage to surrounding growths not actually consumed, the injury to root-stocks, the loss of seeds and minor products, and even the destruction of soil-covering, bacteria and earth-worms have all to be taken into account. It is in estimating results so wide reaching as those indicated that this work will no doubt prove valuable to British foresters.

Hardwickia binata.—The sylviculture of Anjan (*Hardwickia binata*) is the subject of an article by Mr. D. O. Witt in the *Indian Forest Records* (1910, **2**. Part 3). This species occurs on sandstone and trap formations in the dry forests of Southern and Central India and extends as far north as the Banda District of the United Provinces. The seed germinates during the rains of June and July and develops a strong tap-root, capable of penetrating fissures in the rocky substratum. The rains cease in September, and after about two months of hot weather the seedling shoot dries up and dies back. During the rains of the following season a second shoot is produced, and this arises from a cotyledonary bud, the bud being situated at a point where the cotyledons are attached. This second shoot, which is smaller than the first, also dies back and is followed in the succeeding year by a third. During this time the root has continued to lengthen and may measure as much as 30 inches. From the fourth year onwards the growth of the shoot makes more progress as, owing to the greater length of tap-root, a better supply of moisture is obtainable. From this stage the plant gradually develops into a dwarf bush, from which a strong shoot eventually breaks away which is destined to form a tree. During the bush stage, shoots and lateral branches die back in the hot season and are shed after the manner of leaves, the points at which they break off being marked by scars. A bud forms on the surface of the scar, from which a shoot is produced in the following year. The growth of the Anjan tree is slow, the age of a 10-foot sapling being estimated at about 20 years. A height of from 60 to 80 feet is eventually attained, and a girth of from 6 to 12 feet. The dark reddish-brown timber weighs about 82 lb. per cubic foot, and is valued for building and ornamental work.

Although the tree produces a crop of seed almost regularly every five years, it is remarkable that natural regeneration is almost entirely absent from the Anjan forests. Various causes have been suggested for this, but recent observations indicate that it is the supply of subsoil moisture and the ability of the tap-root to reach it which are primarily responsible for the survival or death of the seedling, and not, as was formerly held, the thick mass of grass roots which the seedling is easily able to penetrate. Details of schemes for the regeneration of Anjan forests based on the preceding observations are given, and also methods of tending the trees during their early growth.

Sandalwood.—"The germination and growth of sandal" (*Santalum album*) forms the subject of a paper contributed to the same journal by the Conservator of Forests, Travancore. Sandal occurs in small patches over a limited area in the Nallamalai hill-range of the Kurnool District, and it was with a view to ascertaining the best methods of propagation in order to introduce it to the central Nallamalais, where natural conditions appear favourable, that some experiments in sowing sandal seed were undertaken. Successful results were obtained by sowing in a nursery the seed of sandal mixed with that of host plants at the same time. The sandal seedling will attach its roots to those of almost any plant, but in the experiments the following species proved the best hosts:—*Pongamia glabra*, *Gossypium arboreum*, *Albizzia Lebbek* and *Cleistanthus collinus*.

Other experiments consisted in sowing seeds of sandal *in situ*, mixed with seeds of the most successful hosts, noted above. The forest growth amongst which the seeds were sown consisted of bushes of species belonging to genera that are generally found in the natural habitat of sandal, viz. : Zizyphus, Randia, Webera, Limonia, Toddalia, Murraya, Acacia, Pterolobium, Albizzia, Pongamia, Melia, etc. Although no waterings were given to these seeds there were many successful germinations, and the young plants appear vigorous. These experiments therefore tend to show that, provided suitable host plants are available, it is possible to introduce sandal to localities where at present it does not occur, and that sowing *in situ* is the best method to adopt.

Pine Tree Diseases.—In the *Progress Report on Forest Administration, Punjab*, 1909–10, it is mentioned that in Simla over 16,000 "blue pine" attacked by the fungus *Trametis pini* were felled. The disease is in full activity in the Nogli and Pabar ranges of the Bashahr Division. Trees of the third class from 12 inches to 18 inches in diameter are most subject to the disease. The natives value the diseased trees on account of the torch-wood they yield, which is particularly rich in resin, and are adverse to the wholesale removal of them from the forests. The fungus has also been found on deodar trees. The cutting-out experiments on a large scale in the Simla forests will serve to show whether the methods employed are effective in eradicating the disease, but it is to be regretted that there is no mycologist on the spot to deal with the matter.

In the *Kew Bulletin* (1911, No. 1), Bancroft records further investigations of the pine disease caused by the fungus *Diplodia pinea*. The disease is confined to the terminal portions of the branches, which present a primary yellowing and casting of the leaves, followed by the death of the terminal 10 to 18 inches of the twigs. The perithecia appear chiefly on the shoots. Diseased shoots of *Pinus insignis* and *Pinus montana* received from Cape Colony were found to be attacked by this fungus, and the opportunity appeared favourable for ascertaining the mode of infection and range of hosts. Five species of Pinus, *Picea excelsa*, *Abies pectinata* and *Larix europœa* were selected and infection experiments carried out. It was found that the three last-named plants were immune, while all five species of Pinus were attacked, the fungus, however, effecting an entrance only at a broken or wounded surface. There is reason for supposing that under natural conditions such wounds are caused by insects. No perithecia were produced during the investigation, which occupied four months.

The disease is most commonly met with in the nursery, and it is suggested that it is here that strong measures should be taken to prevent its spread. Removal and destruction of all diseased twigs is recommended. Preventive measures in the forest are impracticable.

MISCELLANEOUS.

The *Forest Report for the North-West Frontier Province, India*, for 1909–10 states that in Kagan trees are said to be occasionally barked by bears. The damage done would be inappreciable were it not for the fact that the bears show a marked preference for trees standing in the open.

"Blue pine" saplings and large trees of *Quercus dilatata*, growing at high elevations, are found to be particularly liable to damage by snow.

The removal of a number of large spruce trees in Karkana has resulted in the appearance of a fairly abundant supply of deodar seedlings in their stead. This seems to point to the fact that the spruce canopy is too dense to permit of the growth of deodar, hence the necessity for keeping the former, which is capable of growing in shade, within due bounds.

As a result of the experimental plantings of *Eucalyptus tereticornis*, it seems probable that this species can be profitably grown in some of the Khanpur forests. Coppice shoots at Abbotabad, 12 months old, are 15 feet high and 7½ inches in girth; others, 5½ years old, have a girth of 22 inches.

which has been identified as the source of "white" mangrove-bark. The subsequent sections of the paper are largely concerned with a botanical discussion of the characters of the tropical rain-forest, but reference is also made to the economic aspects of the flora. Among plants of greater or less economic importance met with in the secondary forest may be mentioned *Elæis guineensis* (in abundance), *Lophira alata*, *Irvingia Barteri*, *Mimusops Djave*, *Guarea* sp., *Chlorophora excelsa*, *Pterocarpus* sp. (dye-wood). The concluding section deals with the principal timber trees met with, and comment is made upon the relative paucity of tree species occurring in the Kamerun as compared with other parts of the tropics, *e.g.* the Dutch East Indies. Many of the questions briefly considered in this section are dealt with at greater length in the paper of the same author mentioned below (p. 79).

FOREST PRODUCTS.

Timbers.—Investigations by the Indian Forest Department have shown that of timbers laid down in 1907 as railway-sleepers none of those derived from *Pinus longifolia*, *P. excelsa*, *Picea morinda* or *Abies Pindrow* have a life of over 2½ years if not treated with a preservative. Sleepers of "blue pine" promise to be the most lasting. The following woods are stated to have been found suitable for pencil-making:—*Podocarpus periifolia*, *Cedrus deodara*, *Cupressus torulosa*, *Wrightia tomentosa* and *W. tinctoria*. The timber of *Sonneratia apetala* has proved suitable for making packing-cases, and a demand for this wood has been created in Calcutta (*Progress Report Imp. For. Res. Inst.*, 1909–10).

The *Punjab Forest Report*, 1909–10, states that the scheme for working the forests of *Populus euphratica* for the manufacture of matches in Multan has been abandoned.

The total export of timber from the Andamans, according to the *Progress Report of Forest Administration*, 1909–10, amounted to 222,107 cubic feet, the principal species in demand being *gurjan* and *padouk*. A large increase in trade in the latter was due to orders received from a German buyer in Colombo, who was supplied with 550 tons in rough-hewn squares.

A *List of Forest Trees and their uses* has been prepared and published by the Forest Department of Southern Nigeria. The information is based on notes collected from 1904 to 1910 by officers of the Department. The names of the species are grouped under natural orders, and both Latin and native names are given when known, together with remarks as to the economic uses of the trees. In cases where timber has been submitted for commercial valuation the price per foot super. is given. There is no information in the notes as to whether any particular species is plentiful or rare, and this omission is to be regretted, as data relating to supply are of great importance when placing a new timber on the market.

Under the title of "*Beiträge zur Kenntnis der Pflanzenwelt und der Hölzer des Kameruner Waldlandes*" (*Mitteilungen aus den deutschen*

Schutzgebieten, 1910, *Heft* 2), Prof. Büsgen gives an account of the botanical results of an expedition through a considerable part of the forest country of the Kamerun. In the large number of specimens collected the preponderance of trees is very marked, and the usual wide taxonomic distribution of the flora of tropical forests is well brought out in the fact that no fewer than 70 natural orders are represented. Of these, Leguminosæ claim 43 species, Apocynaceæ 25 species, Euphorbiaceæ 22 species, with Moraceæ, Sterculiaceæ and Anonaceæ with 20, 12 and 10 species respectively. Among the non-arboreal vegetation Rubiaceæ and Anonaceæ play the most important part, being represented by 78 and 31 species. Five species of Ebenaceæ and seven mahoganies (Meliaceæ) were found. The more important species are described in simple botanical language, and grouped under natural orders arranged according to Engler and Prantl. Among the plants of economic importance are to be noted *Chlorophora excelsa* (Iroko, Odoum of British West Africa), *Monodora myristica* (calabash nutmeg), *Pentaclethra macrophylla* (Atta bean), *Irvingia Barteri*, *Entandophragma* sp. (a "mahogany"), *Kola acuminata* var. *grandiflora*, *Rhizophora Mangle*, *Poga oleosa*, *Mimusops Djave* ("Kamerun mahogany," Baku oil nut). This section of the paper closes with a useful vocabulary of native plant-names, over 100 native names being coupled with botanical equivalents.

The second section consists of a detailed description of a collection of upwards of 70 specimens of Kamerun timbers in the Botanical Institute of the Forest Academy at Hann. The author's experience of Kamerun plant-names has permitted the identification of a small proportion of the specimens, but the majority can still be referred to only by their native names. Among those botanically identified certain well-known West African woods appear, e.g. *Lophira alata*, *Mimusops Djave*, but it would seem that comparatively few are of promise as commercial woods. The collection has for convenience of reference been divided into four groups, representing as many different types of structure, as seen under a low magnification of ten to sixteen diameters. It is perhaps doubtful whether all botanists would share the confidence of the author in the efficacy of this system of identification.

Lac Resin.—A considerable amount of attention is now being given in India to the matter of lac production. According to the *Report of the Agricultural Research Institute, Pusa*, for 1909-10, the cultivation of the lac insect on *Zizyphus Jujuba* and *Serissa glomerula* is being carried on experimentally, and courses of training in lac production have been given to students and lac-workers. A complete collection of races of the lac insect has also been made and arranged, for investigation by the Government Entomologist in Ceylon. In this connection reference should also be made to the issue of a second edition of Mr. Stebbing's important monograph on the lac insect in *Indian Forest*

Memoirs, Zoology Series (1910, **1**. Part 3). This gives a complete account of the lac insect, its food plants, natural enemies, distribution in India, and of the methods of cultivation and propagation. Later sections of the monograph deal with the exploitation of lac, the manufacture of various forms of lac resin, their industrial uses, composition, etc. (compare this *Bulletin*, 1909, **7**. 63).

ECONOMIC MINERALS.

Asbestos.—Zdarsky describes the igneous rocks of the Troodos mountains in the island of Cyprus, and the asbestos deposits associated with them, in the *Zeitschrift für praktische Geologie* for September 1910. An abstract of the details of economic importance is published by the *Mining World* (Chicago) for January 7.

Building Materials.—In the *Mining Journal* (London) for January 7, 1911, it is stated that machinery has been set up in Selangor, Federated Malay States, for the manufacture of cement. Limestone occurs in large quantities, and this is to be used in conjunction with river mud from Port Swettenham.

Coal.—The *Mining Journal* (London) of January 7, 1911, states that coal has been found near Rawang in Selangor, and that the Federated Malay States Government is having the occurrence investigated. The coal so far met with is stated to be of poor quality. In the *Colliery Guardian* for January 20 and 27, 1911, G. Roblings gives an account of the washing and sorting of small coal. He points out that the consideration of this subject is becoming more and more important, as the production of small coal is increasing, due to the fact that thin seams are being worked to a much greater extent than formerly. He describes the various methods employed to eliminate impurities, and sort the coal, and gives suggestions based on his own experience in this work.

It is stated in the *Engineering and Mining Journal* (New York) that large quantities of briquettes are made in Holland from a mixture of peat and charcoal, and are regarded as being superior to the lignite which was formerly used.

In the *Report on the Mining Industry of Natal for* 1909 it is pointed out that the exploitation of new coal areas has been more active than for some years past. Coal prices were considerably lower than in any previous year; hence, although the total output was greater than in the previous year, the total value was considerably less.

The Irwin River Coalfield and the adjacent districts from Arrino to Northampton are described in *Bulletin No.* 38 *of the Geological Survey for Western Australia.*

The rocks include gneiss and granite, a series of quartz conglomerates and submarine tuffs of undetermined age, Carboniferous or Permo-Carboniferous rocks consisting of shales, clays, sandstones and limestones, with coals and a glacial boulder bed, lower Jurassic rocks including sandstones, clays, shales, and limestones, succeeded by limestones and arenaceous rocks believed to be of Tertiary age. On the coast are recent limestones and sandstones. Analyses and calorific values of the coal are given. Other economic products found in the area are diatomaceous earth, gypsum, cave guano and salt. Maps on a scale of 3 inches to the mile extending from 28° 7′ to 32° 53′ south latitude, are included in the Bulletin.

Gold.—In *Bulletin No. 74 of the Institution of Mining and Metallurgy*, J. B. Wilson gives an account of the Mount Morgan ore deposits of Queensland. He states that the gold is so finely distributed in the ore as to be rarely visible, even when the ore assays show over a hundred ounces to the ton.

Bulletin No. 39, 1910, of the Geological Survey of Western Australia gives an account of geological observations made by H. W. B. Talbot along a strip of country about 150 miles wide, extending from Wiluna (lat. about 26½° S.; long. about 120½° E.) to Hall's Creek (lat. 18° 15′ S.; long. 127° 45′ E.); and also describes a portion of the country between the latter locality and Tanami in the northern territory of South Australia. The formations met with are of uncertain age, but are supposed to be chiefly Palæozoic and Pre-Cambrian, including granites and metamorphic rocks. The belt of metamorphic rocks south of the Gardiner Range has every indication of gold occurrence. The reefs are of considerable extent, and some of the samples collected were found to carry gold, but only in small quantities. The author is of opinion that prospecting will reveal the presence of alluvial gold in some of the numerous gullies that abound in the neighbourhood of the southern cliffs of the Gardiner Range. It is of interest to know that a large artesian water-bearing area probably exists towards the interior of the State, and it is thought that artesian water may confidently be looked for anywhere along Sturt Creek, and in certain other places.

The Geology and Ore Deposits of Hedley Mining District, British Columbia, are described in *Memoir No. 2, Dept. of Mines, Geol. Surv. Branch, Canada*, 1910. This important gold-mining district lies on the Similkameen River, at the mouth of Twentymile Creek, about twenty miles north of the International Boundary line and the same distance west of the Okanagan valley. The oldest rocks in the district are a series of limestones, quartzites, argillites, and volcanic tuffs and breccias. They are correlated, on purely lithological grounds, with Dawson's Cache Creek group, which is of Carboniferous age. Masses of diorite and gabbro were intruded into these sedimentary rocks, metamorphosing them and forming the primary ore deposits. A later intrusion of granodiorite, though on a very large scale, was accompanied by comparatively little metamorphism and mineralisation. The ore deposits occur as irregular, ill-defined bodies, lying in limestone which has been altered by contact with diorite or gabbro intrusives. The ore minerals are arsenopyrite, pyrrhotite, chalcopyrite, pyrite and zincblende; and the accompanying gangue minerals are garnet, epidote, diopside, tremolite; and less commonly, calcite, quartz and axinite. At and near the surface there is much free gold, but below the surface zone the gold is in combination with the sulphides mentioned above and especially with the arsenopyrite. No metal other than gold has been extracted from the ores.

Iron Ore.—In "Recent Advances in the Construction of Electric Furnaces for the Production of pig iron, steel, and zinc" (*Bulletin No.* 3, *Dept. Mines, Mines Branch, Canada*), it is pointed out that the absence of coal over large areas and the abundance of water-power in most parts of the Dominion render the development of electro-thermic smelting processes of special importance to Canada. In Sweden, where similar conditions prevail, the electric furnace has been used with great success in the smelting of iron ores too low in iron to be worth exporting, and it is to Swedish engineers that most of the recent advances in this field are due. Some of the latest types of electric furnace are described in the 76 pages of this Bulletin, which is illustrated by numerous diagrams and drawings.

In a *Bulletin of the Institution of Mining and Metallurgy, No.* 67, J. M. Campbell describes the process of iron smelting adopted by the natives of Haute Guinea (West Africa). The ore used is stated to be of the lateritic variety, containing a considerable amount of free hydrated alumina, but very little silica.

Monazite.—The *Mining Journal* (London) of December 17, 1910, gives a brief account of the use of the Humboldt magnetic separator in separating monazite from the other minerals with which it occurs in the sands of rivers and beaches.

Ochre.—In the *Mining World* (Chicago) for December 31, 1910, W. S. McCallie, State Geologist, gives an account of ochre mining and treatment in Georgia. The State produces nearly one-half of the total output of ochre in the United States. The mines are situated near Cartersville, Bartow County, in the north-western part of the State.

Petroleum.—The *Canadian Mining Journal* of January 15, 1911, gives an account of the progress of work in the Stony Creek Field, Albert County, New Brunswick. The field which is being exploited is stated to be only a mile wide and two miles long. The oil wells have a total daily capacity of 50 barrels; and the total flow of gas from the wells is estimated at about 40,000,000 cubic feet per day.

The *Mining Journal* (London) of December 17, 1910, states that four seams of oil shale, which can be easily worked, have been proved at Latrobe, Tasmania. A later report states that a seam three feet thick, richer than any previously met with, has been opened up on the property.

The *Mining World* (Chicago) of January 14, 1911, gives an account of the Transvaal oil-shale deposits. The most notable occurrences are at Ermelo and Wakkerstroom in the Great Eastern Coalfield. Some prospecting has been done already, but it is stated that the areas so far proved are insignificant in extent, and that much more prospecting requires to be done before industrial development can take place.

In an article on the "Oil Resources of California" in the *Mining Magazine* (London) for January 1911, the possible future oil-production of the State is discussed. It has been estimated that the minimum resources are represented by a total of 5,000,000,000 barrels, and the maximum by 8,500,000,000. Assuming a mean of 7,000,000,000, we get a possible yield of 70,000,000 barrels over a period of 100 years. The writer gives reasons for thinking that the maximum figure here given is a conservative estimate.

Phosphates.—According to the *Mining Journal* (London) for December 17, 1910, the Mount Lyell Superphosphate works have been opened at North Fremantle in Western Australia. For some years past Western Australia has imported large and increasing amounts of artificial manures, the amount in 1910 being 35,000 tons.

According to the *Report on the Mining Industry of Natal* for 1909, mineral phosphate to the extent of 343 tons was crushed and sold during the year; this was applied directly in the crushed state as a manure, as it contained too much iron and alumina to be suitable for the manufacture of superphosphate (see also this *Bulletin*, pp. 42, 52).

Precious Stones.—The *Mining Magazine* (London) for December 1910 describes a new hand-jig for diamond washing, designed for the use of prospectors in testing gravels for diamonds and other precious stones.

Tin Ore.—Writing on the subject of tin lodes in Malaya and Banka in the *Mining Journal* (London) for February 4, 1911, J. B. Scrivenor, Government Geologist in the Federated Malay States, makes the following interesting statement:—"Two important points about our tin-fields that are not generally known, are that a vast quantity of the so-called alluvial deposits are not alluvial at all, and that we have here the remains of an old Gondwana Land tin-field, which is far older than the granite of our hill ranges, and appears to have been formed under glacial conditions. The extension of this old tin-field under younger rocks is now the great problem for the future of the tin-mining industry in the Federated Malay States."

The *Report on the Mining Industry of Natal for* 1909 states that little or no progress was made in developing the tinstone deposits of the Umfuli valley in Zululand. The tin-bearing dykes so far discovered are numerous and large, but the ore is of low grade.

Miscellaneous.—A large number of analyses of New Zealand minerals are given in the *Report of the Dominion Laboratory, New Zealand*, for 1909. These include gold ores, coals, limestones, manures, waters, soils, and ores of iron, copper, molybdenum, antimony, manganese and chromium. The molybdenum ores, which were chiefly from Mount Radiant, did not contain more than 4 per cent. of the metal, but workable ores of chromium, tungsten, and manganese are reported from several localities.

The search for phosphate rock produced many samples, but, as in previous years, few contained more than traces of phosphate; the two most promising being from Whangarei and Onewhero, which contained 58·35 and 10·60 per cent. respectively of tricalcic phosphate.

The analyses of mineral waters include one of more than usual interest, from the lake on White Island, which contained 9·24 per cent. of solids, including 4·83 per cent. of free hydrochloric acid and 0·03 per cent. of boron trioxide, more than is found in some Tuscan waters used as a source of boric acid. The presence is also recorded of 0·024 per cent. of pentathionic acid, a compound stated not to have been previously recorded in a natural water.

In an article on mineral production in India during 1909 published in the *Indian Geological Survey Records* (1910, **40**. Part 1), it is pointed out that there was a striking decrease in the value of the output of coal, from £3,356,209 to £2,779,865, due to over-production in previous years which lowered the price. There were also decreases in the values of salt, graphite, tin ore and amber. Among the minerals that showed an increase were gold, manganese, petroleum, saltpetre, mica, gems, jadestone and iron ore. A total of 9,250 tons of chromite was produced, as against 5,535 in the previous year; the supply coming in about equal amounts from Mysore and Baluchistan. An important feature was the commencement of the regular production, on a large scale, of lead and silver ore from Bawdwin and Namun in the northern Shan States, and Mount Pima, Yamethin, in Burma. Tungsten has been obtained both in Mergui, Lower Burma, and at Agargaon in the Nagpur district. The value of the total mineral output fell from £7,861,935 in 1908 to £7,499,228 in 1909.

The Mining Journal (Queensland), September 1910, states that wolfram (tungsten ore) has been discovered on Dingo Mountain, four miles west from Kirrama station, and sixty miles south-east from Mount Garnet in the north of Queensland.

Publication No. 59 *of the Department of Mines, Mines Branch, Canada* is a report on analyses of ores, minerals, fuels, etc., made during the years 1906, 1907 and 1908.

The analyses are classified under the headings: (1) rocks; (2) coals and lignites; (3) peat; (4) limestones and dolomites; (5) iron ores; (6) chrome iron ores: (7) copper ores; (8) gold and silver assays; (9) natural waters; (10) brick and pottery clays, and (11) miscellaneous examinations. In an appendix, an illustrated description is given of commercial methods and apparatus for the analysis of oil-shales.

In an article on the "Mining Situation in Madagascar" in 1909 (*Bulletin de l'Office Coloniale*, 1910, p. 317) it is pointed out that the output consisted almost entirely of gold, the total production of which amounted in 1909 to 118,779 ounces, as against 101,195 in the previous year. It was mainly alluvial gold.

two sub-species, which further work may render it desirable to raise to specific rank. These sub-species are called *Elæis nigrescens* and *Elæis virescens*, the distinguishing feature being that the former produces fruits that are black at the ends, in the unripe stage, whilst the second sub-species furnishes fruits that are green towards the extremities whilst still unripe. *E. nigrescens* consists of seven varieties, one of which, viz. var. *communis*, may exist in three forms; whilst *E. virescens* contains four varieties.

A very full discussion of the biology of the oil palm is given, in the course of which the natural dispersion of the seeds, germination, flowering, fertilisation, formation of hybrids, development of fruit, age of full production, and the causes of sterility in palms are dealt with. This is followed by chapters on the influence of the physical environment and that of other plants and of insect and animal enemies. The cultivation of the oil palm, already carried on by certain of the West African peoples in a primitive manner, is described.

The last chapter, in which the future of the oil palm industry is discussed, deals with methods of increasing and improving production. In this connection it is pointed out that the statement often made, that only a small fraction of the oil palms existing in West Africa is actually utilised as a source of oil and kernels, needs qualification, since many of these unexploited palms are infertile owing to the conditions under which they are growing. As a first step in increasing production, it is recommended that natives should be encouraged to keep down weeds and creepers in such natural forests of palm trees, in order that the latter may become productive. The formation of plantations is also recommended; the trees being placed from 6 to 8 metres apart, the intervening space being used for maize in the first two years, beans in the third, native vegetables in the fourth and fifth, returning to maize in the sixth. It is suggested, also, that mixed plantations of oil palms with cocoa, kola, or fruit trees would do well. The necessity for planting only palms yielding fruits rich in oil and possessing thin-shelled nuts is insisted on, and in this connection the interesting fact is recorded that the failure of thin-shelled nuts (Lisombé palm nuts) used as seed, to produce oil palms yielding nuts of the same type, in the Cameroons (this *Bulletin*, 1909, 7. 373) was due to cross-fertilisation of the flowers with pollen from the ordinary variety of palm, yielding thick-shelled nuts. In plantations, therefore, when it is desired to produce nuts for sowing, hand pollination should be resorted to, as is done in the cultivation of the date palm in Tunis.

Dr. Chevalier also advocates the formation of an experimental station for work on the oil palm in French West Africa, and suggests as the most important problem for such a station the discovery, or, if necessary, the breeding, of a variety of oil palm possessing the following characteristics: (1) a short trunk to facilitate collection of heads of fruits; (2) the property of maturing all its heads of fruits at nearly the same time so that all could be collected at one operation; (3) a large annual yield of fruits; (4) a fruit rich in pulp and carrying large thin-shelled nuts.

From what has been said, it will be seen that Dr. Chevalier's monograph must prove useful and suggestive to all interested in the utilisation of the West African oil palm, and especially to agricultural and forestry officers in West Africa, on whose work the future of this industry so largely depends.

LES BOIS INDUSTRIELS. Par J. Beauverie. Pp. 420, with 53 figures in the text. (Paris: Octave Doins et Fils, 1910.)

This handbook forms one of a series of monographs on technical botany in course of publication in connection with *L'Encyclopédie Scientifique*. It deals in a concise manner with the principal home and foreign timbers entering the French market, and a large amount of useful information has been brought together in a very readable book.

The author has treated his subject under two chief heads. The first eighty pages are occupied with a general consideration of timber from the botanical, physical, and chemical standpoints, the treatment being much on the lines of that of standard works already reviewed in this *Bulletin*. The botanical structure of timber is considered at some length. The important question of the relationships between the proportional development of the constituent tissues of the xylem and the physical qualities of the timber is treated in a clear and suggestive manner, and though the usual accounts of the annual development of the wood and the occurrence and functions of heart- and sap-wood are once more given, they are repeated with some freshness. Moreover, the description of the formation of annual rings is supplemented by a discussion of the influence of the climatic conditions of the tropics upon the structure of wood.

The second part is concerned with specific descriptions of the various timbers entering France, their botanical origin, sources of supply and application in the arts. There are two sections, the first dealing with home-grown woods, and the second with those imported. In the case of the former, an artificial but practical classification is made into hard woods, *e.g.* the oaks, beech, chestnut, ash, and elm; white woods, *e.g.* hornbeam and its congeners, sycamore (*Acer*), alder, birch, lime, and poplar; and resinous or coniferous timbers. The foreign woods are treated of under the headings of timbers valuable for cabinet-making and joinery; timbers used in building construction; and dyewoods. The article on mahogany is somewhat disappointing, especially when dealing with West African mahogany, where the important advances recently made as to the botanical identity of the several species affording this increasingly popular timber have not been adequately noticed. Further, the difficult problem of West African teak is not treated as a modern question, since *Oldfieldia africana* is alone considered as the source of this timber. It is important, however, to note the definite assertion that the timber of the species named, once largely used in Europe, no longer enters the French market.

The book contains a good bibliography and a useful index.

LES PLANTES À GOMMES ET À RÉSINES. Par H. J. de Cordemoy. Pp. xiv. + 412. (Paris: O. Doins et Fils, 1911.) This book forms Volume 16 in the *Bibliothèque de botanique appliquée*, which is being published under the general editorship of M. Lecomte. Two volumes in this library have appeared already, viz., that on "plantes à tubercules," by Prof. Jumelle, and that on "industrial woods," by M. Beauverie (see above).

Dr. Cordemoy devotes 168 pages to the subject of gums. He commences with a discussion of the mode of origin and the significance of gum production in plants, and gives a summary of information on the composition and properties of these products. He divides the gums into three great groups: (*a*) *true gums*, typified by the so-called "gum arabic" of the Sudan and Senegal; (*b*) *mixed gums*, which includes tragacanth and similar so-called "insoluble" gums; and (*c*) *tannin-gums*, represented by the kinos. Under each of these headings he discusses at length the botanical sources, methods of collection and distribution, quality and properties of the chief commercial gums of each class. These summaries are very well done, particularly on the botanical side, though the commercial and statistical information given in them is in some cases rather inadequate. Thus figures of export of gum from Egypt are not given for later years than 1906. Reference is made to the system of grading Senegal gum at Bordeaux, but nothing is said as to the grading of Sudan gum as carried out at Trieste and elsewhere (see *Selected Reports from the Imperial Institute* [Cd. 4971], p. 147).

The second of the three portions of the volume is devoted to resins and oleo-resins, the method of treatment being similar to that adopted for the gums, the turpentines being dealt with first, then sandarac, copals, dammars, elemi, mastic, the oleo-resins, and finally the balsams and balsamic resins. It is unfortunate that the author includes the "Kauri gums" of New Zealand and New Caledonia, and the copals of Manila and Pontianac with the dammars, as this can only add to the confusion which already exists between copals on one side and dammars on the other. The distinction between these two kinds of resins is clearly drawn on the commercial side, and the confusion which has arisen in the scientific literature appears to be due entirely to the fact that botanists have not attached due weight to the well-marked differences in composition and physical properties which exist between the two groups. It is too late in the day to attempt to apply the name dammar to resins derived from *Dammara* spp.

The third section of the volume deals with gum-resins, in which class, for no very obvious reason, Dr. Cordemoy includes the lacquers of China, Japan, and Burma. In this section also the yellow gum-resin of

The author's views on the diffusion process are also worth recording here. The usual way of obtaining the sugar from the cane is to express the juice by passing the cane between rollers; but an alternative method similar to that by which beet sugar is obtained, is to cut the cane into thin slices and immerse these in water or in weak syrup and allow the sugar to diffuse out. It is known as the diffusion method, and the liquid so obtained is invariably purer than that extracted by milling, since in the latter the gummy matters from the broken joints and fibro-vascular bundles get mixed with the juice. The method first came into prominence about 1884, and since then has received extended trials. The majority of the factories that tried it have reverted to milling, but the process cannot be considered as dead, since several of the older plants remain in successful operation, and a few have been erected in recent years. The author discusses the defects of the method, among which is excessive coal consumption, but thinks that this can be reduced by better design of the factories.

THE FEEDING OF CROPS AND STOCK. AN INTRODUCTION TO THE SCIENCE OF THE NUTRITION OF PLANTS AND ANIMALS. By A. D. Hall, M.A., F.R.S. (Director of the Rothamsted Experimental Station). Pp. xvi. + 298. (London: John Murray, 1911.)

This book is designed to afford to the student an introduction and survey of agricultural science, so that he may gain a general idea of the scope and objects of the subject before entering upon a detailed study of its various sections; it is also intended to provide the practical farmer with an outline of the theory of the processes by which his crops and stock make their growth. It is a companion volume to *The Soil* and to *Fertilisers and Manures*, by the same author, which were reviewed in this *Bulletin* (1903, **1**. 215, and 1910, **8**. 222). It deals first with the composition and growth of the plant, describing the nature and functions of leaf and root, air and soil; then the food and feeding of the animal are treated of, and, finally, there are chapters on farmyard manure, artificial manures and dairy products. The subject matter is illustrated by numerous plates, and many simple experiments are described which afford evidence of the properties described in the text.

The information given by soil analysis has long been a source of disappointment to those who hoped that it would throw a flood of light on the causes of the relative fertility of different soils, and would readily afford guidance as to their requirements; the author's remarks on this subject are therefore of great interest as representing the soundest modern views on the subject.

He points out that an ordinary straightforward analysis which determines all the nitrogen in the soil and all the phosphoric acid and potash which can be dissolved out by strong hydrochloric acid shows enough food material for fifty and even one hundred ordinary crops, so that it is difficult to base upon it any recommendations regarding the manures required. The difficulty is not much lessened by employing weak solvents such as citric acid or carbon dioxide solution, which have been suggested, for it is not possible to say that if a soil contains less than a certain amount of phosphoric acid determined by these methods, it follows that phosphatic manuring is required. For example, a sandy soil may contain much less phosphoric acid than a clay soil, and yet feed the plant equally well because its open aerated texture induces a much greater root development. He considers that the analysis of a soil, even by the most refined methods, is chiefly of value when it can be compared with a number of analyses of similar soils of the same type of land, so as to ascertain its *relative* deficiencies or excesses, and interpret them in the light of what has been ascertained beforehand about this type of soil by experience or by field trials. For example, if the average percentage of phosphoric acid in soils of a given type is 0·15, and it is also known that phosphatic manures usually meet with a fair response on such land, then if the soil of a particular field only shows 0·12 per cent. it will be safe to predict the need for phosphatic manures on that field, though on other soils 0·12 per cent. might indicate a richness in phosphoric acid not requiring phosphatic manures.

In agricultural science it may be said that the unexpected always happens, that is to say, that the results one is tempted to look for after applying in practice the indications given by the first few discoveries, fail to be realised and disappointment ensues. In this work the author is successful in clearly and simply explaining how the different factors of each problem work out and effect the results observed, and in making the subject interesting even to those who are not immediately concerned with agriculture.

A HANDBOOK OF TROPICAL GARDENING AND PLANTING, WITH ESPECIAL REFERENCE TO CEYLON. By H. F. Macmillan. Pp. xii. + 524 + xvi. (Colombo: H. W. Cave & Co., 1910.)

The outstanding feature of this book is the wide field the author has attempted to cover, as will be seen from the following brief summary of its contents.

Section I. (pp. 1–115) deals with climate, soils, plant physiology, manures, soil and cultural operations, propagation of plants, tools, garden accessories and the laying out of gardens. Some of the topics are necessarily dealt with very briefly, but on the whole the result is good. The matter is clearly arranged and concisely presented, and the information is generally accurate, much of it being the outcome of the author's successful work for some fifteen years as Curator of the Royal Botanic Gardens at Peradeniya. On page 17 the author, perhaps unintentionally, intimates that in plants respiration only takes place at night. The reference on p. 104 to *Paspalum conjugatum* as "Barbados sour grass" is inaccurate; this valuable plant is *Andropogon pertusus*, mentioned on p. 462 without a common name.

Section II. (pp. 116–253) deals with fruits, vegetables and spices, well arranged according to their suitability for low- and up-country cultivation. The descriptions are followed by short cultural directions, seasons for sowing, and other thoroughly practical notes.

Section III. (pp. 254–389) deals, in similar fashion, with ornamental trees and garden plants generally, shade trees for roads and crops, and gardens for railway stations and schools; hints to competitors and judges at agri-horticultural shows are also included.

Section IV. (pp. 390–524) is mainly devoted to descriptive and cultural notes on the economic plants of Ceylon, and, to a subsidiary degree, those of other parts of the tropics also. Insect and fungoid pests, the transport of plants and seeds, reference data, recipes for jams, etc., and very useful horticultural calendars for different regions of Ceylon complete the volume.

Regarding the book as a whole it is a very useful production, and one which should be of service in other parts of the tropics in addition to Ceylon, because the author has generally taken care to indicate the conditions as to temperature, rainfall, elevation and soil to which the plants are suited.

Mistakes, naturally, are to be found in a volume dealing briefly with such a diversity of topics. This is particularly the case in the notes on industries other than those of Ceylon, and in the broad surveys of products; matters not within the scope of the author's practical work. On p. 428 crystallised sugar is said to be obtained from cane-juice by a process of "fermentation, clarification, etc." Fermentation in the sugar industry is important in connection with rum production, but not of sugar crystals. Under "Cotton," Queensland is placed fourth as a producing country, ranking with the United States, India, and Egypt, no other region being even mentioned; this, needless to say, is entirely erroneous. Shea butter should be transferred from the group of vegetable waxes (p. 449) to that of the oils and fats. There is an obvious slip on p. 411, where the tea crop is given as ranging from 500 to 11,000 lb. per acre. Cigar and pipe tobaccos are stated on p. 413 to be obtainable from the same plant, apparently mainly by grading; this certainly is not usually the case, whatever may be done in Ceylon. It might, too, have been indicated that there are other methods besides air-curing employed in tobacco preparation. Considering the mass of scientific names and that the book was printed in Ceylon, misprints are not particularly numerous; they are, however, rather abundant on p. 408 under "Rubber," in which connection it might be noted also that *Sapium Jenmani* is important in British Guiana, and not *S. aucuparium*, as stated. There are several other points which might be referred to, and, in fact, the whole of the information dealing with products, other than their cultural side, would be the better for careful revision by an economic botanist. This well done, the result would be a comprehensive and most useful volume. The illustrations, mostly from Mr. Macmillan's own photographs, deserve a special word of praise.

sixth (1909) editions of this work have been published, both of which have been substantially revised.

The extracts are not in all cases correctly rendered, and it is presumably due to imperfect proof-reading that we get the misprinted equation on p. 208, which is sure to confuse the beginner. On p. 59 we are informed that "the planes of all crystals are referred to certain imaginary lines termed axes, which are supposed to exist within the crystal. . . . That part of each axis extending from the centre to the surface of a crystal, or, in other words, the axial intercept, is called its parameter." On p. 143 the Longmyndian is included in the Cambrian, but on p. 187 we find it in the Precambrian, and on the latter page we are informed that *Eozoon Canadense* is a problematic fossil. For his lists showing the succession of strata in North America, Australia, New Zealand, and South Africa, the author quotes Prestwich's *Geology*, published in 1888. In common with many other authors Colonel Sorsbie does not appear to be aware that Ireland is not a part of Great Britain.

Three-fifths of the book is devoted to general geology; the remainder deals with what the author calls "practical geology," which includes water-supply; building-stones; bricks and clays; limes, cements and plasters; roads and canals; rivers; and coast erosion. Even this section of the book is unsatisfactory, and shows lack of knowledge of recently published sources of information. The book concludes with a hopelessly inadequate account of the "Uses of Minerals" in which iron is dealt with in seven lines, tin and copper in three lines each, although two whole pages are devoted to "mineral pigments."

A text-book of geology for engineers is not an easy one to write or compile, and there is need of such a book to suit the requirements of engineering students; but the author of this work cannot be complimented on the outcome of his effort to meet the need. The book gives much useful information, but it contains so many objectionable features that it cannot be recommended to students in its present condition, and drastic revision will be necessary to make it even tolerable.

THE MINING MANUAL, 1911. By Walter R. Skinner. Pp. xxii. + 1,372. (London The Author.)

This well-known work of reference fully maintains the standard established in former years. It includes particulars of the officers, property, capital, output and profit of almost every mine, shares in which are held in this country, as well as a directory of mine directors, secretaries, engineers and managers.

AUSTRALIA: PHYSIOGRAPHIC AND ECONOMIC. By Griffith Taylor, B A., B.Sc., etc. Pp. 253. (Oxford: The Clarendon Press, 1911.)

This is one of the Oxford Geographies edited by Dr. A. J. Herbertson. It is a welcome contribution to the economic geography of Australia. In the preface the author states that the present work is merely an introduction to the study of commercial geography of Australia, in which, following the plan of Mackinder, Davis, and other modern geographers, he has endeavoured to avoid bare statistics by laying most stress on the physical conditions which govern the industrial development of the Island Continent.

Mr. Taylor is well known in Australian geographical and geological circles, and is personally familiar with much of the area dealt with.

The book, as the title signifies, is divided into two parts. In Part I., the dominant meteorological, topographical, and geological features are clearly described and illustrated with numerous instructive diagrams. This forms a sound basis on which to proceed to the discussion of the economic aspects in Part II. Most of the diagrams and maps appear to have been carefully prepared. The map of Victoria, however, on page 71, has several errors, which will no doubt be corrected in future editions. Mt. Macedon is wrongly placed to the east of Melbourne instead of to the north, while several of the other errors are probably due to the printer. The town of Belfast has now long been known as Port Fairy.

The three sections into which the first part of the book is divided are well chosen, and in Section 3 the natural physiographic regions are clearly and concisely described.

Part II. is divided into six sections: I., Stock raising; II., Agriculture; III., Mining; IV., Other Industries of Australia; V., Transport; VI., Forecast. The relation of these to the physiographic aspects is well brought out. Some of the statistics given might with advantage be brought a little more up to date, and the latest information from Western Australia places the Collie coal in the Permo-carboniferous. These are minor defects, which would, no doubt, not have appeared if the author, who is now in the Antarctic, had had an opportunity of revising the final proofs.

The book is the outcome of much careful thought and study, and the aim of the author to show the intimate relation between economic and physiographic conditions is well sustained throughout.

AFGHANISTAN: THE BUFFER STATE. Great Britain and Russia in Asia. By Captain Gervais Lyons, 2nd Batt. Suffolk Regiment, late of the Indian Army; with an introductory note by Lieut.-General Sir Reginald C. Hart, K.C.B., K.C.V.O., V.C. Pp. iii. + 232 + x. (London: Luzac and Co., 1910.)

It is as a "Buffer State" between Russian and British Territories that Afghanistan plays such an important part. Almost twice as large as the British Isles, Afghanistan consists of a square, mountainous, irregular plateau, 3,000 to 5,000 feet above sea-level. The greater part of the country is valueless for agricultural purposes, owing to the extremes of heat and cold experienced, and for this reason the population, estimated at about 5,000,000, is largely nomadic. Afghanistan is now within the British sphere of influence; our interest in that country, as in Persia and Tibet, being practically Indian.

In addition to an account of Afghanistan, the book contains a description of the whole of that vast mountainous country which would become the theatre of operations in the event of an invasion of India from the north.

The book is published with the official sanction of the Army Council. It is provided with a complete index to proper names and contains two outline maps showing all frontiers and existing and projected railways.

Primarily intended for the use of officers in the British Army, the book will also appeal to those of the general public who desire a knowledge of the real state of affairs in Central Asia.

HEATON'S ANNUAL, 1911. The Commercial Handbook of Canada and Boards of Trade Register. Pp. 540. (Toronto : Heaton's Agency. London Agents: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.)

Heaton's Annual, now in its seventh year, contains in its first section the usual information found in reference books of its character, *e.g.* an official directory, postal regulations, the Customs tariff, etc.

The second portion presents two characteristic features. The first is a gazetteer of towns with, under "special opportunities," indications as to likely business openings. The second is a very useful summary of information on apparently every topic of practical interest, classified in such a manner as to be readily accessible.

THE SNAKES OF CEYLON. By A. F. Abercromby. Pp. 89. (London: Murray and Co., 1910.)

Prior to the publication of this little treatise the only information available on this interesting group of the Ceylon fauna was contained in general works on natural history or included in the "faunas of India," which were often inaccessible or of too technical a character to be of use to the general reader. Owing to the climatic and geographical conditions obtaining in Ceylon, that country is particularly favourable to snakes, and is an admirable hunting-ground for those interested in the study of ophiology. Of the 9 families into which snakes are divided, 6 are represented in Ceylon; these include 31 genera and 55 species (excluding 3 which are doubtfully native). Lest these numbers should intimidate intending visitors, it may be pointed out that many of the Ceylon snakes are harmless, others are extremely rare and but seldom seen unless specially sought for. Eight species only are recognised as dangerous, and the author has devoted a chapter to the description of these which will render their identification easy even by those who have no scientific knowledge of the subject.

In addition to matter descriptive of the various species of Ceylon snakes, the book includes chapters on snake-hunting, skinning, and preserving; protective colouring, snakes in captivity, and some interesting Sinhalese legends and stories relating to snakes.

To intending visitors to Ceylon or to residents in the island, this little book should prove interesting reading, and naturalists and sportsmen will find it a useful manual.

BULLETIN

OF THE

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SCIENTIFIC AND TECHNICAL DEPARTMENT.

RECENT INVESTIGATIONS.

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Colonial and Indian Governments concerned.

"AMANG" FROM THE FEDERATED MALAY STATES.

IN a previous report published in this *Bulletin* (1906, 4. 301) attention was directed to the discovery of monazite in the tin-bearing alluvium of the Malay Peninsula, and a large number of analyses of heavy sands from the Federated Malay States were then published. In October 1909 the Government Geologist at Batu Gajah, Federated Malay States, forwarded to the Imperial Institute nine samples of "amang" for detailed analysis. It may be explained that the term "amang" is applied to certain heavy sands obtained in the Chinese process of tin-mining in Malaya (*loc. cit.*).

These samples have been analysed, with the following results. Each sample was examined for tungsten, chromium and copper, and where these constituents are not recorded they are definitely known to be absent.

(1) "Selama, Perak."

This specimen consisted chiefly of zircon and ilmenite, with small amounts of tourmaline, quartz, tinstone, monazite, pyrite, magnetite, rutile and brookite.

A chemical analysis showed the sample to contain:—

		Per cent.
Stannic oxide	SnO_2 . . .	5·64
Chromium sesquioxide . .	Cr_2O_3 . . .	*trace*
Thoria, ceria and allied oxides .	ThO_2, Ce_2O_3, etc.	0·35

(2) "Puchong Babi, River Kenring, Perak."

Tinstone appeared to be the principal constituent of this sample, but considerable amounts of ilmenite and monazite were also present, with small quantities of zircon, tourmaline, quartz and magnetite.

A chemical analysis showed the sample to contain:—

		Per cent.	
Stannic oxide . . .	SnO_2. . .	62·35	
Ceria and allied oxides .	Ce_2O_3, etc. .	10·59	11·16
Thoria	ThO_2 . .	0·57*	

(3) "Sri Muka, Perak."

This specimen consisted chiefly of ilmenite, with a considerable amount of tinstone and small quantities of tourmaline, quartz, monazite, zircon and topaz.

A chemical analysis showed the sample to contain:—

		Per cent.
Stannic oxide	SnO_2 . . .	15·98
Thoria, ceria and allied oxides .	ThO_2, Ce_2O_3, etc.	*trace*

(4) "Upper Perak."

This specimen consisted chiefly of ilmenite, with small amounts of quartz, tinstone, monazite, zircon, tourmaline and rutile.

A chemical analysis showed the sample to contain:—

		Per cent.
Stannic oxide	SnO_2 . . .	2·59
Thoria, ceria and allied oxides .	ThO_2, Ce_2O_3, etc.	0·94

* *Equivalent to* 3·5 *per cent. of thoria expressed on the monazite present in the sample.*

consisted chiefly of pyrite, tourmaline, quartz and zircon, with small amounts of monazite, tinstone, magnetite, brookite, anatase, topaz and fluorspar.

A chemical analysis showed the sample to contain :—

		Per cent.
Stannic oxide	SnO_2 . . .	2·60
Chromium sesquioxide . .	Cr_2O_3 . .	*trace*
Thoria, ceria and allied oxides .	ThO_2, Ce_2O_3, etc.	1·35
Sulphur	S . . .	4·43
Arsenic	As . . .	*nil*

(9) "Situpeh, Perak."

This specimen consisted chiefly of tinstone, with some zircon, ilmenite and monazite, and small amounts of pyrite, tourmaline, quartz, anatase and magnetite.

A chemical analysis showed the sample to contain :—

		Per cent.
Stannic oxide	SnO_2 . .	76·50
Thoria, ceria and allied oxides .	ThO_2, Ce_2O_3, etc.	2·67

General Conclusions.

The results of examination of the present samples serve to confirm the qualitative mineral composition found for the "amangs" previously examined at the Imperial Institute (*loc. cit.*), but No. 6 contains copper, which has not been previously noticed in samples analysed at the Imperial Institute, but its occurrence in this specimen from Kinta is not surprising, since in his Annual Report for 1908 the Government Geologist for the Federated Malay States has recorded the presence of metallic copper in a tin ore concentrate from the same locality.

The quantity of monazite in the present samples is uniformly small, and is in no case sufficient to render the "amangs" of value as a source of thoria.

The most noticeable feature of certain of the samples is their richness in tinstone, and Nos. 2, 5 and 9, containing respectively 62·35, 67·8 and 76·5 per cent. of that ore, should be valuable sources of tin if they are available in quantity.

MONAZITE SAND FROM TRAVANCORE, INDIA.

A SAMPLE of monazite sand from Travancore was forwarded to the Imperial Institute in 1909 by the Geologist for the Northern Division, Travancore, who stated that it represented naturally concentrated sand, of which a deposit of considerable extent had been found near Quilon.

The sand contained over 46 per cent. of monazite; ilmenite and zircon being the other principal constituents, with some rutile and traces of spinel, garnet, quartz and hornblende.

A chemical analysis gave the following results:—

	Per cent.
Thorium dioxide (ThO_2)	4·00
Cerium, yttrium and lanthanum oxides (Ce_2O_3, Y_2O_3 and La_2O_3)	28·34

The monazite in this sand can be readily separated in a fairly clean state by means of an electro-magnet.

A specimen of pure monazite separated from the sample was found to contain 8·5 per cent. of thoria (ThO_2), so that as the crude sand contained 4·00 per cent. of thoria, the amount of monazite present must be about 46·2 per cent.

In reporting these results, it was pointed out that the value of this Travancore sand would be much enhanced by eliminating the valueless minerals, such as ilmenite, zircon, etc., by electro-magnetic separation, as described in a previous number of this *Bulletin* (1905, **3**. 289).

A second sample of monazite sand from Travancore was received in May 1910. This contained about 50 per cent. of monazite, the other constituents being the same as those in the first sample.

Subsequently the Imperial Institute received a sample of a concentrate obtained from the crude sand.

This had the following approximate mineral composition:—

	Per cent.
Monazite	$90\frac{1}{2}$
Ilmenite (including a little garnet) . . .	$6\frac{1}{2}$
Zircon (including a little rutile) . . .	3

The thoria (ThO_2) present amounted to 8·87 per cent., expressed on the concentrate as received, and a specimen of practically pure monazite, separated electro-magnetically from the concentrate, contained 10·08 per cent. of thoria (ThO_2). The above was a specially-prepared concentrate, and it is understood that the concentrate prepared on the large scale from the Travancore sand and marketed in London usually contains from 5 to 6 per cent. of thoria.

This commercial material is probably represented by a fourth sample, which reached the Imperial Institute in May of the present year. It consisted chiefly of monazite, with a considerable amount of ilmenite and some zircon. Small amounts of magnetite, garnet, rutile, sillimanite and quartz were also present.

The following is approximately the composition of this concentrate, as ascertained by electro-magnetic separation :—

			Per cent.
Fraction	1.	Chiefly ilmenite	26
"	2.	Practically pure monazite .	62
"	3.	Chiefly zircon	11

Commercial Valuation of the Monazite Sand.

The first sample of Travancore monazite sand was submitted for valuation to chemical manufacturers in London. They stated that it would be worth about £5 per unit per cent. of thoria present (June 1910).

General Conclusions.

It will be seen from the foregoing information that this Travancore deposit consists of material of considerable commercial value even in its natural state, and that by concentration its value as a source of thoria can be enhanced far beyond that of the Brazilian material, which, as marketed, contains as a rule less than 4·0 per cent. of thoria (*loc. cit.* p. 287).

The monazite in the Travancore sand is also of interest from the fact that it is richer in thoria than the monazite in the Brazilian and Carolina sands. In this respect it resembles the variety of monazite which occurs in Ceylon. The Ceylon

useful in European commerce. The nuts must therefore be freed from the external shell or pericarp before exportation, not only on account of the freight, but also because decortication would be too expensive to conduct in this country.

The nuts are bluntly conical in shape, ranging from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in height and from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in diameter at the base, and are covered with a brown fibrous layer, which varies from $\frac{1}{32}$ to almost $\frac{1}{16}$ inch in thickness. On cutting a number of the nuts, they were found to possess a large central cavity, which was enclosed by a peripheral layer of albuminous matter (endosperm), nowhere exceeding $\frac{1}{4}$ inch in thickness, and this was covered by the fibrous layer already mentioned. The albuminous material was hard, milk-white and opaque, and on this account it was suggested that the nuts could possibly be utilised in the same manner as the true "vegetable ivory nuts" (corosos nuts), derived from *Phytelephas macrocarpa* and other species in South America. The latter are largely utilised for making buttons, and, consequently, samples of the Dum palm nuts were supplied to firms of button manufacturers at Birmingham for trial. They reported that the nuts were not as good as "corosos nuts" for this purpose, as the presence of the large cavity involved a considerable waste in cutting, and, in addition, the material could not be polished to a sufficiently fine finish. Corosos nuts, being almost solid, can be cut to much greater advantage, and the buttons made therefrom are easily polished to a fine finish.

The Dum palm nuts would therefore only furnish an inferior button, and their value delivered at Birmingham was estimated at £5 per ton, compared with £9 per ton for corosos nuts from Carthagena and £11 to £12 for corosos nuts from Guayaquil (November 1903). An importer of the latter stated that the cost of dock dues, warehouse charges, etc., at an English port and the carriage to Birmingham would be from 35*s.* to 40*s.* per ton, which would leave about £3 per ton; and out of this sum the cost of collection and transport to this country would have to be paid.

In addition to these investigations into the suitability of the nuts for the manufacture of buttons a number of inquiries were made in other directions. Samples were supplied to makers of various composite preparations used for the manufacture of billiard and bagatelle balls and many other purposes, but after trials they reported that the material could not be utilised in this way. It had been suggested that the nuts might be made into small balls suitable for bagatelle or other games by turning them on a lathe, but owing to their shape and the presence of the large cavity this is difficult to accomplish without making the shell unduly thin at certain points, and the balls thus formed would be liable to shrink and become distorted.

Several ivory merchants and others have also been furnished with samples of the nuts, which have been tried for a variety of different purposes, including the manufacture of round knobs for umbrella handles. No practical suggestion has been received for their utilisation, however, as in most cases the large cavity in the centre has proved a great hindrance to their use. In one case it was considered that a means of utilising the nuts had been found and a provisional price of £6 per ton in London was quoted, but further experiments proved unsatisfactory.

The position up to 1905 was therefore that these nuts, though inferior to corosos nuts for the manufacture of buttons, could be used in this way, but that the price they would fetch for this purpose was too low to pay for their collection and transport.

Since then the price of corosos nuts has risen very considerably and they are now quoted at £20 to £35 per ton in London, and it is to this rise in price that the interest shown recently by manufacturers in the nuts of the Dum palm is mainly due.

The Hyphænæ included under the name "Dum palm" and their distribution are discussed fully by Signor O. Beccari in an article published in *L'Agricoltura Coloniale* (1908, **2**. 137). This author concludes that there are at least 42 species included in this genus, and that these occur throughout tropical and subtropical Africa, from Natal in the south to Central Egypt in the north, and from Senegal in the west to Cape Gardafui in the east. Of these species he regards three as producing nuts suitable for use as vegetable ivory, viz. *H. nodularia*, which is much the best, and *H. benadirensis* and *H. mangoides*, which both yield inferior but still possibly useful nuts. His description of the nuts of these species is as follows :—

H. nodularia.—This species occurs in Erythræa principally along the Gasc and the Bara, and from thence across to the Nile valley in Egypt.

The nuts vary from 36 to 41 mm. in length and from 36 to 38 mm. in breadth at the broadest part near the base. They are roughly conical in shape, with a slightly concave base and an asymmetrical blunt apex. In transverse section they are roughly circular, but the endosperm is slightly thickened at three nearly equidistant points, which gives the section the appearance of being somewhat triangular. The endosperm was from 8 to 9 mm. thick in the single specimen measured, but it is stated to be usually thicker than this.

H. benadirensis.—The specimen examined by Beccari was from Dum palms growing near Billic, a town near the Juba in Italian Somaliland. The nut was irregularly pyriform in shape with a flat base and a blunt asymmetrical apex. The endosperm was 8·9 mm. thick.

H. mangoides.—This species occurs all along the Somaliland coast. The nuts examined were from 42 to 44 mm. in length, about 35 mm. broad in one direction and about 28 mm. broad in the direction at right angles to this. They were ovately pyriform in shape with a slightly concave base and a rounded apex. The endosperm was 9 to 10 mm. in thickness.

The nuts of *H. thebaica*, the variety received at the Imperial Institute from the Sudan are also described by Beccari. He states that this species occurs along the central portion of the Nile valley and in Upper Egypt. The nuts are 35 to 40 mm. in length and 27 to 28 mm. broad at the base. They are ovately conical in shape, and usually narrower in comparison with their length than those of the other species mentioned. The endosperm is from 8 to 9 mm. thick.

His description of the nuts of *H. crinita* is also interesting in the present connection, since a supply of these was received at the Imperial Institute from Natal for investigation in March 1906. This species, according to Kirk, occurs along the Zambesi to a distance of 200 miles from the coast, and Drude has recorded it in Madagascar. The nut is described as pyriform in shape, with a blunt apex and a large internal cavity. The endosperm is 7 mm. thick.

SOLANACEOUS DRUGS FROM INDIA.

In previous numbers of this *Bulletin* (1903, **1**. 175; 1904, **2**. 222, 224) an account was published of the results of examination at the Imperial Institute of *Datura Stramonium* seeds and of *Hyoscyamus muticus* herb from India and Egypt. Apart from their interest from a scientific point of view, the results then recorded were of commercial importance in establishing the fact that *Hyoscyamus muticus*, as produced in Egypt, is of great value as a source of the alkaloid hyoscyamine, since the leaves may contain 1 per cent. or more of this alkaloid uncontaminated with the other Solanaceous alkaloids. Hyoscyamine itself is but little used in medicine, but it is convertible by a very simple process into the alkaloid atropine, which is used in considerable quantities in medicine, and consequently *Hyoscyamus muticus* has come into use for the manufacture of atropine, and is now regularly imported into the United Kingdom for this purpose.

Since 1904 a number of samples of other Solanaceous plants have been received at the Imperial Institute from India for examination, and the results obtained enable a general survey to be made of the value of these materials as sources of the Solanaceous alkaloids, hyoscyamine, atropine and scopolamine (hyoscine), in comparison with the similar materials obtained elsewhere and now used more or less, either directly in medicine or as sources of these alkaloids. A full account of the results will be communicated shortly to one of the scientific journals, and the following summary gives particulars of general and commercial interest only.

DATURA STRAMONIUM.

The specimens of *Datura Stramonium* were received from the Officiating Reporter on Economic Products to the Government of India at intervals during the period 1905 to 1907.

From the materials supplied a number of typical specimens were selected for chemical examination. The alkaloids contained in the plants were carefully isolated and their amount and nature determined. The results are given in the following table :—

RESULTS OF EXAMINATION OF *DATURA STRAMONIUM.*

No. of Sample.	Part of Plant examined.	Percentage of Total Alkaloid in dry material.	Alkaloids present.	Remarks.
24242	Leaves . . .	0·420	Hyoscyamine and scopolamine	These alkaloids were present in the proportion of about 5 to 1 respectively.
24243	Seeds	0·186	Hyoscyamine and scopolamine	These alkaloids were present in the proportion of about 3 to 1 respectively, and there was in addition a small quantity of impure alkaloid, probably hyoscyamine.
24244	Roots	0·159	Not identified	
26963	Fruits of large plant *	0·450	Hyoscyamine only	There was no indication of scopolamine or any other alkaloid but hyoscyamine.
26963	Leaves of large plant *	0·410	Hyoscyamine and scopolamine	These alkaloids were present in the proportion of about 4 to 1 respectively.
26964	Fruits of small plant *	0·460	Hyoscyamine and scopolamine	These alkaloids were present in the proportion of about 4 to 1 respectively.
26964	Leaves of small plant *	0·450	Hyoscyamine only	There was no indication of any other alkaloid but hyoscyamine.
26965	Stems of large plant	0·260	Hyoscyamine and scopolamine	The amount of scopolamine was small in proportion to the hyoscyamine.
26966	Stems of small plant	0·250	Hyoscyamine and scopolamine	There appeared to be rather more scopolamine than in the case of No. 26965 ; about 1 part to 3 or 4 parts of hyoscyamine.
26967	Very small complete plant	0·220	Scopolamine only	There was no indication of any other alkaloid but scopolamine.
26968	Roots of large and small plants †	0·214	Hyoscyamine, scopolamine, and another alkaloid not identified	The hyoscyamine and scopolamine were present in about equal amounts.

The first three samples were from Madras, the remainder from the Punjab.

* *In specimens Nos.* 26963 *and* 26964 *the fruits and leaves were examined separately; there was about* 10 *parts by weight of fruits to* 1 *part of leaves.*

† *The alcoholic percolate of these roots contained potassium chloride and potassium nitrate, amounting when calculated as* K_2O *to* 1·42 *per cent. of the roots.*

The following points are noteworthy in connection with the foregoing results :—

In Nos. 24242 and 24243 from Madras, the predominant alkaloid in the leaves and seeds was hyoscyamine, the only other alkaloid present being scopolamine. In Nos. 26963-26968 from the Punjab, the percentage of total alkaloid in similar parts of the large and small plants was practically the same, whether in the fruits, stems or leaves.

The alkaloids were either hyoscyamine or scopolamine, or both in varying proportions, except in the case of the roots, where there was evidence of a third alkaloid. No atropine was present in any of the samples.

Hyoscyamine was the only alkaloid found in the fruits of the large plant and in the leaves of the small plant. In each case it was present to the extent of nearly 0·5 per cent., and could readily be isolated in a crystalline condition.

Scopolamine was the only alkaloid found in the very small complete plant (No. 26967). With this one exception, the predominant alkaloid in these Punjab plants was hyoscyamine, as in the case of the plants from Madras.

The alkaloids in the stems of the large and small plants consisted of both hyoscyamine and scopolamine, but in the case of the fruits and the leaves it is noticeable that scopolamine is absent in the leaves of the small plant and in the fruits of the large plant.

The single specimen of the roots examined consisted of the mixed roots of both large and small plants. The alkaloids present consisted of hyoscyamine and scopolamine in about equal proportions, together with a third alkaloid which was not identified. The following table will indicate these results more clearly :—

ALKALOIDS IN *DATURA STRAMONIUM* FROM THE PUNJAB.

	Stems.	Leaves.	Fruits.	Whole plant.	Roots.
Very small plant . .	—	—	—	Scopolamine	—
Small plant .	3 or 4 parts of hyoscyamine to 1 part of scopolamine	Hyoscyamine only	4 parts of hyoscyamine to 1 part of scopolamine	—	Hyoscyamine and scopolamine in about equal proportions, and a third alkaloid
Large plant .	Hyoscyamine and scopolamine. Rather less scopolamine than in stems of small plant	4 parts of hyoscyamine to 1 part of scopolamine	Hyoscyamine only	—	

The percentages of total alkaloid found in the specimens of *Datura Stramonium* from India are compared in the following table with those recorded for the plant grown in other countries :—

	Indian specimens.	*Other countries.*
Seeds	0·186	0·21 to 0·48 (European) 0·35 (Egyptian)
Fruits	0·46	—
Leaves	0·41 to 0·45	Up to 0·4 (European)
Stems	0·25 to 0·26	Main stems 0·09 (European) Upper branches 0·36 (European) Average 0·22 (European)
Roots	0·214	Main roots 0·10 (European) Rootlets 0·25 (European) Average 0·17 (European)

It is clear from a comparison of these figures that the Indian *Datura Stramonium* is on the whole quite equal if not superior to the European plant in the amount of total alkaloid which it

It weighed 20 lb., and consisted of whole plants dried, and in a broken condition. The leaves and fruits had for the most part become separated from the stems, and were to a large extent in small fragments. The stems were in lengths of 2 to 3 feet, and varied from $\frac{1}{8}$ to $\frac{3}{4}$ inch in diameter.

The leaves and seeds were submitted to chemical investigation, as being more important from a commercial point of view than the stems.

The results of the determination of the alkaloids present were as follows :—

Part of Plant.	Moisture.	Total Alkaloids.		Alkaloids present.
		In moist material.	In dry material.	
	Per cent.	*Per cent.*	*Per cent.*	
Leaves	9·45	0·22	0·25	Scopolamine and a small proportion of atropine.
Seeds	8·07	0·21	0·23	Scopolamine and a small proportion of atropine.

Specimens of *Datura Metel* grown in France were examined a few years ago by Schmidt, who found that scopolamine was present in all parts of the plant, unaccompanied by any notable quantity of other mydriatic alkaloids. The dried leaves were found to yield 0·55 per cent. and the seeds 0·50 per cent. of scopolamine. Kircher has confirmed these figures, and also asserts that scopolamine forms the bulk of the alkaloid in the plant, only small quantities of hyoscyamine and atropine being present.

A comparison of these results with those obtained for the present sample indicates that *Datura Metel* grown in India resembles the European plant in so far that scopolamine is the predominant alkaloid. In this particular case the Indian specimen contains a smaller proportion of scopolamine than the European plants, but it is impossible to conclude that this is a general rule, as the quantity of alkaloid in Solanaceous plants is known to vary considerably with their age.

It has been suggested by Schmidt that *Datura Metel* should become the commercial source of scopolamine (hyoscine) which is employed in medicine.

Samples of the seeds and capsules of *Datura Metel* collected at Patiala in the Punjab were received in January 1910.

The results of their chemical investigation were as follows:—

	Seeds.	*Capsules.*
Moisture, *per cent.*	7·68	12·7
Total alkaloid—		
Expressed on material as received, *per cent.*	0·23	0·10
Expressed on dry material, *per cent.*	0·25	0·12
Akaloids present—	Hyoscyamine and scopolamine in the proportion of about 2 to 1; also a small amount of atropine.	Scopolamine only. No other alkaloid could be found.

The percentage of total alkaloid in the present sample of seeds, viz. 0·25 per cent. in the dry material, is in close agreement with the amount found (0·23 per cent.) previously (*see above*), and this result confirms the view that the Indian seeds contain considerably less alkaloid than seeds derived from *Datura Metel* grown in Europe.

The present sample of *Datura Metel* seeds is also exceptional in containing hyoscyamine as the predominant alkaloid (*see above*).

The sample of capsules of *Datura Metel* contains considerably less alkaloid than the seeds or leaves; but scopolamine is the only alkaloid present in the capsules.

HYOSCYAMUS RETICULATUS.

The specimens were received in August 1904, and consisted of the seeds and entire plants of *Hyoscyamus reticulatus*, collected in Baluchistan. It was stated that camels, sheep and goats eat this plant, but that cows, donkeys and horses will not touch it.

The material was examined and the following results obtained:—

No. of sample.	Part of plant.	Total alkaloid. *Per cent.*
23021	seeds	0·082
23023	whole plant	0·240
23024	whole plant	0·116

The total alkaloid obtained in the three determinations was mixed and carefully examined in order to ascertain its nature.

The presence of hyoscyamine was proved, but on account of the small amount of total alkaloid available it is not possible to state definitely whether any other alkaloid was present.

The results of the present investigation of *Hyoscyamus reticulatus* show considerable variation in the amount of total alkaloid in the whole plant, the two results obtained being 0·116 per cent. and 0·24 per cent.

No explanation can be given at present of the fact, mentioned in the correspondence, that camels, sheep and goats eat this species of Hyoscyamus. It suggests a tolerance for Solanaceous alkaloids which is not shared by other animals, but this peculiarity is not on record.

HYOSCYAMUS NIGER.

Leaves and seeds of *Hyoscyamus niger* from Saharanpur, India, were forwarded to the Imperial Institute in May 1902. They gave the following results on examination :—

The leaves were found to contain 0·062 per cent. of total alkaloid, expressed on the dried material, equivalent to 0·058 per cent. expressed on the material as received. The quantity of total alkaloid obtained was too small to permit of its constituents being identified.

Two determinations carried out on the seeds gave a mean of 0·081 per cent. of total alkaloid. It was found impossible to isolate hyoscyamine in a crystalline condition from the material.

The results of the examination of the samples of Indian *Hyoscyamus niger* agree with those recorded for the European plant, the leaves of which have been found to contain from 0·04 to 0·08 per cent. of total alkaloid, and the seeds from 0·06 to 0·1 per cent.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

THE UTILISATION OF WATTLE-BARK.

IN a previous number of this *Bulletin* (1908, **6**. 157) an article was published giving detailed information regarding the cultivation of wattle for the production of the valuable tanning

table, accounts for a large proportion of the total output from South Africa and Australia.

TANNING VALUE OF WATTLE-BARK.

Detailed analyses of wattle-barks from many sources are given in the *Bulletin* articles already referred to, and for the present purpose it will be enough to give in summary, analyses of the wattle-barks from British territory which now appear in commerce or may do so in the near future. The analyses of barks from Natal, Cape Province, and the East Africa Protectorate quoted in the following table, were made at the Imperial Institute.

Name.	Source.	Tannin.	Non-tannin matter.	Ash.	Moisture.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Black wattle-bark .	Natal	35·2 to 39·8	7·3 to 10·3	1·5 to 2·8	9·5 to 11·7
,, ,, .	Cape Province	40·1 to 44·1	7·1 to 13·0	1·5 to 1·8	10·1 to 10·9
,, ,, .	East Africa Protectorate	36·7 to 42·1	9·4 to 12·7	1·5 to 2·4	10·2 to 13·0
,, ,, .	Australia	38·3	4·4	—	11·1
Golden ,, .	S. Australia	40·2 to 49·5	9·0 to 9·4	—	11·2

These figures show that the wattle-barks from all these countries are rich in tannin, and this is confirmed by Paessler's statement (*Collegium*, 1911, p. 76), that the results of analyses of 260 samples of wattle-bark made at the Versuchs-anstalt für Lederindustrie zu Freiburg, in recent years, gave on the average 31·5 per cent. of tannin.

In view of the fact that most of the wattle-bark received in Europe is at present used in Germany, recourse must be made to the literature on the tanning industry of that country for information as to the practical value of wattle-bark as a tanning material. This subject is fully discussed by Paessler in the article already referred to, which is written mainly with the object of advocating a still more extended use of wattle-bark by German tanners. Paessler points out that apart from its richness in tannin, wattle-bark has the advantage of containing only 30 to 35 parts of non-tannin extractive matter to every 100 parts of tannin, and the quantity of sugars in this non-tannin extractive matter corresponds to about 3 parts for every 100 parts of tannin, whereas in oak-bark the sugars amount to 26 parts, and in hemlock-bark to about 32 parts to every 100 parts of tannin. Liquors made from wattle-bark are, therefore, far less prone to fermentation than those from most other tanning materials. The same expert has carefully investigated the actual relative cost per unit of tannin for the principal tanning materials, and his results are summarised in the following table (*loc. cit.*, p. 150):—

Name of material.	Average value of raw material per 100 kilograms. *Shillings.*	Average quantity of tannin present. *Per cent.*	Average cost of tannin per kilogram. *Shillings.*
Oak-bark	10·5	9·0	1·17
„ extract	25·0	25·0	1·00
Valonia	25·0	27·0	0·93
Quebracho wood	12·0	19·0	0·63
Divi-divi	24·0	28·0	0·63
Myrobolans	15·0	30·0	0·50
Mangrove-bark	15·0	38·0	0·39
Wattle-bark	20·0	33·0	0·61

It is clear from this comparative statement that wattle-bark is a very cheap tanning material when its actual cost is compared with those of the materials it would probably replace in the tan-yard, viz. valonia in the United Kingdom, and quebracho wood in Germany.

Further, the tannin contained in wattle-bark is very easily extracted, and Paessler states that not more than 3 or 4 per cent. of tannin need be left in the spent bark. Owing to the fibrous character of the bark its admixture with other tanning materials facilitates their extraction by preventing "clogging" and the formation of channels in the leaches.

It is a matter of common knowledge that liquors prepared from most tanning materials become weaker on keeping. Paessler's investigation of some of the chief tanning materials from this point of view is summarised in the following table and is of interest in showing that wattle-bark liquors show very little loss of strength when kept. The figures given represent the percentage loss of tannin in liquors of strength 2° Beaumé, after keeping for sixty days:—

Source of liquor.	*Percentage loss of tannin.*
Gambier	0·0
Mangrove-bark	0·0
Quebracho wood	3·4
Oak-bark	7·5
Oakwood extract	11·5
Galls	16·0
Myrobolans	24·0
Valonia	29·0
Divi-divi	29·0
Wattle-bark	2·0

So far wattle-bark has been chiefly used in Germany for the production of heavy leathers, and from this point of view its weight-giving properties are important. Paessler classifies the principal tanning materials in the following descending order in this respect: Quebracho wood, wattle-bark, oakwood extract, oak-bark, mangrove-bark, divi-divi, myrobolans and valonia.

In spite of its peculiar suitability for tanning heavy leather, Paessler considers that it might well be used for the production of light leathers, and in support of this he points out that with calf-skin it furnishes a full soft leather.

Leather tanned with wattle-bark has a slightly reddish tinge and the colour darkens on exposure to light, but not more so than the colour of leather tanned with oak or hemlock-bark. According to Borgman (*Feinlederfabrikation*), though it is unsuitable for the manufacture of very pale leathers, the low percentage of acid-forming substances present renders it very suitable for tanning leather for uppers of boots and similar purposes, and Watt (*Leather Manufacture*) suggests it as suitable for admixture with valonia to correct the colour given by the latter.

To sum up, wattle-bark presents the following advantages: (1) it is being produced in increasing quantities so that there is no danger of a failure in supply, (2) it is being cultivated in several different countries so that no monopoly in production is likely to occur, (3) it is produced mainly in British Territories having rapid and regular means of communication with the United Kingdom, (4) it presents, as marketed, very little

kapok trees are commonly planted about 12 to 15 feet apart along the roads in the coffee and cocoa plantations. When the trees are grown in special plantations, they should be placed about 18 feet apart (about 144 trees to the acre), for if planted more closely they soon interfere with one another. The trees commonly attain a height of 30 feet, but sometimes grow to 50 feet or even more.

Before transplanting, it is advisable to strip off all the leaves and to cut the stem down to a height of $1\frac{1}{2}$ to 2 feet, and also to cut the chief roots so as to make stumps of them. If the top is not cut it will usually die down to the ground. The trees subsequently require very little attention, but the soil must be kept free from weeds.

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

The trees begin to bear in the third or fourth year, but sometimes not till later. The crop is never very large until the sixth year. A large tree brings 1,000 to 1,500 fruits to maturity per annum, each of which contains about 0·7 to 1·2 grams of dry fibre. Hence, on an average, a well-developed tree may be expected to give an annual yield of $\frac{3}{4}$ to $1\frac{1}{4}$ kilograms (or about $1\frac{1}{2}$ to $2\frac{3}{4}$ lb.) of clean fibre.

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

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

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

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

An account of the properties and uses of the fibre has been given in this *Bulletin* (1905, **3**. 221).

A German firm has recently discovered a method by means of which kapok can be spun either alone or in admixture with cotton (see this *Bulletin*, 1911, **9**. 70).

The market price of kapok has advanced during the last few months from 7*d*. to about 9*d*. per lb., and it is therefore possible that the collection and preparation of this fibre for export would prove a remunerative industry in certain British Colonies and Dependencies.

PREPARATION OF CALCIUM CYANAMIDE AND ITS USES AS A MANURIAL AGENT.

PART II.

THE first part of this article was published in the previous number of this *Bulletin* (1911, **9**. 44). It gave an account of the manufacture of calcium cyanamide and general information as to its use as a manure. In the present portion a summary of the information available regarding the results of field trials of cyanamide with various crops is given.

RESULTS OF FIELD TRIALS.

Cereals.

Wheat.—Trials by Immendoff, at Jena, showed the following results from the application of (1) nitrate of soda, and

(2) calcium cyanamide in amounts equal to (*a*) 20·8 and (*b*) 41·7 lb. of nitrogen per acre.

Manure applied.	Yield per acre. (a) Grain. *Cwts.*	(a) Straw. *Cwts.*	(b) Grain. *Cwts.*	(b) Straw. *Cwts.*
Nitrate of soda	20·82	35·70	22·81	39·97
Calcium cyanamide	22·16	38·21	24·07	41·87
Without nitrogenous manure	18·90	32·40		

In a series of experiments made at Fretoy, in France, in 1906, the soil was a highly productive light loam, which had previously borne grass, oats and wheat, in the order mentioned. The manures were applied at the time of sowing at the rate of 42 lb. of nitrogen per acre. The yields per acre obtained were as follows:—

Manure applied.	Yield of grain. *Bushels.*	Gain of grain. *Bushels.*
Sulphate of ammonia	46·54	2·76
Dried blood	52·58	8·80
Crude tankage	45·05	1·27
Calcium cyanamide (at time of sowing)	57·10	13·32
Calcium cyanamide (before sowing)	57·40	13·62
No nitrogenous manure	43·78	—

The experiments carried out at Woburn in 1909, for the Royal Agricultural Society of England, gave the following results. The plots were treated with a preliminary manure consisting of 3 cwt. of superphosphate and 1 cwt. of sulphate

as a top dressing at the rate of 24 lb. of nitrogen per acre.

Manure applied.	Yield of grain per acre. *Weight.*	*Bushels.*	Value of grain per quarter. *s.*	*d.*
Sulphate of ammonia	966	16·5	32	9
Nitrate of lime	943·5	16·2	32	9
Calcium cyanamide	997	17·1	33	6

The sulphate of ammonia plots gave slightly the better results as regards grain, but the differences between the plots receiving nitrogenous manures are all within the range of experimental error, and the yield of grain may be taken as approximately the same for each. As regards proportion of offal grain: calcium cyanamide and sulphate of ammonia produced less than the nitrates; this is in accordance with the results of previous experiments. It should be noted that in the above experiments the calcium cyanamide could act only as a nitrogenous manure as the land already had sufficient lime.

Calcium cyanamide has been suggested as a weed exterminator, and the results obtained in 1908 at the Agricultural School at Arenenberg, Switzerland, are of interest in connection with this crop. About a quarter of an acre of barley with first-year clover was treated by hand with 22 lb. of calcium cyanamide; heavy rain fell on the next night. A month later, the plot was found to be almost free from charlock; the clover had suffered only slightly, and the barley stood four inches higher than the crop in the remainder of the field (*Deutsche Landw. Presse*, 1908, Nov. 4). Similar results were obtained elsewhere with a crop of barley, peas and vetches (*Mitt. der Deutschen Land. Gesell.*, 1907, July 27).

Oats.—Trials carried out at five centres under the instructions of the Department of Agriculture for Ireland in 1909, gave the following results (*Journ. Dep. Agric. Ireland*, 1910, **10**. 352):—

Manure per acre.	Yield per statute acre. Grain. *Cwts.*	*qrs.*	Straw. *Cwts.*
Sulphate of ammonia 1 cwt.	26	2	47
Nitrate of soda $1\frac{1}{2}$ cwt.	25	2	50
Calcium cyanamide 1 cwt.	27	0	44
Nitrate of lime $1\frac{1}{2}$ cwt.	27	0	48
Without nitrogenous manure	24	1	41

All the plots also received superphosphate and kainit.

The following results obtained with oats in 1906 in three experiments at the North of Scotland College of Agriculture (*Bulletin* No. 13) are of interest in indicating that calcium cyanamide, with superphosphate and potash, applied to oats produces a yield of grain about equal to, and sometimes exceeding that obtained with amounts of sulphate of ammonia or nitrate of soda of equivalent nitrogen value.

Manure per acre.	Yield per acre. Grain. Cwt.	qrs.	Straw and chaff. Cwt.	qrs.
Superphosphate 2 cwt. + potash manure	22	2·4	37	1
Same as 1 + nitrate of soda *	24	2·1	41	3
,, + sulphate of ammonia *	24	2·1	42	0
,, + calcium cyanamide *	25	0·2	43	0
,, ,, ,, ,,	25	1·7	44	1
Without nitrogenous manure	21	0	33	1

Maize.—Numerous experiments have been carried out in Italy on the effect of manuring this crop with calcium cyanamide. The following results obtained by Prof. Tito Poggi of Verona show the effect of applying the manure at different periods. The plots received a preliminary dressing of 3·98 cwt. of superphosphate and 0·8 cwt. of sulphate of potash per acre.

Manure per acre.	Grain per acre. Cwt.
Sulphate of ammonia, 0·8 cwt. at sowing	34·03
Sulphate of ammonia, 0·8 cwt., half at sowing and half at banking up	34·20
Sulphate of ammonia, 0·4 cwt., and nitrate of soda, 0·4 cwt. at banking up	34·19
Calcium cyanamide, 0·8 cwt. at sowing	37·02
Calcium cyanamide, 0·8 cwt., half at sowing and half at banking up	38·51
Calcium cyanamide, 0·4 cwt. at sowing, and nitrate of soda, 0·4 cwt. at banking up	36·69

Other results recorded show that the yield of maize obtained by the use of calcium cyanamide is in most cases about equal to that obtained with sulphate of ammonia or nitrate of soda.

Rice.—Manuring of this cereal with calcium cyanamide does not seem to have been attempted except in Italy. The following results, obtained by Prof. Alice of Lodi, indicate that as a manure for rice, calcium cyanamide gives a slight advantage over sulphate of ammonia as regards yield of grain.

The experiments were carried out on a rice field in its second year. Superphosphate was applied to all the plots at the rate of 3·58 cwt. per acre and the calcium cyanamide at the rate of 78½ lb. per acre to the dry field before sowing. Sulphate of ammonia was applied to plot 1, in the same quantity, at the first clearing up. The yields per acre of unhusked rice were as follows:—

	Cwts.
Sulphate of ammonia	47·94
Calcium cyanamide	50·43
Without nitrogenous manure	41·61

* *The nitrogenous manure applied contained nitrogen equivalent to 1 cwt. of calcium cyanamide per acre.*

Other experiments carried out near Milan by Dr. Menozzi indicate that as regards increasing the yield of grain, sulphate of ammonia and calcium cyanamide are about equally efficient.

Root Crops.

Potatoes.—A series of experiments with potatoes was carried out in 1909 under the direction of the Department of Agriculture for Ireland (*Jour. Dep. Agric. Ireland*, 1910, **10**. 353). At ten selected centres the soil received a dressing of superphosphate and some form of potash manure. Farmyard manure was applied at eight centres.

Manure per acre.	Average yield per statute acre. Saleable.		Total.	
	Tons	*cwts.*	*Tons*	*cwts.*
Sulphate of ammonia 1 cwt.	10	12	12	6
Nitrate of soda $1\frac{1}{3}$ cwt.	10	8	12	2
Calcium cyanamide 1 cwt.	10	16	12	15
Nitrate of lime $1\frac{1}{2}$ cwt.	10	15	12	10
Without nitrogenous manure	9	12	11	10

Similar experiments were carried out at the Glasgow and West of Scotland Agricultural College Experimental Station (*Bulletin* No. 40). The results obtained over several seasons, with sulphate of ammonia and calcium cyanamide used in conjunction with other manures, were as follows:—

Variety.	Manure per acre.	Saleable. *Tons.*	Seed. *Tons.*	Smalls. *Tons.*	Diseased. *Tons.*	Total. *Tons.*
		Yield of Potatoes per acre.				
"Up-to-date"	6 cwt. superphosphate 3 cwt. sulphate of potash 2 cwt. sulphate of ammonia	11·04	1·21	0·52	2·80	15·61
	6 cwt. superphosphate 3 cwt. sulphate of potash Calcium cyanamide containing nitrogen = 2 cwt. of sulphate of ammonia	9·75	0·84	0·36	2·64	13·59
	10 tons dung 4 cwt. superphosphate $1\frac{1}{2}$ cwt. sulphate of potash 1 cwt. sulphate of ammonia	11·24	1·24	0·46	3·20	16·14
	10 tons dung 4 cwt. superphosphate $1\frac{1}{2}$ cwt. sulphate of potash Calcium cyanamide containing nitrogen = 1 cwt. of sulphate of ammonia	11·12	1·0	0·40	2·82	15·34
"Northern Star"	6 cwt. basic slag $1\frac{1}{2}$ cwt. sulphate of potash $1\frac{1}{2}$ cwt. sulphate of ammonia	10·99	1·94	0·76	1·15	14·85
	6 cwt. basic slag $1\frac{1}{2}$ cwt. sulphate of potash Calcium cyanamide containing nitrogen = $1\frac{1}{2}$ cwt. of sulphate of ammonia	10·65	1·6	0·64	1·09	13·97

manure on the yield of sugar. The field was manured with 80 lb. superphosphate and 176 lb. of sulphate of potash per acre. The nitrogenous manures were applied at the rate of 35·7 lb. of nitrogen per acre, the cyanamide being applied half at sowing, and half three months later, as a top dressing.

	With nitrate of soda and sulphate of ammonia.	With calcium cyanamide.
Total weight of 12 plants .	19·003 lb.	18·651 lb.
" " of leaves, 12 plants	10·957 lb.	10·758 lb.
" " of roots, 12 plants	8·046 lb.	7·893 lb.
Sugar in pulp, per cent. . .	15·800	16·200

Grasses.

Experiments during the two seasons 1904–05 at the Glasgow and West of Scotland Agricultural College (*Bulletin* No. 40) on hay grown from seed, indicated that calcium cyanamide may prove inferior to sulphate of ammonia or nitrate of soda, when applied as a top dressing to hay. The calcium cyanamide was mixed with damp earth before being applied to the grass. In 1905 the nitrogen added per acre in the form of manure was in each case equal to that contained in 15 cwt. of nitrate of soda, and the yields of hay were as follows: nitrate of soda plot, 2 tons 0·7 cwt.; calcium cyanamide plot, 1 ton 15·4 cwt.; sulphate of ammonia plot, 2 tons 0·6 cwt.

These results differ from those obtained in Italy by Prof. Z. Bonomi, of Udine, who found that with permanent grass the yield of hay obtained by the use of calcium cyanamide was about equal to that afforded by sulphate of ammonia.

Sugar Cane.—The following are the results of experiments made at Haçienda Santa Rita, Porto Rico, in 1909. Manure was applied to the plots at the rate of 144 lb. of nitrogen per acre, in two portions at an interval of two months.

Manure applied.	Cane per acre. *Tons.*	Available sugar (96°) per acre.
Sulphate of ammonia . .	45·22	4·86
Nitrate of soda . . .	47·34	5·37
Tankage	49·23	5·31
Calcium cyanamide . .	58·35	7·32
Without nitrogenous manure .	48·19	5·80

Fibre Plants.

Hemp.—Experiments carried out in Italy by Prof. Munerati in 1905 on a somewhat sandy soil, which had previously borne a wheat crop, gave the following results:—

Manure applied.	Yield of green hemp per acre. *lb.*
Sulphate of ammonia . . .	756
Nitrate of soda . . .	803
Calcium cyanamide . . .	825
No manure	513
No nitrogenous manure . .	625

The manures were all applied one day before sowing, except the nitrate of soda, which was applied as a top dressing.

Flax.—The results recorded by C. Hoffmeister (*Flachs u. Leinen*, 1908, No. 170, 3701) indicate that calcium cyanamide is a useful manure for this crop. With this manure applied about 8 to 10 days before sowing, in a loose friable soil, increased yields both of seed and fibre were obtained, the thickness of the latter being also increased.

Cotton.—It is stated that experiments made at Montgomery, Alabama, U.S.A., showed that plants manured with calcium cyanamide gave 7 to 9 more bolls per plant than those manured in the ordinary manner.

Miscellaneous.

Tobacco.—During 1907 experiments were carried out by Prof. Vignani of the Vegni Agricultural Institute, Arezzo. The soil selected was clayey and of medium fertility but poor in lime. The ground was divided into five plots each holding six rows of plants, and treated as follows:—

		Cwt.	*Date of application.*
1.	Nitrate of soda . .	1·6	July 1 at first working.
2.	Calcium cyanamide .	1·6	June 3 at planting out.
3.	Sulphate of ammonia .	1·6	„ 3 „ „
4.	Calcium cyanamide .	1·6	July 2 at banking up.
5.	Nitrate of soda . .	1·6	„ 2 „ „

The plants, which were of the Kentucky variety, were planted between June 6 and 16. The leaves were dried, cured and weighed on January 15, 1907. The leaves from plots 2 and 4 were stated to be of excellent quality and superior to those from the other plots. The Government testing station reported that all the samples were of dark chestnut colour and possessed good flavour, medium aroma and fair burning qualities.

Plot No.	Fineness.	Elasticity.	Weight in ozs.			Development of leaf.
			Of 10 leaves.	Ribs from 10 leaves.	Laminæ from 10 leaves	
No. 1 .	Medium	Medium	7·648	2·357	5·291	Fair
No. 2 .	,,	Normal	7·584	1·893	5·691	,,
No. 3 .	Not very fine	Little	6·768	1·937	4·831	Medium
No. 4 .	Fair	Good	7·648	2·005	5·643	Normal
No. 5 .	Not very fine	Medium	5·825	1·768	4·057	Medium

Hops.—Trials were carried out in Germany in 1906 (Wagner, *Viertljschr. Bayer. Landw. Rat.*, 1907, **12**. 200) on the manuring of hops with calcium cyanamide and sodium nitrate, and the following table gives a summary of the results:—

Manure applied.	Quantity per hectare.	Increase in yield per hectare.	Value of increased yield per hectare.	Cost of manure per hectare.	Net profits per hectare.
	Kilograms.	*Kilograms.*	*Marks.*	*Marks.*	*Marks.*
Calcium cyanamide .	318·0	151·5	212·1	95·5	116·6
,, ,, .	517·0	200·0	280·0	155·2	124·8
Nitrate of soda . . .	400·0	200·0	280·0	95·5	184·5
,, ,, . . .	560·0	257·5	360·5	133·7	226·8

Grape Vines.—The following are the results of experiments carried out at Alvert, Dordogne, France, on vines of the red "Merlot" variety growing in a very porous light sandy loam, which rested on a gravelly subsoil. The manures were applied at the rate of 42 lb. of nitrogen per acre.

Manure applied.	Yield of grapes per acre.	Density of must.
	Cwt.	
Calcium cyanamide . .	63·68	11·2
Sulphate of ammonia . .	65·11	11·5
Without nitrogenous manure	54·43	11·7

GENERAL CONCLUSIONS.

From the results quoted above it is evident that calcium cyanamide can either be harrowed in or applied as a top dressing, but in most cases the former method gives the better result. The quantity applied should be between 25 and 45 lb. of nitrogen per acre or 1 to 2 cwt. of cyanamide containing 20 per cent. nitrogen. It appears to be advisable to apply the manure when the soil is wet or when there is a prospect of rain.

As a general rule it may be stated that from the results of experiments, the manurial value of calcium cyanamide is about equal to that of sulphate of ammonia when the culture is carried out on a fairly good soil, but is inferior on poor moorland or sandy soil. The beneficial effects of its application are more noticeable when applied to crops which especially need nitrogen for their successful cultivation; but on soils requiring lime as well as nitrogen, calcium cyanamide is likely to give a better return than sulphate of ammonia or nitrate of soda, especially during the second season when the effect of this lime is more noticeable than during the season of application.

ADDENDUM.—Since the publication of the first part of this article it has been ascertained that in order to avoid trouble from the dustiness of cyanamide as hitherto marketed, a small quantity of shale oil is now added before the product leaves the works. This addition is stated to cause agglomeration of the finer particles without interfering with the efficacy of the manure when applied to soil.

THE DISTRIBUTION AND USES OF TITANIUM ORES.

THE present article is a continuation of the series in this *Bulletin* dealing with the occurrence and utilisation of ores of the less common metals, of which those on molybdenum, tantalum, vanadium and tungsten have been published already. Titanium has come into prominence largely owing to its application in the manufacture of steel, and since ores of this metal occur in many of the British Colonies a *résumé* of the information available regarding the distribution of its ores and methods for their utilisation is now given.

Titanium in the metallic form does not occur in nature, but in the form of titanic oxide (TiO_2) it is one of the most widely distributed elements of the earth's crust. Rutile, the commonest natural form of titanic oxide, is rarely found in large deposits, but enormous quantities of ilmenite or titaniferous iron ore carrying varying amounts of titanic oxide are known to occur in many localities, and these two minerals are those which have been utilised as sources of titanium.

Rutile is known to occur compact or massive in igneous, sedimentary and metamorphic rocks; it varies in colour from yellow to reddish-brown and black, and gives a pale brown streak. The hardness is about 6·5 and specific gravity 4·2 to 4·3. The mineral usually contains 98 to 99 per cent. of titanic oxide and from 1 to 2 per cent. of ferric oxide.

Ilmenite or titaniferous iron ore is an iron-black mineral occurring massive or in the form of thin plates or grains. Its hardness is 5 to 6, specific gravity 4·5 to 5·0, and lustre sub-metallic. The fracture is conchoidal, and streak brownish-red to black. Its composition is represented by the formula FeO, TiO_2 which corresponds to 47·3 per cent. of ferrous oxide and 52·7 per cent. of titanic oxide.

Other minerals containing a large percentage of titanium are *titanite* or *sphene*, which is calcium titanium silicate, and *brookite* and *octahedrite*, crystalline forms of titanic oxide.

DISTRIBUTION OF TITANIUM ORES.

In view of the present very limited utilisation of these ores only those deposits which are or have been worked to any extent will be described in this article.

Europe.—The principal rutile-producing deposits in Europe are those of Kragero, to the north-east of Kristiansund in Norway. The annual production averages about 50 tons of nearly pure rutile besides a certain amount of lower grade material (*Min. Industry*, 1908, **17**. 823).

America.—Rutile is obtained at Roseland, near Arrington, Nelson Co., Va., U.S.A., from pegmatite dykes, of which it constitutes about 4 per cent. The dykes consist chiefly of orthoclase and albite felspars together with blue quartz. The soil covering the deposits also contains some rutile and is utilised as a source of the mineral. The plant in operation includes a 10-stamp mill, engines, pumps, concentrating tables and a Wetherill magnetic separator. The final concentrate contains on the average about 98·4 per cent. of titanic oxide (*Min. Res., U.S.A.*, 1908, Part 1, p. 744). Several dykes yielding ilmeno-rutile (a mineral containing varying amounts of iron and titanic oxides) and apatite occur in this locality, one being about 30 feet thick and half-a-mile in length. These deposits may become of value as a source of titanium for purposes where the presence of small quantities of phosphorus is not objectionable.

Well-crystallised rutile is also obtained in Chester Co., Pa., but the amount is small and is usually sold to collectors.

Other important occurrences of rutile in the United States are situated in Lincoln and Habersham Counties (Georgia), Warwick County (New York) and Warren County (Maine).

Australia.—Rutile occurs, and has been worked in a desultory fashion for many years, in the hundred of Talunga, about 6 miles north of Blumberg, S. Australia (*Rec. Mines, S. Australia*, 1908, 4th edition, p. 356). The workings, which are about 150 yards in length, consist of small shafts and trenches in a kaolinised dyke formation from 10 to 12 feet wide, striking slightly east of south. Rutile crystals of varying size occur distributed throughout this matrix, and can be extracted by panning. On the surface for some distance on either side of this formation fine rutile can be obtained. The mineral also occurs in a small seam of gravel about 12 inches below the surface. The average yield from these workings amounts to about 1¼ per cent. of the material treated. The deposits appear to have been prospected only to a very limited extent. Nearly 2,000 lb. of rutile were produced at Para Wira in 1907 from 2,000 tons of gravel. Rutile occurs at a number of other localities in this State, but has not been worked.

Small quantities of rutile, which is stated to be almost entirely free from iron, are also produced from time to time in Queensland.

by the Goldschmidt process, which consists in mixing the oxide to be reduced with finely powdered metallic aluminium and starting interaction by means of a fuse. A rapid reaction occurs, and the titanic oxide is reduced to the metallic state, the aluminium combining with the liberated oxygen to form alumina.

The most important use of ferro-titanium is in the purification of steel, particularly for rails. The presence of certain elements in minute quantities in steel has a far-reaching effect on its quality; and of these elements nitrogen is one of the most important. According to Braune (*Stahl und Eisen*, 1906, **26**. 1357, 1431, 1496), the effect of nitrogen is at first to slightly increase the toughness and reduce the ductility. Hard steel containing from 0·030 to 0·035 per cent. of nitrogen becomes quite brittle, whilst soft steel loses its ductility when the amount of nitrogen reaches 0·05 to 0·06 per cent. The presence of nitrogen also favours segregation of the phosphorus and sulphur, causing "cold shortness." Dr. Tholander (*Stahl und Eisen,* 1909, **29**. 1594) found that a steel which normally contained 0·012 to 0·022 per cent. of nitrogen, on being "overblown" in a converter for three minutes, contained 0·032 per cent. of nitrogen.

The removal of the greater proportion of the nitrogen normally found in steel is a matter of much importance; and it is stated that this can be attained by the use of titanium, which combines with nitrogen at a temperature of 800° C. to form titanium nitrides. Titanium has a melting-point of 1,850° C. and a specific gravity much less than that of iron; and these physical properties preclude the use of titanium itself, and lead to the use of an alloy of titanium and iron instead of the pure metal, which would float on the fused steel and be difficult to dissolve. Exhaustive experiments with titanium alloys have shown that the best results are obtained with an alloy containing from 10 to 15 per cent. of titanium. The numerous steel works in the United States which employ ferro-titanium specify an alloy of this composition.

The alloy is added just as the steel runs into the ladle, *i.e.* after recarburisation and the addition of the necessary ferro-manganese and ferro-silicon. An instantaneous reaction occurs, and after a short time the slag formed by the reaction (chiefly titanic oxide) rises to the surface. According to the experience of E. von Maltitz, the addition of one-half per cent. of ferro-titanium, containing 10 to 15 per cent. of titanium, *i. e.* a maximum consumption of 1·7 lb. of titanium per ton of steel produced, is sufficient in most cases to purify steel for rails to the desired extent. The beneficial effect of titanium alloy in preventing segregation of the sulphur, phosphorus and carbon, and in concentrating the blowholes in the pipe cavity, has been demonstrated by the experiments of many well-known metallurgists in America. Improvement was also noticed in the working of the steel in the rolling-mill. The rails produced were found to give much better service than ordinary Bessemer steel rails (*American Soc. for Testing Materials*, 1910, **10**. 201). Tests on steel rails laid at a crossing at a New York railway station showed that in six months the steel treated with ferro-titanium had lost by flange wear less than one-third of the amount lost by the Bessemer rails which preceded them. Interesting comparative tests have been carried out by the Baltimore and Ohio Railway. The plain Bessemer rails contained 0·55 and the titanium-treated rails 0·48 per cent. of carbon; each rail weighed 90 lb. to the yard. After five months' wear on a heavy curve, the plain Bessemer rails had lost 4·18 lb. per yard, whilst the titanium-treated rails had only lost 1·45 lb. per yard. The Bessemer rails showed excessive wear and the usual indications of segregation, whilst the treated rails were solid and homogeneous (*Times, Eng. Suppl.*, 1909, May 26).

The following table, showing the quantities of "special" steel rails produced in the United States, indicates the growing preference for the titanium-treated steel rail (*Met. and Chem. Eng.*, 1911, **9**. 121):—

	1909. *Gross tons.*	1910. *Gross tons.*
Titanium steel . . .	35,945	195,940
Nickel-chrome steel . .	12,207	81
Nickel and electric steel .	1,464	4,210
Manganese steel . . .	1,028	390
	50,724	200,621

Of the above quantities, 70 per cent. in 1909 and 87 per cent. in 1910 were made from Bessemer steel.

Recent information states that an order for 41,500 tons of titanium-treated steel rails has been given by the New York Central lines, where rails of this type have been under trial for several years past. On these lines the rails are subject to great variations in temperature, which often falls in winter to 30 degrees below zero. The results of tests on rails employed on various sections of this line are given in the *Journal of Industrial and Engineering Chemistry* (1910, **2**. 299).

The beneficial effects of using titanium alloy for purifying basic open-hearth steel were demonstrated by experiments carried out in the Osnabrück Steel Works (*Stahl und Eisen*, 1910, **30**. 651). In every case the bars treated with alloy showed increased strength, the fracture showing a fibrous structure similar to that of forged iron. In bending tests the titanium-treated steel also gave results superior to those obtained with untreated steel. Improvement was even seen with the addition of such a small quantity of titanium as 0·04 per cent.

In addition to the above-mentioned uses for ferro-titanium as a purifier for steel, it is stated that certain manufacturers of crucible steel in the United States are adding the alloy in sufficient quantity to retain 0·05 to 0·20 per cent. of titanium in the finished steel. This addition is said to increase the toughness and durability of the tool steel produced.

Titanium-iron alloy, containing 5·8 per cent. of carbon, is also used to some extent for improving the quality of iron by removing occluded gases and preventing segregation of subsidiary constituents. The quantity added varies from 1 to 3 lb. of 10 per cent. ferro-titanium to each 1,000 lb. of metal. It has been demonstrated by the experiments of Dr. R. Moldenke that the improvement is most noticeable in machinery pig (grey) iron (*Trans. Amer. Founds. Ass.*, 1908, **17**. 57). These experiments showed that the average crushing strength of machinery pig iron was increased 52 per cent. by the use of 0·5 per cent. of the ferro-titanium alloy.

Results indicating similar improvements have been recorded when the alloy is added to metal for chilled car wheels, rolls, and to malleable iron. In the case of chilled car-wheel iron, the titanium treatment increases the crushing strength considerably.

The present price of ferro-titanium alloy containing from 10

At the present time it is difficult to negotiate a sale in the United Kingdom of ore for iron smelting which contains even 2 per cent. of titanic oxide. In the past, highly titaniferous iron ores have been successfully smelted in various localities. An iron company which had works at Norton, near Stockton-on-Tees, many years ago smelted successfully an ore containing 39·2 per cent. of titanic oxide to yield forge iron (*Trans. Amer. Inst. Min. Eng.*, 1882, **11**. 159). The fuel and fluxes employed were about 17 cwt. of coke, 12 cwt. of limestone, and 3 to 4 cwt. of basalt, or similarly fusible silicate, per ton of ore. Owing to the uncertainty of the supplies and the small quantity of iron in the ore the work was abandoned.

The question of the smelting of titaniferous iron ore is thoroughly discussed, and the results of many important blast-furnace experiments quoted in an article by A. J. Rossi (*Trans. Amer. Inst. Min. Eng.*, 1892, **21**. 832), where he shows that it is possible to obtain a good pig iron and a fluid slag from ores containing 20 per cent. of titanic oxide. Iron ore fairly high in titanic oxide was formerly mined and smelted in Sweden, but the production is stated to have ceased in 1904. In the larger of the Swedish furnaces which smelted this ore, the consumption of fuel is stated to have averaged 275 bushels of charcoal to the ton of ore, a consumption considerably in excess of that required for non-titaniferous ore (*Eng. Min. Journ.*, 1904, **78**. 350). Ores carrying a high percentage of titanium were successfully smelted in blast furnaces during a period of 20 years in the Adirondack Mountains, New York State (*Stahl und Eisen*, 1909, **29**. 1593). According to recent information ores from this latter locality rarely contain less than 8 per cent. and often 15 per cent. of titanic oxide (*Min. Res. U.S.A.*, 1908, Pt. 1, 91). The iron ore smelted by the natives of the Salem district, India, by the Catalan process, is stated to carry a certain amount of titanic oxide (*Rec. Geol. Sur. India*, 1892, **25**. 139).

From a review of the literature on this question it would appear that under suitable conditions the smelting of iron ores containing a moderate percentage of titanium should be a commercial possibility, especially as there are enormous quantities of such ore, which is usually very low in phosphorus, obtainable at a low price.

Other Uses of Titanium.

The employment of titanium carbide as an electrode for arc lighting is making progress. According to recent investigations (*Trans. Amer. Electrochem. Soc.*, 1909, **16**. 217) this substance gives a high candle-power efficiency. It has been found that the titanium carbide arcs are most satisfactory when operated on a constant current circuit. The electrodes are prepared by grinding the carbide to a fine powder, mixing with a suitable binder, and forcing the paste through a nozzle by means of a hydraulic press. The rods so produced are cut into suitable lengths and dried, first in the air, then in a gas oven, and finally in an electric furnace of the carbon-tube pattern. The electrodes are plated with copper to prevent oxidation during burning. The characteristics of the titanium carbide arc light are an extremely luminous inner path, very little light from the outer mantle, and none from the craters. The electrodes are used as the cathode, whilst the anode is a rod of copper or carbon. Electrodes of the sub-oxide of titanium prepared by the reduction of rutile have also been tried for arc lighting, but with no great success. At the present time, according to recent information (*Mining World*, 1910, **33**. 230), the most extensively used electrode containing titanium is the so-called "magnetite" arc lamp. This electrode is composed of magnetite, 15 to 20 per cent. of rutile, and some chromite; the first-named giving conductivity to the electrode, the second being the light producer, and the last adding to the life of the electrode.

Titanium has been suggested and tried to a limited extent as a material for filaments for electric glow lamps, the processes of manufacture and use being covered by numerous patents. It is claimed that they give a high candle-power efficiency, and are less sensitive to variations in voltage than other filaments. A trial lot of about 1,000 of these lamps was produced in America in 1906 (*Mining World*, 1910, **33**. 230). A suitable means for the production of such filaments is to force a colloidal solution of titanium hydroxide through a small nozzle, and after drying the fine thread thus produced to reduce it in hydrogen to the metallic state. It is interesting to note that should there be the slightest trace of carbon present in the filament, such as may get into it from the vaporised oil from the pump during exhaustion, the efficiency of the lamp will be so impaired as to be practically useless (*Electrician*, 1907, **58**. 892).

A process for obtaining pigments from titaniferous iron ore, such as ilmenite, has been described (*Journ. Soc. Chem. Ind.*, 1910, **29**. 1023). The ore is roasted at a temperature below incipient fusion and crushed in water, yielding a finely divided product of a yellow to red colour.

Rutile is sometimes added to porcelain tiles to give a soft yellow underglaze colour, and it finds a similar use in the manufacture of artificial teeth. Only the purest varieties can be employed for the latter purpose (*Min. Res. U.S.A.*, 1906, 530).

Pure titanium compounds, particularly the oxalate and the double ammonium oxalate, are used to a limited extent as mordants (*Mining World*, 1910, **33**. 230). They are stated to give with tannin a yellow colour of great durability. Titanous chloride has been used as a mordant and the sulphate as a mordant and "stripper." The double pyrophosphates of titanium with the alkali metals are stated to be capable of application to textiles without damage to the latter.

It has been suggested that titanium nitride, which is produced during the smelting of titaniferous iron ore, should be utilised as a nitrogenous manure, but experiments do not seem to have been made to test the availability of this compound for agricultural purposes.

COMMERCIAL VALUE OF TITANIUM ORES.

According to recent information one of the largest firms producing rutile concentrates in the United States is selling three grades of ore, viz: grade A, containing over 95 per cent. of titanic oxide and practically free from iron, at £33 6s. ($160) per ton (2,000 lb.). This grade is stated to be used principally for arc lamp electrodes. Grade B, containing 75 to 80 per cent. of titanic oxide, the balance being largely iron oxide, sells at £16 13s. ($80) per ton (2,000 lb.). Grade C (largely ilmenite), containing 55 to 60 per cent. of titanic oxide, the balance being chiefly iron oxide, sells at £8 6s. ($40) per ton (2,000 lb.). Grades B and C are stated to be utilised in the production of ferro-titanium.

new industries which might be started in Grenada, and reference to hese may be made here. It is thought that a tanning industry might be developed, and to that end it is suggested that the import duty on tanning materials might be remitted. Cotton was exported from Grenada to the extent of 2,000,000 lb. per annum a century ago, but this industry has disappeared, although it flourishes in the neighbouring dependency of Carriacou. Experiments made a few years ago with "Sea Island" cotton were unsuccessful, but those with "Marie Galante" cotton gave good results, and the Committee recommends that the Agricultural Department should give special attention to the encouragement of this industry, and that a Government cotton gin should be erected at St. George. The cultivation of cigar tobacco for local use is also advocated, though it is not considered likely that tobacco can be grown for export. The possibility of starting a central sugar factory in Grenada or of carrying out sugar manufacture on simple co-operative lines is fully discussed in the Report, but the Committee was not unanimous in its recommendations on this subject. Other industries, the development of which is discussed, are fishing, pig-keeping, soap-making, and corn-grinding.

The Natural Resources of British Guiana.—The Permanent Exhibitions Committee for British Guiana has issued a series of booklets describing some of the chief industries of the Colony. Those available relate to timber, balata and rubber, coconut and limes, cacao and coffee, rice and sugar. Each booklet describes the present position of the industry dealt with, and gives information as to the conditions under which land for cultivation may be purchased or leased, or, in the case of forest products, a summary of the laws, regulations and conditions under which extraction of the product may be carried on. Copies of these booklets are available for distribution at the Central Stand in the Exhibition Galleries of the Imperial Institute.

East African Cedar.—In a previous number of this *Bulletin* (1906, **4**. 15), a report was printed giving the results of examination at the Imperial Institute of samples of pencil-cedar from the East Africa Protectorate. It was pointed out that this timber, which is derived from *Juniperus procera*, would answer all the purposes to which the pencil-cedar obtained from *J. virginiana* is applied. In this connection it is of interest to note that according to *Der Tropenpflanzer* (1911, **15**. 216), the forests of *Juniperus procera* in West Usumbara, German East Africa, are now being exploited for export, and that pencil-cedar from this source is being sold in Europe. A recent German timber trade report states that in 1910 the quantity of East African cedar-wood landed in Germany was 31,000 logs, weighing 1,267,500 kilograms, as compared with 154,300 and 211,500 kilograms from Florida and Hayti respectively, which formerly furnished the chief supplies of this timber.

Timbers from Mysore.—An interesting collection of hand specimens of Mysore timbers has been forwarded recently to the Imperial Institute by the Government of Mysore, and is now on view in the Indian Section of the Exhibition Galleries. The collection comprises forty-five samples, representing native woods suitable for a very wide range of purposes. Many of the timbers, such as teak, rosewood, ebony, satinwood, etc., are already well known in commerce, but the collection includes other less-known woods which appear to be of promising quality for export to this country. Application has been made to the Mysore Government for detailed information as to which of these timbers are available in sufficient quantity in the State to be worth consideration for export.

Chicle or Sapodilla "gum."—This product which, as is now well known, forms the basis of "American chewing gum," is of comparatively little commercial importance outside the United States and Canada. It is, however, frequently the subject of inquiries, and as the information published regarding it is somewhat scanty it may be useful to put on record in this *Bulletin* a few of the chief facts relating to its production. It consists of the partially evaporated latex of *Achras sapota*, a tree indigenous to Central America and the Northern portions of South America, and also found in the West Indies, the Philippines and elsewhere. The tree is most abundant in Mexico, where it is known as "Zapote," and the latex is extracted on a comparatively large scale in the Yucatan, Chiapas, Campeachy, Veracruz and Oaxaca districts of that State. Considerable quantities are also produced in Nicaragua and British Honduras. The tree also furnishes a fruit, the "sapodilla plum," and a useful hard red timber.

According to Sperber (*Der Tropenpflanzer*, 1911, **15**. 220), sapodilla plums were at one time sold in large quantities in Mexico, but in recent years, owing to over-tapping of the trees for latex, the fruits have diminished in size and become useless for edible purposes, and this trade has almost disappeared in consequence.

The mature tree reaches a height of 30 to 40 feet and a diameter of from 35 to 40 inches, and it is stated (*loc. cit.*) that a full-grown tree may yield as much as 30 to 35 lb. of chicle "gum" per annum. In British Honduras it is not considered advisable to tap trees less than 12 inches in diameter at 4 feet from the ground. The tapping is accomplished by making V-shaped incisions in the bark, down to, but not through the bast layer. The exuding latex is led into a receptacle at the base of the stem, and for this purpose an open perpendicular channel may be cut, connecting together the bases of the V-shaped incisions, or a palm leaf may be used as a lead. The latex is at first thin and white but rapidly becomes thick and yellow, and as it drips into the collecting receptacle it is usually a yellowish-white, sticky product of the consistence of treacle. In this condition it is frequently used in Central America as a cement for small articles. For export purposes the treacly material from a number of collecting pots is put into a large kettle and heated until a test-piece withdrawn from the kettle sets hard on cooling. The contents are then allowed to cool somewhat, when they are taken out and thoroughly kneaded together to form a uniform product, which is finally made into blocks, which may weigh from 5 to 30 lb.

According to Sperber (*loc. cit.*) collection goes on all the year round in Mexico, except during the three or four months of the rainy season, and he estimates that a native collector ("chiclero") can collect and prepare from 500 to 600 lb. of chicle per month.

Chicle is also produced to some extent in the island of Mindanao in the Philippines, but there the trees are merely hacked with axes or knives, and there is no systematic production as in Central and South America. Sperber states that most of the Mexican chicle, which up to 1897 went direct to the United States, now goes in the first instance to Canada, where it is dried artificially and then re-exported to the United States. This indirect trade was brought about by the imposition of an import tax on chicle in the United States in 1897 which made it profitable to Canada to import the crude material and re-export it dried.

The conversion of chicle into "chewing gum" is a very simple matter; it is merely reduced to a fine powder, then warmed till it softens, when it is mixed with sweetening and flavouring agents and finally pressed into suitable tablets.

The exports of chicle "gum" from most of the producing countries are not shown separately in the trade returns. The only export figures available are those for British Honduras, which in 1909 exported 19,763 cwt., valued at £157,853. Of this total 6,633 cwt., valued at £61,192, were produced in the Colony. The extent of the trade in this article can, however, be gauged by the following figures, showing the imports into the United States in 1909:—

	Canada.	Mexico.	Brit. Honduras.	Other Countries.	Total.
Quantity, cwt. . .	30,821	12,492	5,264	85	48,662
Value, £	301,351	75,498	36,208	924	413,981

surface-layer and so retain the soil moisture. It is to be noted that a shower in the course of a dry period will have the paradoxical effect of causing a loss of soil moisture unless a harrowing is given; this it does by consolidating the surface layer and thus putting the lower water supplies in communication with the external evaporating surface. The practice must, of course, be modified to suit the crop and locality, as, for example, in places where there are two rainy periods separated by a comparatively dry interval in the one year.

Plants for Acclimatisation.—In order to render productive the varied regions of its area, the United States is studying the plants of other lands with a view to finding varieties suited to its own needs. In pursuance of this policy the Department of Agriculture has issued as *Bull. No.* 180 *of the Bureau of Plant Industry* an account of "Agricultural Explorations in Palestine," by Aaronsohn. In this, numerous plants are described which it is thought are worth trying in the United States. Leguminous plants of the *Medicago*, *Melilotus*, *Trigonella*, *Astragalus*, and *Trifolium* genera, which aid in maintaining fertility of the soil by their power of fixing nitrogen, and which furnish good temporary pasture in winter and spring, are thought suitable for California. The useful xerophytes and halophytes of the Palestine deserts seem likely to succeed in Arizona and the south-west. Various *Zizyphus* and allied species might be used as stocks for Chinese jujubes (*Z. sativa*); *Pistacia* species for the pistachio nut (*P. vera*); *Amygdalus* species for almonds and apricots; and certain *Prunus*, *Cratægus*, and *Pyrus* species for their fruit or as stocks. Many varieties of fruits, forage and other plants are described. The author also found emmer (*Triticum dicoccum dicoccoides*) growing wild under extreme climatic conditions. He thinks that by selection and crossing, new races of great persistence and hardiness may be produced from it, so that the cultivation of wheat can be extended to regions where, on account of the low quality of the soil and the severity of the climate, it cannot at present be grown.

Suppression of Locusts.—One of the great evils the farmer in South Africa has to contend with is the damage done to his crops by locusts; but it is an evil that can be greatly diminished by persistent and combined efforts. In 1906 the South African Central Locust Bureau was formed, and in the *Fourth Annual Report* (1910) an account is given of the measures adopted to destroy this pest and of the success achieved. The two species of migratory locusts which cause trouble are the Red-winged Locust, *Cyrtocanthacris septemfasciata*, and the Brown Locust *Pachytylus sulcicollis*, also named *Locusta pardalina*. The Bureau hopes that the permanent breeding-grounds may be located, so that action may be taken there to minimise outward migrations. The Red-winged Locust is practically restricted to the eastern side of South Africa; it has been of diminishing importance for several years, and now seems almost to have disappeared from the British Colonies. The Brown Locust, however, made serious attacks in the Orange River Province and in Cape Province, due to enormous swarms having come from the Kalihari Desert in March 1909.

In Mozambique, where labour is cheap, the eggs were collected and destroyed, but in Cape Province and Orange River Province poisoning by means of sweetened arsenite of soda was employed. In Cape Province the arsenite of soda used was of a strength equivalent to 69 per cent. of white arsenic; 200 lb. of this were dissolved in about 15 gallons of boiling water, and the liquid was diluted to 20 gallons. Half-a-gallon of the solution was poured into a metal drum, and a gallon of treacle added, the treacle being the crudest obtainable, and being supposed to contain about 31 per cent. of sucrose and 29 per cent. of glucose. The drums were made of lead-coated steel, and when filled were distributed for use throughout the country. The dilution recommended was one part to sixty-six of water for newly-hatched "voetgangers," and one part to fifty after they were a fortnight old. It was considered better to prepare poisoned bait such as cut-up green forage or bran than to spray the natural vegetation. Care was necessary to keep stock away from the piles of bait.

School of Farming in Togoland.—The government school at Nuatjä, designed to train the negroes in farming, especially with a view to cotton-growing, is described in *L'Agron. Trop.* (1910, **2**. 223). The course lasts three years; in the first year the scholars work at bringing new land under cultivation, and in this way learn to use the plough and other European implements. The care of the cattle and cattle sheds is assigned to four of the scholars, and their place is taken by four others at the end of a month. They also receive instruction in the German and Ewe languages. In the second year they begin to work independently, and are taught the differences between the various crops, their relative values, and the nature of the different farm pests and the way to combat them. In the third year they are set to supervise the work of the new-comers, and must cultivate a piece of land by themselves; they also receive further instruction in farming and in languages. About one hundred scholars attend the school.

Soils.—The important question of the possible damage to fertile land by irrigation is dealt with in *Bulletin No.* 39, *Dept. Agric.*, *Bombay*, 1910. The Nira Valley irrigation canal, which was opened in 1884, passes through an area which, prior to the irrigation, was extremely dry, but possessed a deep, rich, black soil. The introduction of the canal converted the area into fertile land, but within five years patches of the land became salt-incrusted and barren, and these increased in area from year to year. In 1905 a committee was appointed to consider the question, and recommended remedial measures. A survey of the area showed that 12·7 per cent. was affected in this way, and was incapable of bearing ordinary crops. The irrigation water contained only 14 to 47 parts of solid matter per 100,000, so that the salt could not have come from this source. Holes dug to a depth of five feet in the affected area quickly filled with water containing large quantities of soluble salts. As a result of these investigations it was concluded that the high level of the subsoil water was the cause of the deposition of salt, and that this level was maintained by the continual seepage of fresh water which filled the drains and prevented the salt water draining away. The salts, which consist largely of sodium sulphate and sodium chloride, together with small amounts of sodium carbonate, magnesium sulphate, and magnesium chloride, are probably derived from the decay of the trap rock composing the basis of the valley.

Reclamation experiments at Pandara, one of the worst areas, showed that the extension of the barren area could be prevented by deepening the main drainage channels and the provision of feeder drains from the land under irrigation.

For reclamation of salt land the only method found successful has been the digging of small drains of suitable shape across the natural drainage of the land, giving an adequate outlet, and after banking up the land, washing by frequent irrigation. By this means it is stated that the land can be improved sufficiently in one year to be suitable for growing most ordinary crops. It has been demonstrated that the drains must run across the natural drainage channels, and that no open drain is of use if it receives surface drainage.

Various crops were tried on the salt land, and the most resistant were found to be: Wál (*Dolichos Lablab*), Chowli (*Vigna catjang*), and Ambádi (*Hibiscus cannabinus*).

The chemical and mechanical composition of the Western Prairie soils of Canada are described in *Bulletin No.* 6 of the Canadian *Department of Agriculture, Central Experimental Farm*, 1910. These soils are, as a whole, characterised by their large percentage of humus and nitrogen, to which they owe their fertility. The Manitoban soils contain also large percentages of potash and lime, and their phosphoric acid content is slightly above the average. Results are quoted showing the depletion of nitrogen in certain Saskatchewan clay loam soils after being under grain without manure for 22 years.

It is estimated that the actual amount of nitrogen removed by crops was about 700 lb. per acre, and taking the total loss, calculated to a depth of 8 inches of soil, it appeared that twice as much nitrogen was dissipated by cultural methods as was removed by the crops. If the fertility of this and other Western Prairie soils is to be maintained it is pointed out that some system of rotation must be adopted for the conservation of the nitrogen and also of the soil moisture.

Manures.—The bat guano deposits of India are dealt with in *Agricultural Ledger*, 1911, No. 1. The supply of such material is small, as the caves necessary for its accumulation are rare. Analyses of three samples from Kyaukse, and accounts of the deposits of varying size in

Greshoff, Director of the Museum. A great variety of common foodstuffs is reported on, and the Bulletin will be of great value as a source of information on the composition of the foodstuffs of the East Indies.

Maize.—*The Report of the British South Africa Co. for* 1909–10 states that maize is so far the staple crop in Rhodesia, but coffee cultivation is developing in Matabeleland, and throughout the country the area under various other crops is increasing. The maize industry suffered from a fall in price, and also from a scarcity of native labour. It is suggested that the question of export need not be considered at present, and that the surplus grain should be utilised for feeding cattle and pigs. The production of maize in 1910 was slightly over the estimated local consumption, and 10,000 bags of maize were exported from Matabeleland to test the organisation for export in case the output should exceed the local consumption in the near future. The maize was sold in London and appeared to give satisfaction.

The value of first generation hybrids in maize is discussed in *Bulletin No.* 191, 1910, *Bur. Plant. Ind., U.S.A. Dept. Agric.* The maize plant is naturally cross-fertilised, and requires the stimulus of crossing to produce maximum yields. The planting of first generation hybrid seed as a method of securing increased yields, is to be considered as a distinct question from the breeding of superior varieties. Crosses between distinct varieties or strains at once increase the yield, but to maintain this high yield the cross must be made anew each year. Maize is wind-pollinated and has the male and female flowers on widely separated parts of the plant. This combination of characters permits the production of crossed seed by simply planting two varieties together and removing the tassels from the plants of one variety, which will then produce only hybrid seed. As the raising of hybrid seed requires neither special skill nor great outlay of capital, the increased yields, amounting sometimes to 95 per cent., are easily obtainable.

Miscellaneous Publication No. 485, 1910, *Bur. Plant. Ind., U.S.A. Dept. Agric.* describes methods for the production of selected seed maize. A special plot of land should be set aside for seed production, and the best ears selected and re-sown. This should be repeated, and in a very few years the best strain for local conditions is arrived at. This practice is not only cheaper than buying seed, but home-produced seed can often be sold with advantage to less progressive neighbours. The ideal ear of maize is nearly cylindrical in shape, tapering only slightly from the butt to the tip, which should be fairly abrupt. The rows of corn should be straight and compact. The cob should be of medium size, about one-half the diameter of the ear, at a distance of one-third from the base, the length of the ear being four times its diameter. Extra large or extra long ears should be avoided as much as small ears. The grains should be of uniform size and colour, and should fit well into their positions, being nearly flat on the sides and slightly tapering on both edges.

Farmers' Bulletin No. 415, 1910, *of the U.S. Dept. Agric.* emphasises the necessity of drying all maize seed the day it is gathered. This is best carried out by placing the husked ears either suspended on strings or stacked on a seed rack, in a dry place where there is a free circulation of air, as in an open shed or loft. The ears should not touch each other. To destroy weevils or moths fumigation with carbon disulphide is recommended. The seed should be enclosed in an air-tight compartment, the liquid being placed in a shallow pan on top of the seed, and in the proportion of half-a-pint for each ten bushels of seed. After fumigation the seed must be thoroughly aired. After two months in the dry shed the seed may be stored for the winter. To prevent weevil attacks it is suggested that one pound of naphthalene should be added to each bushel of seed stored.

Wheat.—The *Journal of the Board of Agriculture* (1910, **17**, Suppl. No. 4) reprints the papers on wheat read at the Winnipeg meeting of the British Association in 1909. The wheat area of the world for 1908–09 is given as 242 million acres, being an increase of 41 millions over that of 1898–9.

Oats.—According to *Bulletin No.* 182, 1910, *Bur. Plant. Ind., U.S.A. Dept. Agric.*, the results of ten years' experience with Swedish select oat show that it yields, under the same conditions, on an average 10 bushels per acre more than the best varieties previously grown. The feeding value is also stated to be satisfactory, the amount of protein being above the average, and the nutritive value narrow.

Coffee.—The *Bull. Soc. Belg. d'Études Col.* (1911, **18**. 101) contains an account of the successful inter-cultivation of "robusta" coffee with Para rubber trees.

Grapes.—The *Agric. Journ. Cape of Good Hope* (1910, **37**. 528) contains the results of a detailed investigation of the development of the grape, with numerous analyses.

Bulletin No. 36, 1910, *Dept. Agric., Bombay*, deals with the treatment of grape vine mildew. The following remedial and preventive measures are stated to have given good results: (1) removal of all loose bark and dead spurs from the vine; (2) clean weeding; (3) avoidance of excessive watering; (4) spraying with Bordeaux mixture of normal strength, especially after pruning in October, and again one month later, the treatment being repeated at intervals of a month, using a weaker mixture.

Sugar.—*Report No.* 92 *of the Dept. Agric., U.S.A.*, gives a full account of the progress of the beet sugar industry in the United States in 1909. The year's output was 20 per cent. greater than that of the preceding year, and exceeded that of the previous best year by 6 per cent. Although great progress is being made, American methods in beet cultivation are stated to be still inferior to those in vogue in Europe, especially as regards tilth of soil, rotation and manuring. Methods of cultivation, etc., are fully described in the report, and the condition of the industry in each State is given with full statistics. A section of the report deals with the disease known as "curly top," which is attributed to the "beet leafhopper." Various remedial measures are mentioned, but no completely satisfactory remedy has yet been found.

A discussion of some of the many problems of sugar-beet cultivation is contained in *Journ. Board Agric.* (1911, **17**. 793). Descriptions of various continental methods of working are given, and it is shown that beets can be successfully grown in the southern and eastern parts of England.

The *Agric. Journ. Cape of Good Hope* (1910, **37**. 501) discusses the possibilities of sugar-beet cultivation in South Africa. It has been demonstrated that beets rich in sugar can be grown, but the possibility of developing a remunerative industry is still an open question.

The "sugar-cane froghopper" of Trinidad has been identified as *Tomaspis varia*, Fahr. (*Trinidad and Tobago Agric. Soc. Paper* No. 448, 1911). *Circular* No. 5, 1910, *of the Dept. Agric. Trinidad* recommends spraying with paraffin emulsion as a remedy. A fine spray is said to be useless, as unless the froghopper is thoroughly immersed in the fluid it is not killed. A knapsack spray pump having a nozzle orifice of $\frac{1}{32}$ inch is recommended. In *Circular* No. 6 it is mentioned that a mould has been found attacking "froghoppers" and causing considerable mortality. Cultures of this fungus may be made on artificial media such as potatoes, and the spores applied to the canes by means of powder bellows or by placing a small culture in the angle of the leaves.

Fodders.—Little difficulty has been experienced in growing alfalfa in the south-western portion of the United States or in any area where irrigation is practised, but no alfalfa has been available for the humid eastern and southern states, for semi-arid regions, or for the cold northern regions. *Bulletin* No. 185, 1910, *Bur. Plant. Ind., U.S.A. Dept. Agric.* points out that there is need for a hardy variety suitable for cultivation in the Northern States and Canada, and discusses the factors governing the wintering of alfalfa. Good tillage, *i.e.* previous cropping and preparation of the soil, is necessary, whilst inoculation determines success or failure, even when all other conditions are satisfied. The time of cutting must be varied in order to leave a considerable growth on the field in the autumn. As regards weather, a dry autumn inducing comparative dormancy, followed by a heavy covering of snow, is satisfactory. A wet autumn produces new growth, which succumbs to the first frost. Dry winters or alternating frosty and mild weather are also detrimental. It is pointed out that the obvious method of procedure is to sow hardy strains and take precautions to increase the supply of those that do well under local conditions.

Der Pflanzer (1911, **7**. 26) gives descriptions with analyses of fifteen

fruiting at the age of four years, and this appears to be the earliest date at which they will bear fruit. A quantity of Lisombé fruits was obtained from the Duala district and has been distributed for planting in various parts of Southern Nigeria.

A number of analyses of palm fruits of the different varieties occurring in Dahomey (see this *Bulletin*, 1909, **7**. 389) are given by Hébert in *Les Matières Grasses* (1911, **4**. 2171); unfortunately the value of these analyses is small owing to the fact that no moisture estimations were made, and although in all cases the fruits had been dried in the shade, no note is made of the relation between the weight of dried fruits and fresh fruits. An analysis of oil derived from each variety is also given, showing that the oils are practically identical, as has been shown already by analyses made at the Imperial Institute of oils from the different varieties of oil palm from Southern Nigeria and the Gold Coast (*loc. cit.*).

Shea Nuts.—A general article on this oil-seed in *Bulletin de l'Office Coloniale* (1911, **4**. 33) contains the following matters of interest. The possibility of utilising shea butter in the manufacture of margarine and vegetable butter has often been discussed, but the comparatively large amount of unsaponifiable matter renders it unsuitable for European consumption in this way. According to Ammann, the best method of purifying shea butter is that of treatment with warm alcohol. Certain margarine manufacturers in Holland are said to be ready to purchase both shea nuts and "butter," and they seem disposed to instal buying establishments in the principal centres of production with the object of encouraging trade in these products. It is stated that sufficient nuts to yield one ton of kernels can be bought in West Africa (at Koulikoro on the Niger) for £2 10*s.*; the cost of shelling the nuts and the storage and transport to steamer and thence to Bordeaux is given as £5, making a total cost of £7 10*s.*, whilst the price at which shea kernels sell in Marseilles or Liverpool varies from about £9 10*s.* to £13 15*s.* per ton.

In the course of an article dealing with the shea nut, Fickendey (*Tropenpflanzer*, 1911, **15**. 157) states that from Adamawa 55 tons of shea kernels, valued at £210, were exported in 1908, and 182 tons, valued at £1,144, in 1909.

Hébert has published recently (*Les Matières Grasses*, 1911, **4**. 2170) results of some investigations on the composition of shea butter, and appears to be unaware that the fatty acids have been previously investigated by Southcombe (*Journal of the Society of Chemical Industry*, 1909, **28**. 499), who obtained results differing from those of Hébert.

Soy Beans and Oil.—Soy beans have been cultivated experimentally in several districts in British Guiana (*Report of the Department of Science and Agriculture for* 1909–10, p. 29). The varieties tried have not given good results, but the experiments are being continued.

Trials at Skinner's Court, Transvaal, have shown that the "Sakura" variety is the first to ripen, whilst the "Southern" soy bean gave the best germination and growth (*Agricultural Journal of the Union of South Africa*, 1911, **1**. 279).

General articles dealing with the cultivation, harvesting and uses of the soy bean plant appear in the following journals: *Queensland Agricultural Journal* (1911, **26**. 9), and *Les Matières Grasses* (1911, **4**. 2195); whilst a pamphlet reprinted from the Natal Mercury (*Studies in Agriculture, Natal Division of Agriculture*, Series II) will prove of special interest to planters in South Africa who are concerned with this crop.

On account of the high price of linseed oil at the present time, attempts are being made to find cheaper substitutes. Experiments made at the Franklin Institute, Washington, U.S.A. (*Les Matières Grasses*, 1911, **4**. 2115) show that soy bean oil may be mixed with linseed oil in paints in small proportions, but that paint made with soy bean oil alone dries slowly and incompletely.

Miscellaneous.—Heckel describes an oil-seed from the French Congo known to the natives as Casso or Gasso (also N'Kam or Ekoum), which has been identified as *Manniophyton fulvum*, Müll. Arg. (N. O. Euphorbiaceæ). The seeds consist of 34 per cent. shell and 66 per cent. kernels; and contain 51·3 per cent. of oil in the kernels, equivalent to 33·85 per cent. in the whole seed. The oil is a yellow liquid at ordinary temperature and without marked smell or taste. According to Heckel it thickens very quickly on exposure to air in thin films, and could therefore be used for paint manufacture, although this seems rather unlikely from the iodine value recorded, viz. 101 per cent. The plant is a climbing shrub, which occurs at several places in the French Congo, but no information is given as to the possibility of obtaining it in sufficient quantity for commercial purposes.

The results of investigation of a number of little-known oil-seeds from the Ivory Coast (together with the oils and residual cakes yielded by them) are given by Hébert in *Les Matières Grasses* (1911, **4**. 2158). Among these may be mentioned *Dumoria Heckeli*, one tree of which is said to yield as much as 4,000 fruits, equivalent to about 66 lb. of solid fat, which is used by the natives as food.

The composition of rice oil (extracted by solvents from rice bran) has been investigated by Tsujimoto (*Chem. Rev. Fett. u. Harz Ind.*, 1911, **18**. 112). It is a liquid, greenish-yellow oil containing glycerides of palmitic, oleic and isolinoleic acids.

According to information published in the *Indian Trade Journal* (1911, **20**. 110), it appears that much of the "ghi" (clarified butter fat) sold in India is adulterated, and that pure ghi cannot be produced at the price which consumers are prepared to pay. It would seem, therefore, that there is an opening for a substitute made from vegetable oils or fats, and efforts are being made to interest manufacturers in the production in India of a substitute from Indian cotton-seed oil.

"Candle nuts," the kernels of *Aleurites triloba* from the East Indies and the Sunda Islands, have appeared on the market recently in Germany under the name of "Kirimi" nuts (*Chem. Rev. Fett. und Harz Ind.*, 1911, **18**. 60).

RUBBER.

Para Rubber (*Hevea brasiliensis*).—The cultivation of Para rubber in Selangor forms the subject of a well-illustrated article in the *Bull. Agric. Cong. Belg.* (1910, **1**. 79) by M. Leplae, who visited the Federated Malay States in April 1910. After a comparison of the climatic conditions in the various Hevea-growing districts of the world, the following subjects are considered: soils suitable for Hevea cultivation, varieties, dimensions of the tree, the formation, manuring and draining of plantations. The collection and preparation of the rubber is then dealt with, including tapping methods, yield of latex, coagulation, washing, drying and smoking. Particulars are also given of the development of plantations in the Federated Malay States.

In the *Agric. Bull. Straits Settlements and Federated Malay States*, (1910, **11**. 475), K. Bancroft gives the results of an examination of the fungus *Thyridaria tarda*. He states that the following facts are now established: (1) *Thyridaria tarda* is the cause of the "die-back" disease of cacao plants, and the "brown rot" of cacao pods, whilst its *Diplodia* form is identical with the *Diplodia* which is known to cause a "die-back" disease of Para rubber in Malaya. The fungus also attacks mango, papaw, Castilloa rubber, sugar cane and *Albizzia moluccana*, and is considered to cause a root disease of coconuts in Trinidad. (2) It occurs in Tropical America, the Philippines, Java, Samoa, San Thomé, the Malay Peninsula and possibly in Ceylon. (3) It is a wound parasite, and the disease is caused by the fungus in its Diplodia stage. The Diplodia condition is capable of reproducing itself, and passes into the ascigerous (Thyridaria) condition on the affected parts some time after they are dead.

The disinfection of Para rubber seed has been proposed as a preventive of the transmission of disease from one district to another. This subject is discussed by H. N. Ridley (*loc. cit.*, p. 454), who considers that the danger of infection in this manner is practically nil. Experiments designed to determine the effect of disinfectants on the germination of rubber seeds showed that such treatment, especially when the seeds are agitated in water, may lead to a loss in germinating power.

In a critical review (*Journ. d'Agric. Trop.*, 1911, **11**. 11), G. Vernet compares the various forms of "pricking" instruments in use for tapping Hevea, and discusses the causes of formation of the woody excrescences occasionally formed on the bark as the result of "pricking." He also contributes an article (*loc. cit.*, p. 40) on the methods of tapping Hevea and the arrangement of the incisions. M. Vernet favours Stibbe's method, in which the stem is divided into five parts and alternate sections

Winton on the cultivation of *M. Glaziovii* in East Africa, in which the author treats of the soil and climatic requirements of the plant, and the methods of planting, clearing and manuring, and gives notes on insect and fungoid pests, tapping methods and yield of rubber from this species. Mr. Winton has a high opinion of the future of *M. Glaziovii*, and thinks that in favourable climatic conditions, with suitable soil and a good labour supply, the plant is almost as promising as Hevea.

Clitandra spp. and Landolphia spp.—Experiments have been carried out recently at the Botanical Gardens at Eala (Congo) on methods of obtaining rubber from rubber vines by pounding the bark and by tapping respectively (*Bull. Agric. Cong. Belg.* 1910, **1.** 45). The plants experimented with were *Clitandra Arnoldiana* and *Landolphia owariensis*. In the former case the latex flows profusely on tapping and very little is left in the bark, but with *L. owariensis* the flow of latex is much slower, and much congeals in the bark. Consequently, in the subsequent treatment of cutting down the plant and recovering the remaining rubber by beating the bark, very little is found in that of *C. Arnoldiana*, whilst *L. owariensis* yields a considerable quantity. Determinations were also made of the amount of rubber obtainable from the different parts of the vines.

According to the *Report of the British South Africa Company for* 1909–10, p. 19, the indigenous rubber has been strictly protected since 1903, with the result that the number of young vines shows a large increase. In a small portion of North-Eastern Rodesia recently visited, five rubber forests were inspected, which covered an aggregate area of 21,000 acres, and contained approximately 800,000 vines.

In a booklet entitled *Rubber Plants of Northern Madagascar*, H. Jumelle and H. Perrier de la Bathie describe certain rubber-producing plants occurring in the most northerly portion of Madagascar. *Landolphia trichostigma* var. *oxyacra*, bearing the native name "Kalamo," is apparently capricious in its yield of caoutchouc, and therefore its exploitation is not advisable. This is not the case with *L. Perrieri* var. *ambatensis* (native name "dity vahea") from which rubber is sometimes extracted by the natives by a process of pounding the bark. *L. crassipes*, which is met with on the steep slopes and precipices of this district, also yields rubber. At Nossi Bé, the authors describe the occurrence, along with *L. ambatensis*, of another species, *L. Boivini*, Pierre. On Mount Ambre and the neighbouring ranges, the authors show that the conditions cause the disappearance of certain species, which are replaced by others. Thus on the Mahavary, the Loky, and the Manankolala, the typical *L. Perrieri* is again found, whilst *L. trichostigma* and *L. crassipes* disappear. A new species, *L. exilis*, was encountered, but this is of no value as a source of rubber. *L. arborescens* is abundant on Mount Ambre, and assumes there the giant form of "Manogarivo" amongst others, the form apparently varying with differences in the composition of the soil.

Mascarenhasia spp.—Among the plants described by Jumelle and de la Bathie (*loc. cit.*) as occurring in Northern Madagascar is *M. arborescens*, which is, however, rare and polymorphic. It affects forms very nearly approaching those of *M. angustifolia* and *M. lanceolata*. This latter occurs quite commonly below 1,000 metres, on the dry sandy mountain summits, where it attains a height of 6 metres and a diameter of 51 cm. In order to obtain rubber from it the tree is cut down and annular incisions are made on the trunk.

Plectaneia spp.—In Northern Madagascar, at elevations below 1,000 metres, a new species, *Plectaneia microphylla* (native name "mahavaahavana"), was found (*loc. cit.*). The rubber obtained from the latex of this species is tenacious and of good quality. The latex is mixed with those from *Landolphia* spp. by the natives. At elevations of 1,000 to 1,400 metres another new Plectaneia, resembling *P. Hildebrandtii*, was found. *P. inutilis*, which yields a viscous latex, also occurs in this region.

Castilloa spp.—On the subject of "Species of Castilloa and their Cultivation," H. Pittier contributes an article to the *Journ. d'Agric. Trop.* (1911, **11.** 4). The author considers that there are at least ten species of Castilloa which, arranged in chronological order of their discovery, are as follows: *Castilloa elastica*, Cerv., 1794; *C. costaricana*, Liebm., 1851; *C. australis*, Hemsl., 1900; *C. fallax*, Cook, 1903; *C. lactiflua*, Cook, 1903; *C. nicoyensis*, Cook, 1903; *C. panamensis*, Cook, 1903; *C. Ulei*, Warb., 1904; *C. guatimalensis*, Pittier, 1910; *C. daguensis*, Pittier, 1910. The yield of rubber probably varies in the different species, and in planting Castilloa, care should be taken to select the species or variety best suited to the soil conditions.

The development of the laticiferous system in Castilloa trees is considered to be proportional to the variations in intensity of transpiration, and it is deduced (1) that other conditions being equal, the countries most favourable for the cultivation are those which have a well-defined dry season; (2) that indigenous varieties should first be propagated; (3) that planting in the open, in clearings or coppices, is preferable to planting under shade.

Funtumia elastica.—A report on the progress of rubber cultivation in Southern Nigeria is contained in a recent issue of the *S. Nigeria Gazette* (1911, **6.** No. 22 Suppl.). The rubber plants cultivated are principally *Funtumia elastica* and *Hevea brasiliensis*, although experiments are also being made with *Ficus elastica*.

With Funtumia the usual practice is to establish nurseries near the villages where the tree thrives, and from them to equip plantations in the neighbourhood. Altogether 602 such communal plantations have been started, 395 of which are near Benin City and contain 154,100 established plants, the remainder being in the Niger Division. The older plantations near Benin City are in good condition, and many trees are large enough to tap. Besides these, there are also plantations belonging to individuals and private firms.

An account of the experiments on the tapping of Funtumia trees, which have been conducted at Amani in German East Africa, is contributed to *Der Pflanzer* (1911, **7**. 1) by A. Zimmermann. Two sets of experiments were carried out with 4½ and 5½ year old trees respectively. The former had been grown at an elevation of 800 metres at a distance apart of 2½ metres. In the first set of experiments 80 trees were tapped, and four methods of tapping were investigated, so that 20 trees were tapped by each method. The first method consisted in making a long groove (180 cm.) on the stem of the tree, and on this cross cuts were made about 2½ cm. apart and about 8 mm. wide. In the second method the cuts, instead of being across the direction of the long groove, were parallel to it, but were still 2½ cm. apart. The third method was that recommended by Bücher, and consisted of a connected system of long incisions. The fourth method of tapping employed was the herring-bone system, the lateral incisions being 50 cm. apart and extending right round the tree. The main vertical groove was 185 cm. long, and on this were also made cross cuts as in method No. 1.

The data obtained clearly indicate that the herring-bone method of tapping with the lateral incisions made at a distance of 20–30 cm. apart is the one which in general gives the best results.

Kinds (*Bull. Agric. Cong. Belg.*, 1910, **1**. 36) contributes a note on "Dichotomy, the principal cause of the premature branching of the stem of *Funtumia elastica*," in which he draws attention to the fact that the defective method of growth in young plants of *F. elastica* and *F. latifolia* is due to dichotomy of the stem, which is characteristic of these species and also probably of other species of this genus. He noticed that after each period of growth the stem and branches of the plant were terminated by two buds of the same generation, giving rise in each case to two branches, and thus constituting an obstacle to the prolongation of the stem. Experiments on the best methods of overcoming the objectionable results of this mode of growth are in progress.

Fibres.

Cotton.

General.—In a recent pamphlet on "Cotton Selection on the Farm by the Characters of the Stalks, Leaves, and Bolls," by O. F. Cook (*Cir. No.* 66, *Bur. of Plant Indust., U.S.A. Dep. Agric.*), it is pointed out that it is of the greatest importance to the improvement of the cotton crop that selection should be carried out as a part of the regular work of every farm. The plants raised for seed should be grown on a separate plot, and the farmer should make himself thoroughly acquainted with the characteristics of the particular variety. It is not possible to keep any variety uniform without continued selection, since

Singa Districts of the Sennar Province appears to be of very good quality. This cotton is grown on the "terrass" system, a "terrass" being a piece of sloping land, about 100 metres × 50 metres, with a dam about 2 feet high across the lower end and up both sides of the slope in order to retain the water. The seed is sown in October, at the end of the rainy season, and the crop is picked in January. The cotton grown is all of the Yannovitch and Mitafifi varieties. The latter is the more suitable, as it does not require so much water or so much skilled attention. The prospects of the cultivation of Mitafifi as a rain-crop are very promising if the natives can be induced to undertake the industry.

A successful start has been made in growing cotton as a rain-crop on the Setit River in the Kassala Province.

The total production of ginned cotton in the Sudan in the 1909–10 season is estimated at 2,870 tons. Of this, 1,469 tons, or 51 per cent., was grown at Tokar; 249 tons, or 9 per cent., in the Khartum District and on European estates to the north of Khartum; and 1,152 tons, or 40 per cent., in the rain-zones south of Khartum. The last-mentioned was mostly of the native ("beladi") description. About 91 per cent. of the crop was grown by natives, almost entirely without assistance from European enterprise.

The following table gives the quantities and value of the cotton crop (unginned) of the Sudan for the years 1901–10:—

	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
Quantity (tons)	1,200	150	1,100	1,800	2,000	2,300	4,400	5,400	3,900	8,700
Value (£) . .	13,000	1,400	21,000	41,000	34,000	50,000	103,000	89,000	65,000	235,000

Uganda.—A tour made recently by the Government Entomologist (*Uganda Official Gazette*, 1911, **4**. 58) has shown that the cotton plots in many parts of the Protectorate are infested with insect pests, among which may be mentioned millipedes, aphides, and the cotton-stainers, *Dysdercus* sp. and *Oxycarenus* sp. The most important pest is the boll-worm, which is very prevalent in the Bukedi District, and will doubtless cause great damage unless the affected bolls are systematically collected and destroyed. During the quarter ending December 31, 1910, the exports amounted to 5,917 cwts. of seed-cotton of value £5,295, and 6,436 cwts. of lint of value £24,028.

Rhodesia.—It is stated in the *Rep. Brit. S. Africa Co.*, 1909–10, that the cotton exported from Northern Rhodesia maintains its quality, and has realised prices in Liverpool varying from 8¼*d.* to 13¼*d.* per lb. A tour of investigation has been made by Mr. J. Bateson on behalf of the British Cotton Growing Association, and as a result of his favourable report steps have been taken to extend the cultivation. A ginnery and an experimental plantation have been established in the

Kafue District, and over 1,000 acres have been planted by European farmers.

Southern Nigeria.—The report of a tour made in 1909 by a representative of the British Cotton Growing Association in the Ishan District has been published as an appendix to *S. Nigeria Gov. Gaz.* (1911, **6**. No. 22). It is considered that the cultivation of cotton is extending rapidly in this district, and that the natives, having realised the profitable nature of the industry, will continue to increase the production.

India.—In Bombay, the experimental work in connection with cotton (*Ann. Rep. Dep. Agric. Bombay Pres.*, 1909–10) has been continued, and has included the introduction of new varieties, the production of new forms by hybridisation, and the improvement of existing varieties by seed selection. The effects of improved tillage and the application of manures have also been studied, and experiments have been made to determine the best crop to grow in rotation with cotton. Definite and valuable results have been obtained in all these directions.

The Navsari (Broach) variety has been imported into Dharwar from Gujerat, and has given a yield as much as 27 per cent. greater than that of the local Kumpta cotton. Moreover, this new cotton is of superior colour, and gives a larger percentage of lint on ginning. It has the disadvantage, however, that it requires 8 months to mature as compared with 6 months in the case of the Kumpta, and must therefore be sown immediately the rains begin. This restricts the area on which it can be grown, as the early rains are not prevalent at some places which are otherwise suitable.

A hybrid of the local Kumpta variety has been produced which gave a higher yield than the ordinary Kumpta, and the crop realised a price 7½ per cent. in advance of that of the latter.

Good results were obtained at Gadag with American and similar cottons, such as Cambodia (an acclimatised American form), and hybrids of these varieties. Cambodia cotton has proved very successful in several localities.

The cotton of Khandesh consists of a mixture of several varieties. The different types in this mixture have been separated, and seed of the most profitable constituent (*G. neglectum* var. *roseum*) has been distributed to growers.

In the Surat District, the crops obtained from selected and hybridised seed supplied by the Department have yielded the growers an increased profit.

Experiments with American cotton in Sind have been successful, but it is unlikely that these varieties will be able to compete with the local Sindhi cotton, as the latter gives larger yields.

An account of recent work on the improvement of cotton in Madras is given in *Rep. Dept. Agric. Madras*, 1909–10. Tinnevelly cotton includes "Karunganni" and "Uppam" forms. The lint of Karunganni is much superior to that of Uppam, and efforts are in progress to ensure that the former shall become the predominant variety in cultivation. Large quantities of pure Karunganni seed have been grown and distributed, and it is estimated that 80,000 acres were sown with this seed during the 1909–10 season. Attempts are also being made to improve the "Northerns" cotton in Kurnool. At the Nandyal, Hagari and Bellary Agricultural Stations, experiments are being carried out on the improvement of varieties by selection and hybridisation with the object of enhancing both the yield and quality. Encouraging results have already been obtained. An endeavour is being made to introduce Cambodia cotton into various districts. This cotton is superior to that of any of the indigenous varieties, and the plant can be grown on land unsuited to the native kinds, and gives a much larger yield. Satisfactory progress is being made in the introduction of the drill system of cultivation into Tinnevelly.

St. Vincent.—An account of the cotton industry of St. Vincent is given in the *Rep. Bot. Station, Agric. School, etc., St. Vincent*, 1909–10. The area planted with Sea Island cotton in 1909–10 amounted to 2,528 acres as compared with 3,000 acres in 1908–9, the diminution being due to the lower prices obtained in the latter year. The crop amounted to 356,139 lb. or 141 lb. per acre, and realised an average price of 19*d.* per lb. The "extra fine" grade obtained 26*d.*–27*d.* per lb.

In the St. Vincent Grenadines, a hardy perennial, known as "Marie Galante," is grown, and in 1909–10 yielded a crop of 29,452 lb., which was sold at an average price of 10*d.* per lb. The yield per acre varied from 42 lb. to 68 lb. in the different islands. The smallness of the yield was chiefly due to deficient cultivation. The land is merely scraped over, and no manure is applied. The plants are grown about 4 feet apart, and maize and pigeon peas are sown between the rows. The plants are often allowed to remain in the ground for several years, and at the end of the harvest are cut back to about one foot from the ground. Leaf-blister mite and white scale are prevalent and, although it is stated that they do but little damage, doubtless tend to reduce the crop.

The Sea Island seed-cotton gave an average yield of lint of 27·1 per cent., and the "Marie Galante" an average of 23 per cent. The "extra fine" Sea Island yielded only 22–24 per cent. of lint.

The seed was selected and disinfected by the Department, and little, if any, seed is now sown which has not been thus treated. Efforts are being made to improve the quality and yield of the lint, and to establish a strain resistant to attack by insect and fungoid pests.

An ordinance has been passed to regulate the purchase of cotton

rearers. Experiments with Italian silk in the Central Nursery have proved successful.

Flax.

Ireland.—The area devoted to flax growing in Ireland has for several decades gradually diminished, the lowest on record being that of 1898, which amounted to 34,469 acres. Some improvement has since taken place, the average annual acreage being 46,939 during 1896–1900, 48,064 during 1901–5, and 49,169 during 1906–10. In December 1909 a Departmental Committee was appointed to enquire into the present state of the flax-growing industry in Ireland and the causes contributing to its decline, and to submit recommendations. The report of this committee has been published recently as a parliamentary paper [Cd. 5502], and, among its principal conclusions and recommendations, the following may be mentioned.

The area under flax has always been subject to extreme fluctuations, and, for this reason, crop statistics by themselves do not justify definite conclusions with regard to the future of the industry. A simultaneous decline in the area under flax has occurred in other countries, and there is at present a scarcity of the fibre. An increase will doubtless take place in the world's acreage of flax, in which Ireland will probably participate in due proportion.

The Irish flax-spinning industry has extended greatly in recent years, and at present only one-fourth to one-fifth of the fibre required in the Irish mills is produced in the country. Several Irish spinners do not use any home-grown fibre. It is to the interest of flax spinners to encourage the cultivation of flax in Ireland in view of the possibility of some circumstance arising which would interfere with the importation of fibre from abroad.

Several causes have contributed to the decline in cultivation, but the principal cause is the speculative nature of the crop, due to uncertainty of price and yield. There is no evidence that the decline has been brought about by a distinct change in the climate. Having regard to the irregularity of the soil in Ireland as compared with that on the Continent, Irish growers cultivate the crop as intelligently as their continental rivals.

Farmers are recommended to endeavour to improve the yield and quality of their fibre. It is suggested that the Department of Agriculture should carry out trials in order to ascertain whether better seed could not be obtained by a system of selection from the local plants than is available from foreign sources, and should also undertake the investigation of problems relating to retting. The Department should appoint experts to instruct mill-owners in the most approved methods of scutching as well as others to give advice with reference to ventilation of the mills. Other recommendations relate to the methods of disposing of the crop and the advisability of selling all flax in the open market, and to the pollution of rivers by flax-water.

Manila Hemp.

Philippine Islands.—An account of the production and export of Manila hemp in the Philippines by the German Consul at Manila has been published in *Der Tropenpflanzer* (1911, **15.** 163). The crop of 1910 was the largest on record, but the average price was the lowest realised during the American occupation. The total exports for 1910 amounted to 170,000 tons, of average value £21 5*s.* per ton in Manila. The exports to the United States have diminished, whilst those to Europe have increased; the shipments to the United Kingdom exceeded those of 1909 by 100,000 bales. The quality of the fibre appears to have undergone so much deterioration that the present "good current" grade is not superior to the "current" hemp of Spanish times. The hemp growers evidently find it profitable to increase the production at the expense of quality. This, however, can only last until the European demand for the poorer grades is satisfied, and the price will then fall until the production is no longer remunerative. In order to avert such a crisis, the hemp growers should determine to improve the product by better scutching and cleaning.

The Report of the British Acting Consul-General on the Trade and Commerce of the Philippine Islands for 1909 (*Diplom. and Cons. Rep., Ann. Ser.*, No. 4607) states that the total exports of hemp during 1909 amounted to 165,299 tons, of value £3,520,000, and were distributed thus: to the United States, 99,928 tons, of value £2,173,758; to the United Kingdom, 51,566 tons, of value £1,027,512; and to Belgium, 2,842 tons, of value £67,675. The exports to the United States in that year were considerably greater than those of 1908, whilst those to the United Kingdom showed a decrease.

Sisal Hemp.

India.—Experiments on the cultivation of Sisal hemp and similar fibres in Madras were commenced at the Hindupur Agricultural Station in 1901–2, and in 1907–8 samples of fibre were forwarded to the Imperial Institute for examination and were favourably reported on (compare this *Bulletin*, 1909, **7.** 8). In the *Rep. Dep. Agric., Madras*, 1909–10, it is stated that the work has been continued and the leaves cut during 1909–10 yielded at the rate of 200–300 lb. of fibre per acre. It is doubted, however, whether the conditions at Hindupur, and especia y the labour supply, will admit of the successful production of fibre on a commercial scale.

Angola.—It is stated in the *Report on the Trade of the Province of Angola for* 1909 (*Diplom. and Cons. Rep., Ann. Ser.*, No. 4614) that there are about 1,000 acres devoted to the cultivation of Sisal-hemp. The fibre is at present extracted by hand-machines and a good yield is obtained. Very few planters could afford to purchase modern extraction machinery.

MISCELLANEOUS PRODUCTS.

Drugs.—In *Mededeelingen uitgaande van het Departement van Landbouw, Ned. Ind.* (1911, No. 13), Dr. Rant describes "Djamoer oepas," particularly as it effects cinchona. The fungus exists in four forms: (1) *Corticium javanicum*, Zimm., a pinkish-coloured incrustation on the lower parts of branches, (2) small agglomerations of whitish mould cells, (3) a web-like mycelium of white mould threads, (4) occasionally in cracks in bark as the fruiting form of a mould, which has been named *Necator decretus*, Massee. As a rule, Necator forms on the upper surface of the branches, whilst *C. javanicum* prefers the lower surfaces. Necator is, however, rarely seen on cinchona, and never without Corticium. The fungus affects many plants besides cinchona, and Dr. Rant has observed it on 60 different species in Java, including tea, coffee, cocoa, cinnamon, indigo, Para rubber, etc. The results of some investigations on this fungus, especially as it affects Para rubber and tea, have been published already in the *Circs. and Agric. Journ. Roy. Bot. Gardens, Ceylon* (1909, 4. No. 21). As remedial measures for this fungus in cinchona Dr. Rant recommends the destruction by burning of all diseased tissue. He does not think that smearing with antiseptics can have any useful effect. As preventive measures it is important to avoid excessive humidity by (1) selecting suitable localities for plantations and (2) rational pruning and removal of leaves. In this last connection it is pointed out that *Cinchona ledgeriana*, with its close habit of growth, is much more seriously affected than *C. succirubra*, which is of open habit. The importance of producing disease-resistant strains by selection and grafting is also insisted on.

Analyses of 26 samples of Java coca are quoted in the *Jaarboek van het. Departement, Landb., Ned. Ind.*, for 1909, showing that this material contains from 1·51 to 1·96 per cent. of total alkaloids, determined by Keller's method.

Industrial Alcohol.—The question of producing industrial alcohol from potatoes is discussed in detail in *Farmers' Bulletin* No. 410, 1910, *U.S.A. Dept. Agric.* The manufacture is described very fully, particulars of plant with illustrations being given. Mention is also made of the production of alcohol from waste carbohydrate material, which must contain at least 6 per cent. of starch or its equivalent to be profitable. Refuse from distillation has a definite feeding value; and directions for its use as a feeding-stuff for cattle are given.

Tobacco.—It is estimated that in 1908 the value of the tobacco produced in Pennsylvania exceeded that of any other State in the Union. The tobacco grown in Pennsylvania is almost entirely of cigar type, and the methods of cultivation and preparation adopted are fully described in *Farmers' Bulletin* No. 416 of 1910, published by the United States Department of Agriculture. The points of most general interest mentioned are that all varieties of tobacco introduced into

Volatile oils.—In an article on the Allahabad Exhibition, the *Indian Trade Journal* (1911, **20**. 116) gives some particulars of the manufacture of volatile oils, perfumed waters and scented oils, as practised in India.

FORESTRY.

GENERAL.

Eucalypts or Gum Trees.—The large genus Eucalyptus, containing about 150 forms, is practically confined to the Australian region. In *Bulletin No.* 17 *of the Agricultural and Stock Department, Tasmania,* 1910, L. Rodway, Government Botanist, gives an account of the species that occur in Tasmania. He divides these into two sections: (1) those having kidney-shaped anthers and (2) those in which the two lobes of the anther are upright and parallel.

Section (1) contains: stringy bark (*E. obliqua*, L'Her.); gum-topped stringy bark (mostly *E. obliqua* vars.); swamp gum (*E. regnans*, F. v. M.); black peppermint (*E. amygdalina*, Lab.); white peppermint (*E. linearis*, Dehnh.); blue peppermint (*E. Risdoni*, Hook.); bastard blue gum or cabbage gum (*E. Risdoni* var. *hypericifolia*); mountain peppermint (*E. coccifera*, Hook.); iron-bark or white-topped stringy bark (*E. Sieberiana*, F. v. M.), and weeping gum (*E. pauciflora*, Sieber).

Section (2) contains: blue gum (*E. globulus*, Lab.); manna or white gum (*E. viminalis*, Lab.); red gum (*E. acervula*, Hook.); apple-scented gum (*E. Stuartiana*, F. v. M.); cider gum (*E. Gunnii*, Hook.); brown gum (*E. Muelleri*, Moore); heart-leaved gum (*E. cordata*, Lab.); urn gum (*E. urnigera*, Hook.), and dwarf gum (*E. vernicosa*, Hook.).

Detailed descriptions of these species are given, and also notes as to their general appearance in the field. Judging by the leaves, the eucalypts appear to be adapted to life in a region of very intense light. The trees afford little shade owing to the pendent condition of the leaves, and are consequently bad soil-protectors. The leaf-shedding is scanty, and a eucalyptus forest cannot therefore be considered a good soil-producer. With regard to soil, eucalypts are very accommodating, and providing moisture is present, a scanty rainfall has little effect on their growth. Variation in temperature, provided it does not sink too low, only affects the rapidity of growth. Eucalypts are, however, very sensitive to temperatures below freezing point. The eucalypts reproduce themselves readily from seed so long as the seedlings are not subjected to drought, but when once a district has been denuded of trees and shrubs, and the surface soil allowed to become very dry, natural regeneration is difficult.

Eucalyptus timber varies greatly, according to species, in weight, colour, form of grain, durability and resistance to stress, but in structure there is a close similarity in all species. At present it is commonly cut and marketed simply as hardwood, and little attention is paid to the species, age, or condition of growth. Normally the timber is straight-grained, but a peculiar twisting of the fibres occurs in some cases, that renders the wood worthless for many purposes. Eucalypts being evergreen, grow all the year round, and are as suitable for felling at one season as another. The timber produced on alluvial flats is more difficult to season than that produced on rocky hills, owing to its less dense fibre. Some experiments appear desirable to ascertain the best methods of seasoning eucalyptus timber, and when the timber is required for special purposes it is necessary to devote attention to ascertaining the species yielding the timber, its age and condition of growth. The practice of ringing the bark of eucalypts, prior to felling, is said to be undesirable, since it induces rapid drying so that the wood becomes brittle. The enormous size and weight of the trees make the felling responsible for great concussion, which often results in serious "shakes" if ringing has been performed. At present the forest areas are so extensive and the price of timber so low, that little attention has been given to the scientific management of Tasmanian woodlands, or to experiments for ascertaining the best methods of producing high-class timber. As there is much to learn in this connection, it is suggested that experimental areas be formed with these objects in view. For information regarding the working qualities of Australian timbers, see *Technical Reports and Scientific Papers* (Part I. pp. 287–289 and 298–303) published by the Imperial Institute in 1903.

In *Forest Planting Leaflet No.* 6, *Bur. For.*, *U.S.A. Dept. Agric.*, the planting, maintenance, and utilisation of the eucalypts are considered. The most important species is the blue gum (*Eucalyptus globulus*), which is taken as a type, less valuable species being red gum (*E. rostrata*) and sugar gum (*E. corynocalyx*). Sylvicultural information is given, together with an estimate of returns from plantations.

Hicoria spp.—The present position of the supply of hickory timber (*Hicoria* spp.) is dealt with in *Bulletin No.* 80, 1910, *Forest Survey*, *U.S.A. Dept. Agric.* The lightness and strength of this timber have led to its extensive use in America for the construction of vehicles and agricultural implements, and for tool handles, oil-well pumping rods and many minor purposes. The supply of full-grown trees is now rapidly approaching exhaustion, and in the near future it will be necessary to depend upon the second growth for supplies. Apart from the large consumption, it is estimated that fully forty per cent. of the merchantable hickory cut each year is wasted.

The hickories occur in the eastern and southern States from the Great Lakes to the Mexican border, but the areas possessing supplies sufficiently large for commercial exploitation are relatively restricted. The species are slow growing, exacting with regard to soil and climatic conditions, but possess good natural reproduction from both seed and suckers. It is held that no fear for the future of hickory need be entertained, if measures are taken to place under strict sylvicultural management the areas now almost worked out. Advantage should be taken of the strong natural power of regeneration possessed by the species, and the trees grown in mixed stands of uneven age. Meanwhile, much saving of this important timber could be effected by the more economical use of the stocks annually cut out.

Pine Forests.—In the *Indian Forester* (1911, **36**. Nos. 11 and 12) R. C. Milward gives a short description of the pine forests situated along the sandy coast that borders the Bay of Biscay, in the Departments of Gironde and the Landes. Along this coast sand-dunes stretch for an unbroken length of 40 miles, and have an average width of 3 miles. The area of the dunes is estimated at 100,000 hectares (250,000 acres), of which about 80,000 hectares have now been converted into forest. The climate of this region is hot in summer and mild in winter; the rainfall is about 32 inches. The work of reclaiming this area and converting it into forest land was commenced in 1787. In order to provide shelter from the strong west winds from the Bay of Biscay, artificial dunes are formed to a height of 10 metres. Obstacles, such as planks, fences of tree branches, faggots, or wattle-work are raised, against which the sand is blown by the wind. The sand-binding grass, *Psamma arenaria*, is planted between the obstacles and on the dunes, and assists greatly in checking the movement of the sand. The area on the leeward side of these artificial dunes is planted with pine (*Pinus maritima*). Near the dunes the growth is stunted, but is sufficient to form a protective belt. Over the remainder of the forest the growth is moderate, considering the sandy nature of the soil, and the trees are exploited for wood and oleo-resin (turpentine). The forests are divided into rectangular blocks one kilometre square by fire-lines 10 metres wide, which are cleared of all growth every 3 years. The method of management followed is clear-cutting with natural regeneration. The rotation varies, but may be 75, 70 or 60 years, the first being now generally adopted. The maritime pine is a light-loving species, and is an abundant and regular seed bearer. From the age of 12 years it produces cones and seeds, the former sometimes remaining closed for a year, and the latter may lie dormant for from 2 to 3 years before germinating. Only occasionally is artificial regeneration necessary. Thinnings commence at 10 years, and are made every 5 years subsequently. The underwood is removed as a safeguard against fire, and the lower branches of the trees are also cut off to secure a clean bole for future tapping. The average height of trees 75 years old is 50 feet, although some trees may be 80 feet, with a proportional girth. The crop at the final felling with 75 years' rotation averages 250 trees per hectare. The rules of exploitation ensure the cutting being delayed until the maximum amount of turpentine has been obtained. The wood is used for pit props, telegraph poles, boxes, etc. To obtain the turpentine two methods of tapping are practised; these are known as "gemmage à vie" and "gemmage à mort." The former method is employed on trees that are to continue their growth and at the same

is indigenous to the south-eastern part of the United States, and is regarded as most desirable for planting in that region. The respective advantages of planting from nursery-grown stock and from seedlings are considered, and concise information is given as to the climate and soil requirements of the species.

Miscellaneous.—The *Ann. Prog. Rept. For. Admin. in Coorg, India*, 1909–1910, calls attention to the satisfactory results as regards fire protection, the increase in exploitation of the forests by private individuals, and the financial status of the administration during the past year. The usual official information is appended.

The *Prog. Rept. on For. Admin. in the N. W. Frontier Province, India*, 1909–1910, refers to the work done in the Hazara Forest Division. Advance has been made in the extension of roads and in other work, but no sylvicultural operations on a large scale were attempted. A large increase in forest fires, chiefly ascribed to incendiarism, is reported. Departmental statements and appendices are included.

FOREST PRODUCTS.

Timbers.

Beechwood. — Dallimore contributes an interesting article on the "Beechwood Industry of the Chilterns" to the *Kew Bulletin* (1911, p. 109). The beech is the most important tree of the Chilterns, and the timber grown on the heavy soil overlying the chalk has an unrivalled reputation for durability. There are no very extensive plantations, the timber being grown chiefly in situations more or less unfavourable for agricultural purposes, such as the tops and higher slopes of the hills; long shelter-belts for farmlands are also formed. The felling system most generally adopted is the periodical removal of the large and badly placed trees, natural regeneration being relied upon to fill the gaps. A clear felling is occasionally made, when larch is grown as the succeeding crop. The value of the timber varies greatly according to a variety of local circumstances, but a common price for clean-grown trees of medium size is from one shilling to one shilling and sixpence per cubic foot. High Wycombe is the most important centre of the wood-working industry. The world-famous chairs of this town form the chief product, but general cabinet-making is also established, together with several minor industries. The competition of cheap imported birch chairs and of machine-made legs, spindles, etc., is, however, being felt. Chesham has specialised in brush-making. Beech is used for the blocks of scrubbing-brushes, boot-brushes, clothes-brushes, etc., but birch is preferred for bass and other large brooms on account of lightness. The wood employed for the brush backs varies according to the class of article. Horse-chestnut is preferred for scrubbing-brushes; white cherry, sweet chestnut, birch, walnut, and a variety of ornamental foreign woods are used where a polished back is required. Malt shovels, panelling boards, and toys (notably spades and hoops) are also largely made at Chesham.

Poplar.—The question of the planting of poplars to meet the growing demand for the timber in the wood-pulp and other trades is referred to in *Paper Making* (1911, **30**. 58). The price of poplar wood has doubled within the last twenty years, chiefly as a result of the increase of its use for paper-making and in the manufacture of matches. Canadian poplar is the most valuable species, and information is given regarding its cultivation. The species is a rapid grower, is not exacting in its soil requirements, and the trees are ready for grinding for pulp when four or five inches in diameter. A fourteen-year-old Canadian poplar will yield about 35 cubic feet of useful wood. Poplar cultivation has developed greatly in Carinthia and Italy, and there are extensive plantations of the Canadian variety in Central Europe.

Miscellaneous.

Tanning Materials.—The *Kew Bulletin* (1911, p. 114) publishes information, furnished by the Government Botanist of New South Wales, relating to mallet bark. This bark (see this *Bulletin*, 1905, **3**. 196; 1908, **6**. 318) is an important tanning material, which has appeared on European markets during recent years from Western Australia. It is shipped mainly from Albany, the chief destinations being Hamburg and Antwerp, but there are also smaller markets in New South Wales. While the practical value of mallet bark has been fully recognised, its botanical origin has been under some doubt. In 1905 Holmes dealt with the bark under the name of *Eucalyptus occidentalis*, but expressed the opinion that some of the commercial bark must be derived from another species of Eucalyptus, an opinion which is substantially confirmed by Maiden as a result of a visit to the mallet-growing country of Western Australia. According to Maiden, the bark of the typical *E. occidentalis* ("flat-topped yate") is of no commercial value. The "mallet" is a variety of this species, of distinct appearance, and possessing a smooth bark rich in tannin, and has been named *E. occidentalis*, Endl., var. *astringens*, Maiden. This tree occurs in a belt of country following the line of the Great Southern Railway from Beverley to Mount Barker, and extending for about 40 miles on either side of it. The Forest Department has prohibited the cutting of mallet bark from any portion of the area twenty miles on each side of the railway. Two kinds of mallet bark are recognised in Western Australia, viz. brown and white. The former is the better variety, and usually presents exudations of a brownish kino from the whitish, blotched bark; white mallet has little or no kino and a white, smooth bark. There would appear to be considerable uncertainty as to whether these two forms of mallet are botanically distinct. Bibliographical references to mallet bark are appended.

At the Indian Industrial Congress, which met at Lahore in December

1909, Mr. Puran Singh contributed a paper on tanning extracts, which is summarised in the *Indian Trade Journal* (1911, **20**. 179). After giving particulars of the trade in extracts and an estimate of the cost of installing an extract factory, the author states that in India the cost of manufacture of mangrove extract would probably be about 6 rupees per cwt., whilst its value in the United Kingdom would be from 10 to 15 rupees (13*s*. 4*d*. to 20*s*.) per cwt. A summary of information regarding the chief Indian tanning materials is also given. It may be mentioned that the present value of mangrove extract in London ranges from 11*s*. to 14*s*. per cwt., which is rather lower than the prices quoted by the author, and leaves a smaller margin of profit on the cost of production in India.

A short article describing the cultivation and preparation of sumach as practised in Sicily, is published in *Leather* (1911, **3**. 111). It gives analyses of sumach of various qualities and at various stages of manufacture, which consists in grinding the crude material and separating the tough woody matter. Analyses of the chief adulterants found in commercial sumach are also given.

Analyses of a number of tanning materials are quoted in the *Jaarboek van het Departement, Landb., Ned. Ind.*, for 1909. They include two specimens of air-dry *Acacia leucophloea* bark containing 14·6 and 15·8 per cent. of tannin as against 21·0 per cent. quoted by Puran Singh (*loc. cit.*) for Indian bark of this species, and a mangrove bark (bakoe-bark) containing 27·1 per cent. of tannin.

According to the *Leather Trades Review* (1911, **44**. 213) arrangements are being made for the exploitation of a belt of mangrove forest in Queensland, between Cooktown and Cape York. A factory is to be established where the bark collected will be dried, crushed and converted into solid mangrove extract. The average yield of extract from Queensland mangrove bark is given as 45 per cent. (compare this *Bulletin*, 1904, **2**. 276).

Resins.—In an article on useful plants of the Sudan, Uganda and the Northern Congo, Rein enumerates a number of the resin-yielding plants of this region (*Der Tropenpflanzer*, 1911, **15**. 217). Perhaps the most important are various species of *Commiphora*, e. g. *C. africana*, Engl., which furnishes "African bdellium," *C. pedunculata*, Engl., yielding a variety of frankincense, and *C. opobalsamum*, Engl., from which the so-called "Mecca balsam" is procured. *Daniella thurifera* occurs in the Bahr-el-Ghazal, but its oleo-resin does not appear to be used medicinally by the natives as it is in Northern Nigeria. The reddish-brown resin of *Haronga madagascariensis* is said to be used for fixing arrow-heads to shafts. *Boswellia papyrifera* furnishes a frankincense.

Gums.—Rein (*loc. cit.*) gives a list with short descriptions of some of the chief gum-yielding trees of the Sudan, Uganda and Northern Congo.

immediate vicinity of Edmonton. The coal is of Cretaceous age and is regarded as a lignite.

Cryolite.—The *Mining World* (Chicago) of April 1, 1911, has an article on "Cryolite and its Industrial Applications." The uses mentioned for cryolite are (1) manufacture of opaque glass (so-called milk glass); (2) the enamelling of iron ware; (3) metallurgy of aluminium, and (4) the manufacture of white Portland cement, which is used for ornamental purposes.

Gold.—The gold production of the Federated Malay States for 1910, as reported by the High Commissioner to the Secretary of State for the Colonies, is as follows:—

	Oz. (Troy).	*Value at £3 17s. 6d. per oz.*
Gold exported from the Federated Malay States	15,868·5	£61,490 8*s.*
Gold reported to have been bought by buyers in Perak	898·5	£3,481 19*s.*
Total .	16,767·0	£64,972 7*s.*

In the *Mining Journal* (London) of February 25, 1911, statistics are given showing that in Transvaal gold-mining there has been a gradual decrease in the yield per ton of ore mined, from 42*s.* per ton of ore mined in 1902 to 28*s.* per ton in 1910. There has, however, been a reduction in the working costs; but the figures suggest that, with the methods of work hitherto adopted, the limit of reduction in working costs has been reached. It is inferred from these considerations that the Rand as a whole has reached its maturity.

In an article on "Types of Canadian Gold Deposits," *Engineering and Mining Journal* (New York) of March 4, 1911, the commercially important gold deposits of Canada are classified as follows: (1) the placer deposits of the Klondyke district, Yukon; (2) the replacement lodes of Rossland, British Columbia, and (3) the saddle reefs of Nova Scotia. The geological conditions under which the ores occur are discussed for each type.

Graphite.—According to the *Mining Magazine* (London) of February 1911, Canada is increasing its output of graphite. Active development is taking place at Wilberforce, Ontario. The ore averages about 30 per cent. graphite. It is soft and is easily disintegrated after being exposed to the air for a few days.

Gypsum.—The *Mining World* (Chicago) of April 15, 1911, gives an account of the geology and mining of the gypsum deposits in the Maria mountains of California. The gypsum occurs as beds from 10 to 100 feet thick in a series of shales and limestones. According to the official report of the United States Geological Survey the age of the deposits is uncertain, but it may be pre-Cambrian.

Iron Ore.—The *Queensland Govt. Min. Journ.*, December 1910, states that one of the best deposits of iron ore in the State of Victoria is on the banks of the Moorabool river, about four miles east of Lal Lal, where thousands of tons of first-class iron ore occur at the surface. Former attempts to work it were not successful, but another effort is about to be made to work the iron ore in conjunction with brown coal which also occurs in the district.

In *Report* No. 19 *of the Ontario Bureau of Mines*, 1910, Part I, G. C. Mackenzie gives an account of the concentration of the low-grade magnetites of Ontario. These ores are abundant, and since there is a scarcity of good iron ore in the province, the question of the possibility of utilising the low-grade magnetites is one of importance. The results show that first-class Bessemer concentrates can be produced by magnetic separation, but it is doubtful as yet whether the application of the process will be a commercial success.

Peat fuel.—Dr. E. Haanel, Director of the Mines Branch of the Canadian Department of Mines, gives an account of the possibilities of making and using peat fuel in the Central Provinces of Canada (*Canadian Mining Journal* of February 1, 1911). An experimental peat fuel plant has been erected near Alfred, Ontario, similar to those used in Sweden and Russia for the manufacture of air-dried machine peat. In Russia, where there are 1,300 of these plants in operation, 4,000,000 tons of peat fuel were produced in 1902, and there has been a yearly increase since then of 200,000 tons. Operating with the experimental plant at Alfred for fifty days during the last season, 1,500 tons of peat fuel were manufactured, the plant having a capacity of from 25 to 30 tons per day of ten hours. It is stated that the fuel thus obtained has many advantages over cannel coal, and is especially adapted for use in grates, cooking stoves and wood stoves.

Bulletin No. 4, *Department of Mines, Mines Branch, Canada*, deals with an "Investigation of the peat bogs and peat industry of Canada during 1909 and 1910," and includes, as an appendix, a translation of Lieut. Ekelund's pamphlet entitled "A Solution of the Peat Problem," published in 1909. Lieut. Ekelund has invented a peat excavator by means of which, according to Dr. Haanel, the inclusive cost on an annual output of 30,000 tons is reduced to 92 cents per ton in the shed (with the cost of common labour at from \$1·08 to \$1·22 per day of 10 hours). Lieut. Ekelund has also invented a process by which air-dried machine peat carrying 40 to 50 per cent. of moisture can be converted into powder containing only 10 per cent. of moisture. This peat powder is described as a smokeless fuel, and is stated to have a heating effect equivalent to that of the best English bituminous coal, and to be well adapted for industrial uses.

According to the *Times* of April 20, 1911, a factory has been opened at Khartum for the manufacture of fuel from "sudd" by compression in special presses.

Petroleum.—In *Bulletin* No. 77 of the *Institution of Mining and Metallurgy*, Mr. A. Beeby Thompson deals with "The relationship of structure and petrology to the occurrence of petroleum." Whilst admitting that many important oil-fields are located on anticlines, he points out that the anticlinal theory should not be pushed too far, and that oil is associated with many types of structure other than the anticlinal. In a contribution to the discussion on this paper, Sir Thomas Holland stated that in many cases structural complications are so numerous, and outcrops so few, that the oil-driller might as well trust to chance as to reasoning in selecting a boring site. He gave as an instance the Yenangyaung oil-field of Burma, where the structure, though apparently simple, is proved by drilling to be very complex.

The "*Petroleum Review*" of March 25, 1911, states that Australia imported 20,000,000 gallons of oil, chiefly from America and Sumatra, during 1909. About 1,000,000 gallons are being produced from shale in Australia, and during the present year the amount may be expected to be increased eight-fold owing to the installation of new and improved plant for treating shale.

The *Records of the Geological Survey of India* (1910, **40**. Part IV) includes a paper by Mr. Stuart on "The sedimentary deposition of oil." The author puts forward the theory that the Burma oil was deposited *in situ* as oil; and that it does not represent the remains of organic matter embedded in the sediments and afterwards decomposed. He claims that the oil was produced from the organic matter before, and not after, the deposition of the sediment. In support of his theory he gives the results of experiments showing that when suspended muddy matter is precipitated in water carrying oil globules, the oil globules are carried down with it, forming an oily sediment; and points out that this is not due to the affinity of the wet particles of mud for oil, but due to mechanical admixture of the oil with the sediment.

Phosphates.—The *Engineering and Mining Journal* (New York) of April 22, 1911, states that the total production of phosphate in Florida during 1910 was 2,029,797 tons as against 1,826,151 tons in 1909.

Platinum.—The *Mining Journal* (London) of April 29, 1911, states that active prospecting for platinum is taking place in the deposits of the Tulameen and Similkameen rivers in British Columbia. Numerous drill-holes have been sunk, and the returns are so satisfactory that a dredge is to be constructed to recover platinum from the alluvial deposits.

Radium Ore.—According to the *Mining Journal* (London) of March 18, 1911, a Sydney company has decided to build a plant at a cost of between £3,000 and £4,000 for the purpose of treating the radio-active deposits which occur near Olary in South Australia.

that only ten replies were received from English fruit-growers, whilst seventeen were received from New Zealand, is striking evidence of the indifference displayed by English fruit-growers to the value of the work undertaken for their benefit at Woburn. The authors confirm Percival's view that silver-leaf disease is due to the fungus, *Stereum purpureum*. The prevailing belief that fruit trees never recover from "silver-leaf disease" is shown to be erroneous, and though the recoveries at Woburn were mostly from slight attacks, in seven instances recovery took place where "silvering" had extended to the whole of the foliage. No evidence was obtained that trees which have recovered from the disease are immune against further attack. In New Zealand the application of iron sulphate solution to the ground occupied by the roots of affected trees has been suggested as a remedy, but trials with diseased plum trees by the authors did not indicate that iron sulphate had any remedial effect. The balance of evidence is in favour of the view that the disease is spread mainly by the lodgment of spores in wounds. The fungus only fruits on dead trees or dead portions of a tree, and consequently it is such dead material that is the chief, if not the only source of infection. The authors therefore recommend that badly-affected trees, and the diseased parts of slightly-affected trees, should be removed and burned. As a further precaution they suggest that all wounds on trees should be trimmed, cleaned and tarred to prevent the entry of spores.

The blossoming of apple trees has been investigated for 117 English varieties and 67 Scotch and foreign varieties, with a view to determining the order in which different varieties flower. Some of the principal results established are that (1) varieties which ripen their fruit early, blossom on the average two or three days earlier than kinds which ripen their fruit late, though there are many exceptions to this rule; (2) the type of apple ("dessert" or "cooking") has no influence on the date of blossoming; (3) the date on which flowering begins has no definite effect on the period over which the coming into blossom of a number of varieties will extend, and this seems to be determined solely by the weather conditions prevailing at the time.

The foregoing summary of some of the more important contents of this report will serve to indicate its value to those interested in fruit cultivation not only in the United Kingdom but in other parts of the Empire.

TEXT-BOOK OF EGYPTIAN AGRICULTURE. Vol. II. Edited by G. P. Foaden, B.Sc., Secretary-General, Khedivial Agricultural Society, and F. Fletcher, M.A., B.Sc., Principal, School of Agriculture, Giza. Issued by the Ministry of Education, Egypt. Pp. 321–878. (Cairo: National Printing Department, 1910.)

The first volume of this work was reviewed in this *Bulletin* (1909, 7. 444). The present volume is the work of six different authors and is presented as a series of detached contributions. The first chapter gives valuable advice to the farmer about seeds and their selection; the practice of devoting a small area to seed-growing is recommended, and the points to be looked for in the seeds of various crops are described. The next chapter deals with the rotation best suited to farms in different situations; the author appears to endorse Fletcher's views on root excretions and their poisonous action on the plant itself and on neighbouring plants. The different Egyptian crops are then treated separately, both descriptive and practical information being given; considerable space is allotted to cotton, the most important of the Egyptian crops. Fruit and vegetables are then described in the same manner.

Egypt is fortunate in suffering comparatively little from fungoid pests, and the important crops, berseem and maize, are practically free from disease, yet the importance is urged of watchfulness to maintain this happy state and to stamp out at once any new diseases that may appear. Remedial measures are described in the section on fungoid diseases. The attacks of insect pests are much more serious and occasion a large pecuniary loss, and the fact that the same crops are grown without a break from one end of the country to the other favours their distribution. These pests are described together with the methods of keeping them in check. The last two chapters relate to dairying and the live stock of the farm.

The work is full of valuable and practical information and should be of great service to Egyptian agriculture. To show that the Egyptian farmers have still much to learn, one or two instances may be quoted: thus, owing to their ignorance of the existence of the boll-worm the damage occasioned by this pest is attributed to fog and other climatic conditions; and Behara cotton-seeds which had not germinated were held to have been killed by the cold, when examination of the seeds showed that bad cultivation had prevented them from being properly wetted by the irrigation water.

NOTES ON SOIL AND PLANT SANITATION ON CACAO AND RUBBER ESTATES. By H. Hamel Smith. With an introduction by Prof. W. R. Dunstan, M.A., LL.D., F.R.S. Pp. lii + 632. (London: John Bale, Sons & Danielsson, Ltd., 1911.)

This book is largely a collection of articles on special phases of cacao and rubber cultivation by experts having special experience in connection with these two products, and though Mr. Hamel Smith contributes a good deal of matter himself, his task has consisted mainly in arranging these contributions and extracts in proper sequence and in emphasising the moral his contributors teach.

Exception might be taken to many of the opinions expressed in this book, and much might be said as to the irrelevancy of some of the matter included, but the book has a peculiar value in that it is written in a popular style and lays necessary emphasis on the importance to the planting community of plant sanitation and the remedial treatment of plant diseases.

THE PASTORAL HOMES OF AUSTRALIA: NEW SOUTH WALES. ("Pastoralist's Review Propy. Ltd." Melbourne, Sydney and London, 1910.)

This finely illustrated volume is the second of a series devoted to a description of the great pastoral estates of Australia. The object of the book, as stated in the preface, is to place on record a conception of pastoral New South Wales as it exists to-day. There is a detailed account of the development of over 60 pastoral estates in New South Wales. The photographs, of which there are some hundreds, effectively depict many characteristic phases of the pastoral industry, such as homesteads, views on the estates, flocks of sheep, various types of stud rams and ewes, herds of cattle, agricultural and other typical scenes. The result is a handsome book, showing in a striking fashion the huge development of a great industry within a comparatively short period.

LE MANIOC. Par Paul Hubert et Émile Dupré. Pp. x + 368. (Paris: Dunod et Pinat, 1910.)

This further volume in the "Bibliothèque Pratique du Colon" is written on much the same lines as the previous volumes, which have been noticed in this *Bulletin* (1911, **9**. 85).

Cassava is of special interest to those concerned with tropical agriculture for several reasons. It is popular with natives as a foodstuff, is easily grown, and is attacked by few insect pests or fungoid diseases, and consequently in many tropical countries the total quantity grown by natives for local consumption is enormous. To the European administrators of tropical colonies cassava cultivation, as practised by natives, presents two problems. It leads to rapid exhaustion of the soil, and causes serious but often unrecognised losses by soil erosion.

European planters have as yet paid very little attention to cassava except in the East Indies, probably for the reason that the starchy products obtainable from it are unremunerative to produce for export unless labour is relatively cheap or unless starch extraction can be undertaken on a large enough scale to warrant the introduction of machinery.

Cassava is a cheap source of starch, and in view of the increasing demand for starchy materials not only as foodstuffs, but as raw materials in various branches of the textile industries, for the manufacture of glucose and starch derivatives and in various other ways, it is questionable whether it would not pay European planting firms in the tropics to devote more attention to the cultivation of cassava. To any one considering such an enterprise this book will prove useful, since it describes in considerable detail the varieties of cassava and the cultivation of this material.

The second and larger part of the volume is devoted to the discussion of methods of preparing dry peeled cassava and the various forms of cassava starch for the market, and to the utilisation of the starch for the manufacture of alcohol. The machinery described is almost wholly

in detail. One chapter is devoted to the diseases of the cotton plant, and another to the preparation of the crop for the market, including the operations of ginning and baling. Particulars are given with reference to yield and the proportion of seed to lint. Considerable attention is given to the commercial aspects of the industry; the cost of production in various countries is recorded, information is supplied with regard to the commercial classification and sale of cotton in different lands, and a description is given of the principal markets and their business methods. Statistics are furnished of the production and consumption of cotton in all the chief countries of the world.

The second part of the book gives an account of cotton-seed and its products, including the oil, cake and meal, and discusses the alimentary value of these materials.

The work is supplied with numerous illustrations and maps, and forms a valuable addition to the literature of the subject. Its utility would have been greatly enhanced if an adequate alphabetical index had been provided.

DIE BAUMWOLLFRAGE. DENKSCHRIFT ÜBER PRODUKTION UND VERBRAUCH VON BAUMWOLLE. MASSNAHMEN GEGEN DIE BAUMWOLLNOT. Pp. viii + 341. (Jena: G. Fischer, 1911.)

This work, issued as an official publication of the German Colonial Office, deals with the present position of cotton cultivation and its relation to the great cotton manufacturing industries of Europe. The book is divided into four chapters, the first of which is devoted to the question of the "Baumwollnot" (or "cotton famine") and its causes. The second chapter discusses the development and present position of the cotton-growing industry of the United States of America and the prospects of its being able to provide sufficient raw material to satisfy the foreign demand and at the same time to maintain the supply required for home manufactures. In the third chapter, an account is given of cotton cultivation in other countries, with particular reference to their capability of furnishing an adequate supply of cotton to compensate for the deficiency in the American output. Special attention is devoted to the efforts being made in British, French, Portuguese, Belgian and Italian colonies in Africa. The last chapter treats of the prospects of the German colonies as cotton-producing countries. The work concludes with a large number of appendices containing valuable statistical information and reprints of certain important reports.

THE MICROSCOPICAL EXAMINATION OF FOODS AND DRUGS. By Henry George Greenish, F.I.C. Second Edition. Pp. xx + 386. (London: J. & A. Churchill, 1910.)

In the preface to the first edition of this work, issued in 1903, the author pointed out that up to that time the value of the microscope as a means for the examination of food and drugs, and particularly for the detection of adulterants in such products, had been largely overlooked.

Though this complaint is still justified, there can be no doubt that in recent years more attention has been given to the microscopical examination of natural vegetable products of all kinds, including the two groups with which Prof. Greenish is more particularly concerned in this volume.

The contents of the book and the method of treatment adopted were outlined in a notice of the first edition (this *Bulletin*, 1903, **1.** 216). In the second edition the same method of treatment has been retained, and the principal changes are in the addition of new matter. The latter includes a chapter giving the chief distinctive characters of the more common adulterants of ground foodstuffs and drugs, and a useful addition is an outline of a general scheme for the microscopical examination of vegetable powders. These additions enhance the value of the book to the student, especially in the later stages of his work.

The types of products selected for detailed description are much more varied than might be gathered from the title, and the book may well serve as an introduction to the microscopical study of vegetable economic products in general.

THE GEOLOGY AND GEOGRAPHY OF NORTHERN NIGERIA. By J. D. Falconer. Pp. 295. With 24 plates and 5 maps. (London: Macmillan & Co., 1911.)

This book is an outcome of the Mineral Survey of Northern Nigeria, and embodies some of the results of work carried on in the Protectorate during five seasons, from 1904 to 1909. The work of this Survey was undertaken at the recommendation of Prof. Wyndham R. Dunstan, Director of the Imperial Institute, who was also responsible for its supervision. Dr. Falconer was in charge of the field work in Nigeria, and in that capacity he made the observations recorded in the book under notice. In this work he was greatly aided by the late Mr. Arthur Longbottom, to whose excellent work this book owes some of its most interesting pages and best illustrations.

Chapter I gives an account of the physical geography of the Protectorate. This is followed by two rather long chapters on gneisses, schists, and associated rocks, which occupy extensive areas; and there are two shorter chapters dealing with the Cretaceous and Eocene formations. Chapter VI deals at some length with the superficial accumulations and the last chapter is devoted to Tertiary crustal movements. There are two appendices: one gives a brief account of the mineral resources of Northern Nigeria, concerning which further information has been given in the Imperial Institute "Reports on the Results of the Mineral Survey in Northern Nigeria," [Cd. 2875], [Cd. 3914], [Cd. 3915] and [Cd. 4719]; the other is an account of the palæontology of the Upper Cretaceous beds, by Mr. H. Woods. On the whole, one gets the impression that geography plays too small a part in this book to merit the conspicuous recognition given to it in the title.

The book is well printed and excellently illustrated. The illustrations include a useful coloured map showing the general distribution of the rock formations. Dr. Falconer and his colleagues are to be congratulated upon the care with which they have done their work. Imperfect as are the results achieved, they provide a good foundation on which future workers can build.

THE OIL AND PETROLEUM MANUAL, 1911. By W. R. Skinner. (London: The Author, 1911.)

This is a useful manual giving (1) lists of oil and petroleum companies, (2) lists of directors, with addresses and names of the companies with which they are connected, (3) lists of secretaries, (4) lists of consulting engineers, technical advisers, managers and agents. The manual is prefaced with an index of the petroleum companies referred to.

MERCK'S INDEX. By E. Merck. Pp. xii + 392. Third Edition. (Darmstadt, 1910.)

This publication is issued principally for the use of medical men and pharmacists. It gives a catalogue raisonnée of (1) fine chemicals used in medicine, (2) reagents used in the examination of drugs, etc., (3) crude drugs, and (4) minerals, especially those used as raw materials for the preparation of medicinal chemicals. The materials are arranged for the most part alphabetically under the Latin names: the text is in German. Under each name is given a concise summary of the information available regarding the material, especially its composition and its use in medicine. The "Index" contains in small space a very large amount of generally trustworthy information regarding drugs.

DIRECTORY OF PAPER-MAKERS OF THE UNITED KINGDOM. Pp. 228. (London: Marchant Singer & Co., 1911.)

In this new edition the usefulness of the Directory is fully maintained. It contains alphabetical and classified lists of the paper-makers and paper-mills of England and Wales, Scotland, and Ireland. A special feature of this issue is a list of trade designations used by paper-makers and stationers, which is divided into two sections: (1) actual watermarks, and (2) trade names (not being actual watermarks). Among other useful information may be mentioned a tabular statement of the various sizes of papers with their trade names, and a summary of the recognised customs of the paper trade as adopted by the Paper-Makers' Association of Great Britain and Ireland and other bodies.

brown races, Nubians, Begas and Arabs. The Arabs are the most recent immigrants, their effective occupation having commenced probably during the fourteenth and fifteenth centuries. They now dominate the country from Kordofan northwards, and form the trading classes of the country. The negroes constitute the agricultural community.

CLIMATE.—Climate may be expected to vary over so large an area as the Sudan. Roughly speaking, in the country to the north of lat. 17° the climate is dry throughout the year. South of this latitude the summer rains cause a wet season lasting two or three months, the rest of the year being dry. The temperature during the summer is high, but the nights are cool; the winter is bright and invigorating. Certain districts, *e.g.* the Bahr-el-Ghazal, Upper White Nile and Kordofan, are less healthy during the period succeeding the rains or the Nile flood.

RESOURCES.—Until the Anglo-Egyptian occupation the Sudan had been regarded as a country of small promise, the only products of importance being gum, ostrich feathers and ivory. Within recent years, however, a great change has come over the character and extent of the exports, chiefly as a result of the building of the railway and the recognition by the Government of the agricultural possibilities of the country, accompanied by efforts directed towards their development. At the present time the chief exports are gum, dura, sesamum seed, cotton and cotton seed, livestock, ivory, dates, butter, ghi, senna leaves and pods, and gold. The natural resources of the more southern districts, *e.g.* the Bahr-el-Ghazal, remain as yet practically untapped, and to a large extent depend for their development upon the provision of efficient transport.

The principal market for Sudan products is Egypt, which absorbs over half the total exports. The second place is held by the United Kingdom, followed by France, Germany, the United States, Austria and Belgium.

AGRICULTURE.—The soil of the Sudan varies greatly in its possibilities, the ruling factor in most cases being the availability of water. Extreme conditions may be illustrated in the sterile, arid wastes of northern Kordofan and the fertile tracts bordering the rivers. Agriculture is carried on chiefly in close proximity to the Nile and its tributaries; in the Gezira, between the White and Blue Niles; and in the Gedaref District. Operations are confined to the foreshore and banks of the rivers, where irrigation is possible either from the overflow of water at high Nile or by means of primitive water-raising devices. In general, to the north of Khartum agriculture is limited to a narrow strip along the river bank, which, in favourable regions admitting of easy irrigation, may be extended to a broad band three or four miles wide. From about fifty miles south of Khartum to lat. 13°

N. there is sufficient rainfall to allow of general cultivation, but its irregularity in the northern part of this area admits of only short season crops being grown, *e.g.* dura and millet. Cotton has also been raised in increased quantities since the opening of the Berber-Red Sea Railway. To the south the rainfall is more copious and regular, and plentiful crops of sesamum, ground-nuts, cotton, dura, maize, millets and beans are raised. Dates are largely grown in the Dongola Province and are the subject of an important trade.

Much progress has recently been made in cotton cultivation in the Sudan, large areas being suited to the crop, and producing a staple of fine quality. Facilities are being offered by the government to natives and others for extending the cultivation of this product.

ANIMAL PRODUCTS.—The principal animal products are ostrich feathers and hides, obtained chiefly from Kordofan; and ivory from the Bahr-el-Ghazal, and the Kordofan and Upper Nile Provinces. There are also large numbers of cattle, sheep and goats, and the Arabs possess valuable herds of camels.

MINERALS.—There are no mining industries of first-class importance in the Sudan at the present day, but the mineral resources of the country are not fully known, and a Mineral Survey undertaken by government would no doubt more than repay its cost. Traces of former extensive gold-mining works exist, however, as in the Atbai. A European syndicate is working the gold deposits at Om Nabardi, and gold occurs in small quantities in several other localities. Iron ore is plentiful in certain districts, notably in the Bahr-el-Ghazal, where it is worked by the natives for making weapons and agricultural implements. Copper is found in large quantities at the mines of Hofrat-el-Nahas in the Bahr-el-Ghazal.

INDUSTRIES.—Apart from agriculture and gum-collecting, the native industries are at present few. The weaving of cotton cloth, boat-building, and camel-breeding are among the most important, but minor industries such as pottery and leather work (see specimens exhibited) are rapidly improving. A general statement of the resources of the country and their relative importance will be found on the "Statistical Board" displayed on the north wall of the Court.

COMMUNICATIONS.—Roads are the principal means of communication in the Sudan, and transport is chiefly effected by camels, mules and donkeys. The waterway of the Nile is of primary importance. The river is navigable to the north of Khartum except at the cataracts; south of Khartum communication is maintained along the Blue and White Niles and their affluents.

The development of the railway system promises to be of the greatest economic importance to the country. The Sudan Government Railway extends from Halfa across the Nubian Desert to Abu Hamed, running thence along the Nile bank to Khartum North. It then proceeds along the Blue Nile to Sennar, fifty miles beyond Wad Medani, whence it turns westward across the Gezira to the White Nile at Kosti near Goz-Abu-Guma. This portion of the line is now open. A bridge carries the railway across the river, and the continuation of the line to El Obeid, in Kordofan, is being proceeded with. An important line has been opened between Atbara and Port Sudan and Suakin on the Red Sea. A considerable transport trade has already been built up, with an accompanying development of Port Sudan as a distributing centre. Further railway projects are under consideration.

VEGETABLE PRODUCTS.

GUMS.

Sudan Gum.—Gum is the most important commercial product of the Sudan, the average annual export being valued at approximately £E150,000. The bulk of the trade is with the United Kingdom, France, the United States, and Germany, with smaller exports to Belgium, Austria and other countries. There are two principal varieties of Sudan gum, viz. "Hashab," or Kordofan gum, derived from *Acacia Senegal*, and forming the bulk of the export; and an inferior "Talh" gum derived from *A. Seyal.* A third variety, Gezira gum (*A. Senegal*), is also exported in small quantities. The most important gum-producing area is Kordofan, where the product is obtained from trees in privately-owned "gardens." There are also extensive gum forests in the Gezira District, and Gedaref is the centre of a smaller trade. The Blue Nile District yields supplies of gum, chiefly Talh gum. Attempts are being made by the government to extend the producing area and to improve the yield. In the collection of Hashab gum, the trees are tapped at the beginning of the dry season by removing the bark in strips from two to three feet long and about two inches wide, a preliminary incision being made with an axe. Talh gum trees are not tapped, the collectors gathering the gum exuding naturally from the cracks and fissures in the bark.

The gum collected is transported to Omdurman and Khartum, where it is picked and cleaned prior to export. The most important European gum markets are London, Trieste, Hamburg and Bordeaux.

Sudan gum is a typical example of "gum arabic." Gums of this class are largely used in the confectionery trade, in the manufacture of matches and adhesive mucilage, and in pharmacy. The finest qualities are employed in finishing silks and for clearing wines (see *Bulletin of the Imperial Institute*, 1908, **6**. 29).

Other Gums.—Several additional gum-yielding plants occur in the Sudan, and inquiries have been made as to the commercial value of their products. The most important is "Tartar gum" (*Sterculia cinerea*), which would find a market if carefully prepared. It is an

the government to establish an export trade. Dura now stands second in the list of exports (1909–1910), largely as a result of the transport facilities afforded by the railway. The principal markets for Sudan dura are Upper Egypt, Aden, Arabia, and the Somali coast. There is also a small export to Europe, where the grain is used for alcohol manufacture and for cattle and poultry food. In the export trade the demand is chiefly for the better classes of dura, and endeavour is being made to induce the natives to cultivate such varieties (*e. g.* Gassabi, Safra, Hegairi, Taulib) in preference to the common Dura Faterita of the country. It is probable that the dura trade will be of value in enabling the country to tide over such period as may elapse before the establishment on a large scale of more profitable agricultural industries, *e. g.* cotton, wheat, and rubber. A factory for the distillation of spirit from dura has been established in the Sennar Province.

Exhibits—

Grain of the following varieties:—

1. Beida (White Dura).
2. Faterita.
3. Faterita (No. 1).
4. Hakarrig (No. 2).
5. Wad-el-Fahl (No. 3).
6. Safra, Bahr-el-Abyad (No. 4).
7. Mistahi (No. 5).
8. Hegairi (No. 6).
9. Hamaizi (No. 7).
10. Wad Akaa (No. 8).
11. Gassabi (No. 9).

Fruiting heads of the following varieties:—

12. Wad Moshad.
13. Shelsheleh.
14. Fakih-el-Mostahi.
15. Wad Kadileh.
16. Hegairi.
17. Faterita.
18. Wad Aker (Akaa).
19. Zarzorah.
20. Behanah.
21. Photograph, Mugad Dura Crop, Genetti, Dongola Province, 1908.

Dukhn.—This cereal is the Bulrush or Spiked Millet (*Pennisetum typhoideum*). It is largely grown in tropical Africa, and forms one of the secondary crops of the Sudan. In Kordofan dukhn to a large extent takes the place of dura.

Exhibits—

1. Dukhn grain, two samples.
2. Dukhn, fruiting spike.
3. Photograph, Dukhn Crop at Letti, Dongola Province, 1909.

Wheat.—Wheat is the grain of *Triticum vulgare*. It is grown on a small scale only in the Sudan, and at present the exports are negligible. Large quantities of wheaten flour, however, are imported, and projects for meeting the local demand from Sudan-grown wheat have been considered. Cultivation experiments are being carried out in the Dongola Province under a system of basin irrigation.

Exhibits—

1. Sudan Wheat (Gamh Sudani), two samples.
2. Egyptian Wheat (Gamh Masri).
3. Indian Wheat (Gamh Hindi).
4. Photograph, Wheat Crop, Dongola Province, 1908.

Maize.—Maize (Indian corn, mealies) is the grain of *Zea Mays.* It forms one of the secondary cereal crops of the Sudan. An American variety, imported for seed purposes, has given good results planted as a rain crop.

Exhibits—

1. Native maize (Aish-el-Rif).
2. Egyptian Maize, var. Nab-el-Gamal (Aish-el-Rif).
3. Maize, var. Moradi (Aish-el-Rif).
4. Maize (Dura Shami).
5. Photograph, Maize Crop at Letti, Dongola Province, 1908.

Rice.—The grain of *Oryza sativa.* A small quantity of rice is grown, the most suitable areas being parts of the Bahr-el-Ghazal and Upper White Nile Provinces.

Exhibits—

1. Rice grown in the Bahr-el-Ghazal Province, from seed obtained from the French Congo. This variety requires comparatively little water in its cultivation. Valued at £10 11*s.* per ton unhusked; £13 14*s.* per ton husked (July 1908): quality excellent.

Barley.—The grain of *Hordeum vulgare.* The possible extension of the present small cultivation is under consideration.

Exhibits—

1. Barley, valued at 24*s.* per quarter of 400 lb. (July 1909).
2. Barley (Shayir).

LEGUMES.

Several varieties of legumes are grown in the Sudan both as food for human consumption and for feeding to stock. The botanical identity of certain "beans" is not yet definitely established.

Exhibits—

1. White Lubia Beans (Lubia Baida).
2. Red Lubia Beans (Lubia Hamra, Lubia Taiyib).
3. White Lubia Afin Beans (Lubia Fasulia), *Phaseolus lunatus?* Two samples.
4. Lupin Beans (Tirmus), *Lupinus albus.*

5. Beans (Ful), *Vicia Faba.*
6. Lablab (Lubia Afin), *Dolichos Lablab.*
7. Peas (Bissala), *Pisum arvense*).
8. Chick Peas (Hammas), *Cicer arietinum.*
9. Pigeon Peas (Ads Sudani), *Cajanus indicus.*
10. Lentils (Ads), *Lens esculenta.*
11. Fenugreek (Halba), *Trigonella Foenum-graecum.*

OTHER FOODSTUFFS.

Dates.—Dates are the fruits of the date palm (*Phoenix dactylifera*). They are largely grown in the Kordofan, Halfa, Dongola and Berber Provinces, and form one of the principal exports of the country. Egypt is the chief market, and there is also a large local demand. The Sudan product is a "dry" date, the best qualities being obtained from Sukkot (Dongola). The dry variety, however, is not regarded as suitable for oversea export, and experiments have therefore been made in planting the best varieties of Algerian and other "soft" dates (*e.g.* "Deglet-el-Nur" and "Monakhir"). Considerable success has been already achieved, notably in the Dongola Province.

Exhibit—

1. Dates (Belah Sudani), *Phoenix dactylifera.*

Condiments and Spices.

Exhibits—

1. Chillies (Shatta), *Capsicum* sp.
2. East African Cardamoms (Heil Habashi), *Amomum Korarima.*
3. African Pepper (Kumba), *Xylopia aethiopica.*
4. Coriander Seeds (Kisbara), *Coriandrum sativum.*

Miscellaneous.

Exhibits—

1. Egyptian "myrabolans," Lalob (*Balanites aegyptiaca*). A native foodstuff in several parts of tropical Africa. The kernels contain a non-drying oil (see *Bulletin of the Imperial Institute*, 1908, **6**. 365).
2. Nabag Sudani (*Zizyphus spina-Christi*). A fruit allied to the "jujube" (*Z. vulgaris*).

DRUGS.

Senna.—From the commercial point of view senna ranks first among the medicinal plants of the Sudan. This well-known drug consists of the leaflets of certain species of Cassia, a genus of bushy plants

Castor Seed.—The Castor-oil plant (*Ricinus communis*) grows wild in great abundance in many parts of the Sudan. The seed is small, but yields a fair percentage of oil. The cost of harvesting the seed has hitherto militated against the development of an export trade. The indigenous plant is of tall habit, and trials have been made with comparatively low-growing Indian and Java varieties with a view to facilitating the picking. For information as to the value of Sudar castor seed, see *Bulletin of the Imperial Institute* (1911, **9**. 26).

Ground-Nuts.—These seeds (*Arachis hypogea*) are used both as a foodstuff and as a source of oil. The cultivation is still small, but some progress is being made.

Other Oil Seeds.—The Shea Butter Nut or "Lulu" (*Butyrospermum Parkii*) is common in many parts of the Bahr-el-Ghazal. It forms an important native foodstuff, and the expressed fat is largely used in cooking. Safflower seeds or "Gurtum" (*Carthamus tinctorius*) are also grown. Quite recently an export trade in "Senat seed" derived from *Cucumis Melo* has arisen, and efforts are now being made to find a market for Sunflower seed (*Helianthus annuus*).

Exhibits—

1. Sim Sim (*Sesamum indicum*).
2. Sim Sim, fruiting spike.
3. Safflower Seeds (Gurtum) *Carthamus tinctorius.*
4. Castor Seed (*Ricinus communis*); native variety.
5. Castor Seed; Indian variety, grown at Kassala.
6. Castor Seed; Java variety, grown at Kassala.
7. Castor Seed (unhulled); grown in the Upper Nile Province.
8. Castor Seed, grown in Berber Province. Two samples.
9. Castor Seed, grown in Dongola Province.
10. Castor Seed (unhulled).
11. Ground-Nuts (Ful Sudani), *Arachis hypogea.*
12. Shea Butter Nuts (Lulu), *Butyrospermum Parkii.*
13. Senat Seed (*Cucumis Melo*).
14. Sunflower Seed (*Helianthus annuus*).

FIBRES.

Cotton.—Cotton has been long grown in small quantities throughout the Sudan, but it is only within recent years that the possibilities of the country as a great cotton-producing region have been considered. The chief difficulties hitherto encountered are deficiency of water, scarcity of labour and high cost of transport. The last-mentioned has been materially lessened by the completion of the Berber-Red Sea Railway, and the question of water-supply depends upon satisfactory schemes of irrigation.

The principal cotton-growing districts are the region between Berber and Khartum, and parts of the Sennar and Kassala Provinces, while extensions have recently been made in the White Nile and Blue Nile Provinces. A large but fluctuating area is also under cotton at Tokar in the Red Sea Province. A plantation under European control has been established along the banks of the Nile at Zeidab in the Berber Province, and to the north of Khartum smaller plantations exist at Fadlab, Miniawi, Darmeli, Kederu and Sagai. The development of the Gezira—the great plain to the south of Khartum between the converging courses of the Blue and White Niles—as a cotton region is now under trial; the primary condition for success is an efficient system of irrigation. Indigenous varieties are grown by the natives, but efforts are being made to encourage the cultivation of Egyptian cottons, which are found to do well under irrigation. Good results with Egyptian varieties have been obtained at Zeidab and elsewhere. Sea Island and American Upland cottons have also been experimented with. A large number of Sudan cottons have been examined at the Imperial Institute. The results show that cotton of excellent quality can be grown in the country, and that the Egyptian varieties are the most promising for cultivation.

Much of the cotton grown is used locally for the weaving of the native cotton cloth ("damur"), but hopes are entertained of establishing a large export trade. The value of the export during 1909–10 was £E221,945. The growth of the industry may be seen on reference to the Statistical Board.

Exhibits—

MODEL BALES.

1. Mitafifi (No. 2), unginned.
2. Mitafifi (No. 2), ginned. Staple 1·2–1·6 in. Value about 9*d.* per lb. with "fully good fair" brown Egyptian at $9\frac{5}{16}$*d.* per lb.
3. Mitafifi, unginned. Grown at Fadlab, Berber Province, 1908, under unfavourable climatic conditions.
4. Abassi (No. 2), ginned. Staple 1·3–1·7 in. Value 9*d.* per lb. with "good" Abassi at $9\frac{1}{2}$*d.* per lb.
5. Abassi (No. 3), unginned.
6. Abassi (No. 3), ginned. Staple 1·3–1·7 in. Value $8\frac{3}{4}$*d.* per lb. with "good" Abassi at $9\frac{1}{2}$*d.* per lb.
7. Abassi, unginned. Grown at Fadlab, Berber Province, 1908, under unfavourable climatic conditions.
8. Yannovitch (No. 1), unginned.
9. Yannovitch (No. 1), ginned. Staple 1·3–1·7 in. Value about 10*d.* per lb. with "good" Yannovitch at $10\frac{3}{4}$*d.* per lb.
10. Nubari (No. 1), ginned. Staple 1·2–1·7 in. Value about $9\frac{1}{2}$*d.* per lb. with "fully good fair" brown Egyptian at $9\frac{5}{16}$*d.* per lb.

11. Gallini (No. 3), ginned. Staple 1·6–2·0 in. Value about 10*d.* per lb. with "fancy" Florida Sea Island at 12*d.* per lb.

SMALL SAMPLES.

1. Abassi, ginned. Grown at Damer. Staple 1·1–1·6 in.
2. Abassi, ginned. Grown at Kamlin. Staple 1·3–1·6 in.
3. Yannovitch, ginned. Grown at Kamlin. Staple 1·3–1·7 in.
4. Mitafifi, ginned. Grown at Damer. Staple 1·0–1·5 in.
5. Mitafifi, ginned. Grown at the Austrian Mission near Kodok. Staple 1–1·6 in.
6. Mitafifi, ginned. Grown at Wad-Medani. Staple 1·1–1·8 in.
7. Egyptian (probably) unginned, ginned and seed. Staple 1·4–1·7 in. Value about 10*d.* per lb. with "good" Abassi at 12⅝*d.* per lb, and "middling" American at 7·59*d.* per lb. Grown at Monagil, Blue Nile Province.
8. American, ginned. Staple 1·0–1·2 in. Grown in the Public Gardens, Khartum.
9. Native, ginned. Staple 0·8–1·2 in. Grown in Merowe District.
10. Native, ginned. Staple 0·8–1·2 in. Grown at Damer.
11. Native, ginned. Staple 0·8–1·2 in. Grown at Shendi.
12. Wild, unginned. Staple 0·8–1·1 in.
13. Wild, unginned. Staple 0·9–1·2 in.
14. Wild, unginned. Staple 0·9–1·1 in.

COTTON CLOTH.—See under "Native Industries" (Damur).

Other Fibres.—The Sudan flora contains a number of valuable fibre-producing plants, but up to the present their commercial development has not been attempted. The most promising are:—(1) LEAF FIBRES: *Sansevieria guineensis.* This plant is widely distributed throughout the Bahr-el-Ghazal, and the fibre, if carefully prepared, would be of good quality. A sample grown and prepared at Mongalla has been valued at £30 per ton. (2) STEM OR BAST FIBRES: Jute (*Corchorus* sp.) is being grown experimentally at Kodok. Indigenous fibres, which, if carefully prepared, would be of local value for rope-making and for other purposes are: *Hibiscus cannabinus* ("Teel") *Malachra capitata*, *Sida rhombifolia*, *S. cordifolia* and *Urena lobata.* The Deleib palm (*Borassus flabellifer*) yields "palmyra," a brush-making fibre. The leaves of this palm, as also those of the Dum palm (*Hyphaene thebaica*), are used in basket and mat weaving. Flosses or silk cottons are yielded by *Eriodendron anfractuosum* and *Calotropis procera.*

The Papyrus reed (*Cyperus Papyrus*) occurs in enormous quantities along the banks of the Nile, and is a constituent of the "sudd." It has been experimented with as a paper-making material, but although a paper of fair quality is produced, the yield is low.

3. *Landolphia Petersiana* var. *Schweinfurthiana.*
4. *Landolphia florida.*
5. *Landolphia florida.* Flowers preserved in formalin.
6. *Clitandra Schweinfurthii.*

B. Specimens of rubber from the Bahr-el-Ghazal; prepared by approved methods.

1. Light Biscuits (*Landolphia owariensis* var. *tomentella*), valued at 8*s*. 4*d*. per lb. with fine hard Para at 10*s*. 4*d*. per lb.
2. Dark Biscuits (as No. 1). Valued at from 6*s*. 9*d*. to 7*s*. 2*d*. per lb. with fine hard Para at 10*s*. 4*d*. per lb.
3. Resinous product from *Landolphia Petersiana* var. *Schweinfurthiana.*
4. Resinous product from *Ficus platyphylla.*
5. "Gutta" from *Butyrospermum Parkii.*

TANNING MATERIALS.

The principal native tanning materials are Mudus bark (*Parkia filicoidea*), Abu Surug bark (*Prosopis oblonga*), Sant bark and Sant pods (*Acacia arabica*); Akan (*Hymenocardia acida*) is reported to be used in the Bahr-el-Ghazal. Others of less importance are Alimu bark (*Ximenia americana*) and Kili bark (*Ficus Kotschyana*).

Examination at the Imperial Institute has shown that the sant pods contain sufficient tannin (35·4 per cent.) to be worth consideration for export in the crude state; the leather produced is soft and light in colour. Sant bark (17·8 per cent. tannin) is the next in value, producing a fawn-coloured leather of good quality. It is probable, however, that an export of indigenous tanning barks is not at present a commercial possibility. In the event of the manufacture of extracts being considered, sant bark would appear to be the most promising material for experiment. Sant grains have recently been examined and found to be a valuable tanning material, rich in tannin yielding a good leather (*loc. cit.* 1906. **4.** 95; 1907, **5.** 358).

Exhibits—

1. Sant Bark (*Acacia arabica*).
2. Sant Pods (*Acacia arabica*).
3. Sant Grains (*Acacia arabica*).
4. Alimu, bark of *Ximenia americana.*
5. Mudus, bark of *Parkia filicoidea*, from the Bahr-el-Ghazal.
6. Kili, bark of *Ficus Kotschyana.*
7. Abu Surug, bark of *Prosopis oblonga*, from the Bahr-el-Ghazal.
8. Bark—not identified.
9. Leather (small specimen) tanned with sant grains (*Acacia arabica*).

DUM PALM NUT.

The ripe fruits of the Dum palm (*Hyphaene thebaica*) consist of large nuts possessing a thick, tough pericarp and a hard, bony kernel somewhat resembling true vegetable ivory (*Phytelephas* sp.) in character, but containing a central cavity of considerable size. The nuts (kernels) are exported in large quantities to Europe, where they are used as a substitute for vegetable ivory in the manufacture of buttons and other small articles (see *Bulletin of the Imperial Institute*, 1911, **9**. 105).

Exhibits: Dum Palm Nuts from Berber—

1. Undecorticated.
2. Decorticated.
3. Nuts in section.
4. Buttons made from Dum palm kernels.

TIMBERS.

The Anglo-Egyptian Sudan possesses extensive and valuable forests, but up to the present comparatively little has been possible in the direction of their exploitation. Throughout all the forest areas great damage results from fires, which are started by the natives either for the purposes of hunting, or to clear the paths, or for grazing after the rains. Within recent years, however, efforts have been made by the government to establish a system of fire protection in certain districts, and much success has been attained, notably in Sennar and Kordofan, where special attention has been paid to the gum-producing areas. Considerable loss also results in those forests immediately bordering the Nile from the necessity of obtaining from them the timber required as fuel for the steamers. In this connection it is interesting to note that extensive trials have been made by an Anglo-German syndicate in the briquetting of "sudd" into fuel by a process similar to that used in the preparation of peat briquettes.

To the north of Khartum forests are scarce and of little extent. To the south the chief forest areas may be considered under the following heads:—

White Nile Forests.—These forests consist chiefly of belts lining the banks of the river and its tributaries. The most important tree is the "Sant" (*Acacia arabica*), valuable for its timber and the tanning properties of its bark and pods; other species of Acacia, *e.g.* Haraz (*A. albida*) are common. From Goz-Abu-Guma to Lake No the forest is composed chiefly of Heglik (*Balanites aegyptiaca*), Siddir (*Zizyphus* spp.), Dabkar (*Crataeva religiosa*) and several species of Acacia. Away from the Nile, in Kordofan, occur the open woods of gum-yielding acacias (see under "Gum").

Blue Nile Forests.—North of 12° N. these forests have a composition similar to that of the White Nile forests. To the south, however, a change occurs, the most abundant trees being Silag (*Anogeissus leiocarpus*) and the Sudan ebony (*Dalbergia melanoxylon*). Suba (*Combretum* spp.), Leyun (*Odina* sp.), Homeid (*Sclerocarpa* sp.), Inderab (*Cordia crenata*) also occur, together with species of Acacia. Talh (*Acacia Seyal*) occupies large areas inland from both banks.

BAHR-EL-JEBEL FORESTS.—These forests occur not only as belts but also extend over large areas. In composition they resemble the woodlands of the Upper White Nile.

BAHR-EL-GHAZAL FORESTS.—The greater part of the ironstone deposits of the Bahr-el-Ghazal Province is covered by forests which are probably the most important in the Sudan, though at the present time their value is not high owing to the ravages of forest fires. Combretaceae and Mimoseae are well represented, affording useful tanning materials, *e. g.* Abu Surug (*Prosopis oblonga*), Mudus (*Parkia filicoidea*); and Lulu (*Butyrospermum Parkii*), yielding a staple food ("Sudan date"), is common. It is in these forests that rubber-producing vines are most abundant. The chief timber tree is Homra, Bele or Murraya (*Khaya senegalensis*), a well-known African mahogany; and among others may be mentioned Heglik (*Balanites aegyptiaca*), Ardeib (*Tamarindus indica*), Abu Surug (*Prosopis oblonga*), Nwana, Lu, Ulu (*Parkia filicoidea*) yielding Mudus bark; Hoba, Digdig and Gughan. The Ambatch (*Herminiera elaphroxylon*), a wood of very low specific gravity, forms dense covers on the upper Bahr-el-Ghazal (see *Bulletin of the Imperial Institute*, 1904, **2**. 225).

Exhibits—

A collection of timbers, half polished, from the Sennar and Bahr-el-Ghazal Provinces.

A. SENNAR PROVINCE.

1. Haraz (*Acacia albida*).
2. Hashab (*Acacia Senegal*).
3. Talh (*Acacia Seyal*).
4. Kuk (*Acacia verugera*).
5. Kakamut (*Acacia Suma*).
6. Taraya (*Pterocarpus lucens*).
7. Ardeib (*Tamarindus indica*).
8. Siddir (*Zizyphus mucronata*).
9. Heglik (*Balanites aegyptiaca*).
10. Gameiz (*Ficus Sycomorus*).
11. Homeid (*Sclerocarya* sp.).
12. Selag (*Anogeissus leiocarpus*).
13. Leyun (*Odina* sp. ? *fruticosa*).
14. Khash-Khash Abiad (*Stereospermum Kunthianum*).
15. Inderab (*Cordia crenata*).
16. Dabkar (*Crataeva religiosa*).
17. Dum (*Hyphaene thebaica*).

B. BAHR-EL-GHAZAL PROVINCE (Golo native names).

18. Nwana (Arabic), Lu, Ulu (*Parkia filicoidea*).
19. Bishi (*Tetrapleura nilotica*). A hard, heavy wood resembling mahogany in colour and figure, but turning brown on weathering. It is of doubtful value for export. Weight 66 lb. per cubic foot.

Small quantities of Hippopotamus ivory (teeth) are also obtained Samples received at the Imperial Institute have been valued at 1*s.* 6*d.* per lb. approx. (1908).

Exhibits: 1. Hippopotamus Teeth.

Cattle and Livestock.—The Sudan possesses very large numbers of cattle, sheep and goats. Valuable natural markets exist in Egypt and the Red Sea ports, but an export trade has been impossible hitherto on account of restrictions placed upon the movements of cattle in consequence of the prevalence of disease. There is a small but increasing export of sheep, chiefly to Upper Egypt *viâ* Halfa; an additional market has recently been formed at Cairo.

Hides, Skins and Leather.—Dependent upon the livestock industry is the export of untanned hides and skins, and the manufacture of native leather. Goat and sheep skins are chiefly used in the latter industry, the principal tanning materials employed being Sant bark and pods (*Acacia arabica*), Mudus bark (*Parkia filicoidea*), and Abu Surug bark (*Prosopis oblonga*). (See also "Tanning Materials".)

Exhibits—

A. RAW LEATHER—

1. Sheepskin, tanned, red unglazed. Bought at Omdurman.
2. Sheepskin, tanned, red glazed. Bought at Wad Medani.
3. Sheepskin, tanned, white unglazed. Bought at Wad Medani.
4. Sheepskin, tanned, yellow unglazed. Bought at Wad Medani.
5. Sheepskin, tanned, black glazed. Bought at Wad Medani.
6. Goatskin, tanned, yellow unglazed. Bought at Wad Medani.
7. Goatskin, tanned, red unglazed. Bought at Wad Medani.
8. Goatskin, tanned, red glazed. Bought at Omdurman.
9. Goatskin, tanned, black glazed. Bought at Wad Medani.

B. LEATHER MANUFACTURES—

10. Camel Saddle and Trappings (Makhlufa).
11. Camel Saddle Apron (Ragabiya).
12. Camel Saddle Cushion (Barda).
13. Camel Saddle-bags (Khurg).
14. Camel Riding Boots (Maz).
15. Horse Saddle Cover (Farwa).
16. Holdall (Girab).
17. Bandolier (Fashaklik).
18. Sword and Scabbard (Seif).
19. Waterskin (Girba).
20. Water Vessel (Rakuat).
21. Men's Sandals (Nâl).
22. Women's Sandals (Nâl).
23. Men's Shoes (Markuh Ragali).
24. Women's Shoes (Markuh Niswani).
25. Case for carrying Kouran (Beit Guran).
26. Charm Cases (Hugabat).
27. Purses (Mahafid).
28. Knife Sheath (Sakkin).

Ostrich Feathers.—Ostrich feathers hitherto formed one of the three staple products of the country. The export is at present small, and it is probable that no great advance will be made until circumstances permit of the establishment of breeding-farms. Practically all the export is obtained from wild birds. The chief market for the feathers is at El Nahud in Kordofan, and the best qualities are said to come from Northern Darfur.

Exhibits—

1. Feathers, "White Long Bloods." Approx. value £10 per lb.
2. Feathers, "Dark Femina." Approx. value £8 10*s*. per lb.

Beeswax.—Beeswax is reported to be obtainable in large quantities in the Bahr-el-Ghazal, but there would appear to be no immediate prospect of an export trade being developed. There is a considerable export of Abyssinian wax *viâ* the Sudan.

Exhibits—

1. Beeswax from the Bahr-el-Ghazal Province.
   (*a*) Crude, as collected.
   (*b*) Clarified.

The Pearl-Shell Fishery.—The Red Sea pearl-shell fishery is one of long standing. In former times pearls were the object of the fishery, but indiscriminate collection of the oysters has ruined this industry, and there is now but a small fishery for mother-of-pearl shell only.

The Sudan pearl oyster (*Margaritifera margaritifera*) is a species allied to but distinct from the more famous Ceylon pearl oyster (*M. vulgaris*). Unlike the latter animal, the Red Sea oyster is a "solitary" species, individuals occurring singly or in small groups over the pearling grounds, a fact to be taken into account in attempting to establish an industry of any considerable dimensions. Pearls are occasionally found in the Sudan species, but the chief value of the oyster lies in its shell (mother-of-pearl).

A biological investigation of the marine resources of the Sudan Red Sea littoral has been undertaken by the Government. Important work in relation to the pearl fishery has been done, and trustworthy information regarding the species of oysters, their life history and habits, times of breeding and rate of growth of shells is now available. Among the practical results of this work are the fixing of a size-limit (12 cm. diameter) for the shells, below which the fishing is prohibited; the establishment of breeding grounds for increasing the number of oysters available; and proposals for the cultivation of mother-of-pearl "seed" oysters as an article of food. Observations on the destructive habits of shell-destroying fishes (*Balistes* spp., *Trygon* sp.) have also been made.

The Ceylon pearl oyster is also found in the Red Sea, and young specimens are eaten at Suez as a substitute for the true oyster. The latter (*Ostrea culcullata*) occurs in certain areas, but is difficult to collect on account of the solitary habit of the animal. Experiments have been made with a view to increasing the size and number of the oysters.

Exhibits—

1. Specimens illustrating stages in the life history of the Mother-of-Pearl Oyster.
   (*a*) Spat.
   (*b*) Very young stages, with some older individuals.
   (*c*) Young oysters, showing the delicate horny edges and marginal processes of the shell.
   (*d*) Somewhat older oysters, with horny margins in process of calcification.
   (*e*) Older specimens; one covered with growth of marine organisms.
2. Shells illustrating the size-limit below which fishing is prohibited.
3. Shells of good size, not yet full-grown, but above the size-limit.
4. Shells somewhat below size-limit.
5. Shell (old) covered with Coral and Lithothanuria.
6. Shells showing growths of Phyllospongia (a sponge), Xenia, and compound Ascidians on outer surface. These organisms often mask the shells.
7. Diseased and abnormal shells.
   (*a*) Shells attacked by the boring sponge, *Clione* sp.
   (*b*) Shells showing abnormalities of the hinge and byssal notch.
   (*c*) Shells deformed by mechanical obstruction to growth.
   (*d*) Shells with marks and "blisters," caused by a boring worm (*Polydora* sp.).
8. Broken shells, etc.
   (*a*) Broken shells, the result of attacks on the oysters by fish (*Balistes flavimarginatus*, *B. viridescens* and *Trygon* spp.).
   (*b*) Contents of gut of *Balistes flavimarginatus*, consisting of shell-fragments of Lamellibranchiata and Crustacea.
9. Miscellaneous specimens.
   (*a*) Shell of *Tridacna gigas*.
   (*b*) White pearl occurring in shells of *Tridacna gigas*.
   (*c*) Shell of *Avicula Zebra*.
   (*d*) Shell of *Avicula* sp. (? *macroptera*): occasionally sold as mother-of-pearl shell.
   (*e*) Shrimp occurring in pairs (male and female) in the mother-of-pearl oyster.

Exhibits:

A. COTTON CLOTH—

1. Damur.
2. Damur (washed).

B. LOOM AND APPLIANCES—

1. Ginning Appliances (Dulab).
2. Cleaning Appliance (Mitrak). Used in cleaning the cotton.
3. Spinning Appliance (Mighzal).
4. Native Loom (Mighzal). Used for weaving native cotton cloth (Damur).
5. Shuttle (Markub).
6. Bawas. Used in transferring thread to the shuttle.

Leather Work.—(*See* under Hides, Skins and Leather.)

Pottery.

Exhibits—

1. Pipkins (Kantush).
2. Flower Pot (Zalla).
3. Water Jug (Abrig).
4. Coffee Pots (Gabana).
5. Coffee Roaster (Galaiya).

Mats and Basket-Work.—Mats, baskets, and similar articles are woven by the natives from strips of the leaves of certain palms, notably the Dum Palm (*Hyphaene thebaica*) and the Deleib Palm (*Borassus flabellifer*). Grasses are also used.

Exhibits—

1. Mats (Bursh).
2. Bread Basket (Reika).
3. Bread Basket Cover (Ghatta).
4. Plate Cover (Ghatta-Sahn).
5. Basket for holding coffee-pot (Kabbota-Gabana).
6. Gourd Drinking Cup, covered with basket-work.
7. Coffee-pot Stand (Wagaiya).

GENERAL.

Maps.

A. WALL MAPS—

1. "The Anglo-Egyptian Sudan."
2. "Egypt, British East Africa and Uganda" (with the East Africa Protectorate Court).

B. REFERENCE MAPS—

1. Egyptian Sudan. Scale 1 : 250,000.
2. Anglo-Egyptian Sudan, 1909. Scale 1 : 1,000,000.
3. Anglo-Egyptian Sudan, 1904 (War Office, No. 1836).
4. Sudan: Skeleton Map, 1901 (War Office, No. 1513).
5. Other maps, 1883–1906.

Statistical Board.—A presentation of the principal statistics relating to the area, population, revenue and expenditure, and exports of the Sudan since 1907.

Photographs.

1. GENERAL PHOTOGRAPHS—

(*a*) Sudan Government Railways. A series of photographs illustrating the construction of the Suakin-Atbara Line.

(*b*) Photographs illustrating general topography, native types, industries, customs and markets.

2. SPECIAL PHOTOGRAPHS—

(*a*) A series of photographs, diagrams and plans of the towns of Khartum and Omdurman (exhibited at the Town Planning Exhibition, 1910).

(*b*) Photographs illustrating particular crops and industries (which see).

of interest in publishing the report on these to reprint Mr. Henderson's note in a slightly abbreviated form as follows:—

LONG-STAPLED COTTONS IN SIND.

It has often been observed, even from early times, that Sind bears a strong resemblance to parts of Lower Egypt, and for this reason the Province has been long regarded as offering excellent prospects for the cultivation of long-stapled cotton. In 1852, when Sir Bartle Frere was Commissioner in Sind, he engaged an American cotton planter to superintend some experiments in cotton growing, but after three years the work was abandoned. In 1860 Egyptian cotton seed was distributed in several districts; the best results were obtained at Ratodero in Larkana, where the yield amounted to 6 maunds of seed-cotton per acre. Other trials were made at Salaro near Hala, at Malir near Karachi, and in the gardens in Hyderabad. This work was continued until 1889, and numerous varieties were tested, including American, Egyptian and Indian cottons. The best results were obtained with the New Orleans variety. Mr. Strachen, who was in charge of the work, came to the conclusion that Egyptian cotton was not suitable for cultivation in Sind, but was of opinion that it might succeed in Shah Bundar in the Tatta District, which is near the sea. Afterwards, trials of Comilla cotton were carried out in various parts of the Province, but this variety was found to give a smaller yield than the indigenous kind.

All these attempts at improving cotton cultivation in Sind were made by people who had no actual experience of Egyptian practice. In 1904, however, Mr. Fletcher, Deputy Director of Agriculture, Bombay, after a tour in Sind, obtained permission to start experimental work at Dhoro Naro in the Thar and Parkar district. His experience in Egypt enabled him to point out that it was of great importance that the seed should be sown in March instead of June, the month in which the indigenous cotton is usually planted. This restricted the choice of ground to the Jamrao Canal area, as there was no other locality in which the necessary water could be obtained so early in the year. The experimental farm was removed from Dhoro Naro to Mirpurkhas, and sufficient seed for 1,500 acres was distributed to zemindars on the Jamrao Canal. The growers being selected by zemindars, the cultivation was carefully carried out, and in many cases the cotton was sown in ridges and carefully hoed and weeded. The crops only realised low prices, however, as it was found that there was no demand in the Bombay market for cotton of this class.

In 1907 and 1908 about 6,000 acres were under cultivation, but in the former year the cotton was badly attacked by the boll-worm, and in the latter year the water supply was late. A system of auctions was instituted by Mr. Chatfield, the Colonisation Officer, Jamrao Canal, and widely advertised. A number of buyers were attracted and good prices were obtained up to Rs. 14 per maund of 81 lb. of seed-cotton in the case of Abassi, and rather less for the Mitafifi variety. In 1908, however, the auctions were a complete failure, and the cotton had to be disposed of privately to a Bombay firm at a reduced rate. Since that time Egyptian cotton has not been cultivated on the Jamrao, as in 1909 there was no water available in the early part of the kharif season, and in 1910 it was decided to remodel part of the Canal in the following year. In 1912 the cultivation of Egyptian cotton will be renewed, with the advantage of the experience gained from the earlier trials.

The Jamrao Canal area consists of about 700,000 acres, of which possibly 100,000 acres could be devoted each year to the cultivation of Egyptian cotton, but until the proposed perennial canals are in operation in Sind it is not likely that more than about 20,000 acres will be devoted to this staple.

The main points for the success of the industry are: (*a*) Proper cultivation, including sowing before the first week in April, avoiding "kalar" or alkali ground, and if possible growing in rotation with "berseem"; (*b*) a satisfactory system of disposing of the crop, which would ensure that the cotton was properly ginned and graded, and sold in the best market.

The cultivation is by far the simpler part of the problem, the disposal being a more difficult matter. It has already been mentioned that the system of selling the cotton locally by auction did not meet with success, although very fair prices were obtained at first. The different lots offered for sale varied considerably in quality, cleanness and value. The buyers were of two classes: (*a*) Mill owners from Ahmedabad and Bombay, and (*b*) exporters from Karachi and Bombay. The mill owners, several of whom use imported Egyptian cotton, soon ceased to attend the sales. They stated that when they bought Egyptian cotton in Alexandria or Liverpool they obtained a certain grade, *e.g.* "fully good fair," which was uniform and could be depended on to produce certain "counts." On the other hand, for Sind Egyptian they had to send their agents to Mirpurkhas at an unhealthy time of the year, and they, not knowing Sindhi language, were at a great disadvantage. Moreover, they had to bid for a number of small lots, some dirty, some stained, and some good, and had great difficulty in getting their purchases ginned, as the local gins were only suited for short-stapled cotton and were already fully occupied. There does not seem to be the least chance of mill owners buying the cotton direct from the cultivators, although they would probably use a considerable quantity if an assured supply of baled and graded cotton were available. The cotton broker is an essential link between the cultivator and the user of the cotton, but, unfortunately, Indian cotton brokers have no knowledge of Egyptian cotton.

The exporting firms were always afraid of dealing with Egyptian cotton, and one firm suffered a loss by sending a consignment of Abassi to Liverpool. This cotton had not been properly cleaned but was full of dirt and pieces of leaves, and was therefore unsaleable. It does not seem probable that Indian export firms will take up an entirely new and unproved branch while they have as much work as they can possibly do with the indigenous cottons.

Carefully selected average samples of Abassi and Mitafifi cotton have been forwarded to three leading Alexandria brokers during recent years. Their verdicts are very important and are all unanimous to the effect that the Mitafifi is of a good, strong and useful quality but that the Abassi would never grade as such in the market. The Mitafifi has been up to the standard of "fully good fair," that is to say, if properly cleaned, properly ginned and baled, and sent to Liverpool, it would realise the current market price for "fully good fair" brown Egyptian.

exported to the Continent and used for mixing with wool. It is hardy, prolific, and a quick grower.

The points which enable American to compete with Sindhi are as follows: (*a*) Its short growing period, which is shorter than that of Sindhi, and enables it to be sown on the ordinary inundation canals in Sind. There is consequently a very large area on which it can be grown. (*b*) It is hardy, but on the other hand is easily affected by "kalar" or alkali land, and on light soil suffers severely from white ants.

During the past year some good yields were obtained, and, in many cases, the American varieties produced as much seed-cotton as neighbouring plots of Sindhi. In other places, however, the crop suffered from white ants or "kalar."

The reports from Liverpool brokers were very satisfactory. The following is the report made by them to the British Cotton Growing Association:—

Black Rattler.—"Strict Good Middling" in grade, "good colour, staple $1\frac{3}{16}$ inch, little irregular, fairly strong, value 9·25*d.*"

Peterkin.—"Fully Good Middling," "staple $1\frac{1}{16}$ to $1\frac{1}{8}$ inch, fairly strong, value 8·50*d.*"

Griffin variety.—"Fully Good Middling," "staple $1\frac{5}{16}$ inch, inclined to be tender, value 11·00*d.* to 11·50*d.*"

Boyd's Prolific.—"Strict Good Middling," "staple $1\frac{1}{16}$ inch, fairly strong, value 8·40*d.*"

Triumph.—"Fully Good Middling," "staple full $1\frac{1}{8}$ inch, rather soft, value 8·60*d.* to 8·70*d.*"

Toole variety.—"Fully Good Middling," "staple $1\frac{1}{3}$ inch, fairly strong, value 8·60*d.*"

Allen's Improved Long Staple.—"Fully Good Middling," "good colour, staple fine, rather irregular, inclined to be soft, value 10·50*d.* to 11·00*d.*"

Texas Big Boll.—"Fully Good Middling," "good colour, staple $1\frac{1}{8}$ inch, strong, value 8·60*d.* to 8·70*d.*"

On the date of these valuations "middling" American was quoted at 8·20*d.* and "fine" Broach at $7\frac{9}{16}$*d.* per lb.

The yields of lint obtained on ginning the cotton were reported by the British Cotton Growing Association to be as follows:—

Variety.	Lint Per cent.	Seed and dirt Per cent.
Texas Big Boll	31·25	68·75
Boyd's Prolific	31·23	68·77
Triumph	35·71	64·29
Allen's Improved	30·56	69·44
Toole	33·33	66·67
Peterkin	33·30	66·70
Black Rattler	33·37	66·63
Griffin	30·00	70·00

The disposal of the American cotton is a difficult matter. Local buyers do not seem to care about dealing in it, and last season some growers mixed it up and sold it as Sindhi. For this reason very little seed has been distributed to zemindars this season although many applications have been received.

During the present season American cotton is being grown at the following places: Jacobabad, Shikarpur, Sukkur and Ubauro in Upper Sind, where at present very little cotton is grown; and at Noushahro Feroz, Nawabshah, Halla, Nara Valley, Mirpurkhas, Hyderabad, Tando Mahomed Khan, Talhar and Phuleli Escape in Lower Sind. This only leaves out the Larkana and Karachi districts, in which the staff is too small to enable trials to be carried out. If the results obtained at the above centres are successful, it will be necessary to arrange some means of disposal before any extension of the cultivation can be contemplated.

REPORT ON COTTONS GROWN DURING 1910–11.

The following is the report on nine samples of seed-cotton recently forwarded to the Imperial Institute for examination by the Superintendent of the Agricultural Station at Mirpurkhas.

(1) *Egyptian Mitafifi.*—This sample yielded 33·9 per cent. of lint on ginning, or 4·82 grams per 100 seeds. The lint was clean, slightly harsh, fairly lustrous, and somewhat uneven in colour, varying from white to pale-brown, but free from stains. It could be fairly easily detached from the seeds by hand. The

seeds were generally fairly large, dark-brown and smooth, with tufts of greenish down at the ends. Thirty-eight per cent. of the seeds examined were defective, 22 per cent. being mouldy, 6 per cent. withered and 10 per cent. attacked by insect pests. They would be unsuitable for sowing. The cotton was of good strength, but somewhat irregular length, varying from 0·9 to 1·7 inch, but mostly from 1·2 to 1·4 inch. The diameter ranged from 0·0005 to 0·00095, with an average of 0·00067 inch.

This cotton was of rather uneven colour and somewhat irregular length, but was otherwise of good quality, and was valued at 9*d.* per lb., ginned, with "fully good fair" brown Egyptian at 9⅞*d.* per lb.

(2) *Egyptian Abassi.*—This sample yielded 34·4 per cent. of lint on ginning, or 4·7 grams per 100 seeds. The lint was clean, fairly soft and of rather inferior lustre, but white and free from stains. It could be fairly easily detached from the seed by hand. The seeds were generally fairly large, dark-brown, and usually covered with a green or greenish-brown down. Thirty-one per cent. of the seeds examined were defective, 20 per cent. being mouldy, 6 per cent. withered, and 5 per cent. attacked by insect pests. They would be unsuitable for sowing. The cotton was of good strength but irregular length, varying from 1·0 to 1·9 inch, but mostly from 1·2 to 1·5 inch. The diameter ranged from 0·0005 to 0·00085 inch, with an average of 0·00070 inch.

This cotton was regarded as worth 10½*d.* per lb., ginned, with "good" Abassi at 13¼*d.* per lb., the value being reduced by its rather dull appearance and irregular length.

(3) *Sindhi native cotton.*—This sample yielded 38·4 per cent. of lint on ginning, or 2·87 grams per 100 seeds. The lint was clean, somewhat curly, harsh, lustrous, of pale-cream colour and free from stains. It could not be easily detached from the seeds by hand. The seeds were small, and covered with a greyish, velvety down. Twelve per cent. of the seeds examined were defective, 3 per cent. being mouldy, 4 per cent. withered, and 5 per cent. attacked by insect pests. The cotton was of fairly good strength, and mostly from 0·8 to 0·9 inch in length. The diameter varied from 0·0007 to 0·0012 inch, with an average of 0·00085 inch.

This cotton was of good quality though rather short in staple.

by hand. The seeds were fairly large and covered with a white fuzz, and were in good condition, only 8 per cent. being defective. The cotton was generally strong, and from 1·0 to 1·7 inch long, but mostly from 1·3 to 1·6 inch. The diameter varied from 0·0005 to 0·0008 inch, with an average of 0·00064 inch.

This cotton was of good length and strength, and generally of excellent quality. It was regarded as worth from 9·00*d.* to 9·25*d.* per lb., ginned, with "middling" American at 7·75*d.* per lb.

(7) "*Allen's Improved" long-stapled American Upland.*—This sample yielded 35·7 per cent. of lint on ginning, or 3·77 grams per 100 seeds. The lint was clean, fairly soft, lustrous, white and free from stains. It was with difficulty detachable from the seeds by hand. The seeds were generally of medium size but rather mixed, some being covered with a white fuzz whilst others were coated with a white, brown, or greenish, velvety down. Twenty-two per cent. of the seeds examined were defective, 17 per cent. being withered and 5 per cent. mouldy. The cotton was strong but of irregular length; the greater part of the sample had a length of 0·8 to 1·3 inch, mostly from 1·0 to 1·2 inch, whilst a smaller portion varied from 1·5 to 1·8 inch. The diameter of the fibre was also irregular, that of the shorter fibres varying from 0·00065 to 0·0011 inch, with an average of 0·00080 inch, and that of the longer from 0·00050 to 0·0009 inch, with an average of about 0·00064 inch.

The cotton was of very irregular length and diameter, portions of the sample being short and coarse. This irregularity suggests that the product had been grown from mixed seed. It was valued at 7·80*d.* per lb., ginned, with "middling" American at 7·75*d.* per lb. If the whole of the cotton had been of the same length as the longer portion, *i.e.* from 1·5 to 1·8 inch, it would have been worth about 2*d.* or 3*d.* per lb. more than the price quoted.

(8) "*Griffin" American Upland.*—This sample yielded 30·5 per cent. of lint on ginning, or 3·39 grams per 100 seeds. The lint was clean, soft, lustrous, white and free from stains. It could be fairly easily detached from the seeds by hand. The seeds were of medium size, and generally covered with a white or green fuzz. Fifteen per cent. of the seeds examined were

defective, 13 per cent. being withered and 2 per cent. attacked by insect pests. The cotton was, on the whole, of fairly good strength. The length varied from 1·2 to 1·6 inch, but was mostly from 1·3 to 1·5 inch. The diameter ranged from 0·0005 to 0·0009 inch, with an average of 0·00071 inch.

This cotton was of good length and strength, and generally of very satisfactory quality. It was valued at 8·75*d.* per lb., ginned, with "middling" American at 7·75*d.* per lb.

(9) "*Black Rattler*" *American Upland.*—This sample yielded 30·7 per cent. of lint on ginning, or 3·15 grams per 100 seeds. The lint was clean, fairly soft, white and free from stains. It could be easily detached from the seed by hand. The seeds were of medium size, but of mixed type, some seeds being covered with a white fuzz and others with a brown or greenish velvety down. Ten per cent. of the seeds examined were defective, 8 per cent. being withered, 1 per cent. mouldy and 1 per cent. attacked by insect pests. The cotton was in general of fairly good strength. The length varied from 1·0 to 1·5 inch, but was mostly from 1·2 to 1·4 inch. The diameter ranged from 0·00055 to 0·0011 inch, with an average of 0·00073 inch.

This cotton was of good length, strength and colour, and was valued at 8·30*d.* per lb., ginned, with "middling" American at 7·75*d.* per lb.

General Remarks.—These samples represent cotton of remarkably good quality, and such material would meet with a ready sale on the English market. This is especially true of the American Upland cottons, and if these varieties give satisfactory yields their cultivation in Sind may well be extended and should prove very profitable. It must, however, be pointed out that improved Upland cottons are very liable to undergo deterioration, and it is therefore essential that seed should be carefully selected each season for sowing in the next. The selection must, of course, be made in the field. The seed-cotton should be gathered from the best plants which are also truest to type, and care should be taken in ginning to ensure that the seed does not become mixed with that from any other portion of the crop.

BASSIA KERNELS AND FATS.

IN the last few years there has been a remarkable rise in the prices of almost all oil seeds, oils and fats. This is to be attributed in part to the increase in the demand for oils and fats for edible purposes, principally as salad and cooking oils, butter substitutes, chocolate fats and cooking fats.

One of the most promising sources of hard vegetable fat for edible purposes is the seeds of the various species of Bassia (N.O. Sapotaceæ) occurring commonly throughout the East Indies, and already imported into Europe under the name of "mowra" seeds. Seeds of *Bassia* spp. appear also to come on the market as "illipe seeds," but this name is undoubtedly also now applied in commerce to seeds derived from genera other than Bassia. There is a good deal of confusion as to the botanical origin of the seeds known commercially by these names, and the Imperial Institute has endeavoured to obtain for examination authentic samples from India, Borneo, Ceylon and elsewhere, of the Bassia and other Sapotaceous seeds which come into commerce, with a view to obtaining definite information as to the relative values of the kernels of the different species as sources of fat. These inquiries are not yet completed, but as a considerable amount of information has been accumulated it seems worth while to place this on record.

SAMPLES FROM INDIA.

The materials received from India have included specimens of the fruits, seeds, kernels and fat of *Bassia latifolia*, *B. longifolia* and *B. butyracea*. According to Sir George Watt (*The Commercial Products of India*, London, 1908, p. 116) *Bassia latifolia* is generally known in India under the vernacular names "mahua," "mahwa" or "mowha," but is also known in some parts as "illupei" or "illupai," the former being Hindustani and the latter Tamil names. The same names are also applied to *Bassia longifolia* in India, but since this species occurs only in Southern India it is more commonly called by its Tamil names "illupei" or "illipi." It is not safe to assume therefore, as is done by some authorities, that the "mowra" or "mahua" seeds of India are derived from *B. latifolia* and the "illipi" seeds from *B. longi-*

The kernels formed 71·6 per cent. of the weight of the seeds, and contained 33 per cent. of fat, equivalent to a yield of 23·6 per cent. on the whole seeds, or 12·2 per cent. on the fruits. This yield of 33 per cent. from the kernels is unusually low, possibly because the seeds were immature.

The fat extracted from the kernels by light petroleum was yellow, soft at ordinary temperatures, and had a pleasant taste and odour.

The results of examination of the fat of *B. latifolia* are shown in the following table, together with results obtained by previous observers :—

	Fat from Sample No. 1.	Sample of fat No. 2. Prepared in India.	Fat from Sample No. 3.	Results recorded previously for fat prepared in India. (Crossley and Le Sueur.)
Specific gravity at $\frac{100^\circ \text{ C.}}{15{\cdot}5^\circ \text{ C.}}$	0·857	0·870	0·862	0·894 to 0·898*
Acid value †	—	20·0	(See text below.)	4·8 to 70·8
Saponification value † . .	189·8	194·4	188·3	187·4 to 194·0
Iodine value, *per cent.* . .	57·6	76·8	61·5	53·4 to 67·85
Hehner value, ‡ *per cent.* .	94·2	86·7	96·4	94·7 to 95·0
Reichert-Meissl value §. .	0·2	1·0	0·9	0·44 to 0·88
Unsaponifiable matter, *per cent.*	2·0	1·7	—	—
Titer test ‖	43·2° C.	36° C.	46° C.	—

* *Determined at* 100/100° *C.*
† *Milligrams of potassium hydroxide per gram of fat.*
‡ *Percentage of insoluble fatty acids and unsaponifiable matter.*
§ *Cubic centimetres of decinormal alkali required to neutralise volatile acids from* 5 *grams of fat.*
‖ *Solidifying point of fatty acids.*

The fat extracted from the seeds enclosed in the fruits of sample No. 3 had an acid value of 31·8, whereas that extracted from the loose seeds in the sample had an acid value of 41·8.

From the high iodine value and low titer test of the fat prepared in India (sample No. 2), it seems possible that only the more liquid portion of the fat was extracted, or that possibly oil had been added by the native workers to facilitate the expression of the fat from the ground seed.

The fat of *Bassia latifolia* extracted from the kernels by means of light petroleum was found to contain glycerides of oleic, stearic and probably palmitic acids. From the iodine value of the fat, the glycerides appeared to be present in the following proportions: olein 66 per cent.; stearin and palmitin together, 34 per cent.

It has been stated by Lewkowitsch (*Oils, Fats and Waxes*, London, 1909, Vol. II. 429) that palmitic acid is the chief constituent of the solid acids in *B. latifolia* fat, but in the fat extracted from sample No. 3 nearly half of the solid fatty acid was stearic acid, which was readily isolated in a pure state.

Bassia longifolia.

No. 1. "*Bassia longifolia* fruits from Taliparamba, Madras." The fruits were blackish in colour and almond-shaped, containing sepia-coloured seeds with brown kernels, many of which were in a powdery condition. The length of the fruits varied from 1·0 to 1·3 inches. The fruit consisted of outer husk 33 per cent.; inner husk 20·5 per cent.; kernel 46·5 per cent. The kernels yielded 55·3 per cent. of soft yellow fat.

No. 2. "*Bassia longifolia* fat from Taliparamba, Madras." The sample consisted of dirty yellowish fat, which after filtering was pale-yellow in colour.

No. 3. "*Bassia longifolia* kernels from the Palur Agricultural Station, Madras." The sample consisted of brown kernels resembling those contained in the fruits of sample No. 1. The kernels yielded 57·8 per cent. of a soft yellow fat.

The fat of *Bassia longifolia* was examined with the following results; those recorded by previous workers are given for comparison.

	Fat from Sample No. 1.	Sample of fat No. 2. Prepared in India.	Fat from Sample No. 3.	Results recorded previously (De Negri and Fabris).
Specific gravity at $\frac{100^\circ \text{ C.}}{15{\cdot}5^\circ \text{ C.}}$	0·856	0·864	0·861	—
Acid value *	—	5·0	19·7	—
Saponification value *	202·7	198·2	195·3	188·4
Iodine value, *per cent.*	54·8	60·0	60·0	50·1
Hehner value,* *per cent.*	—	87·4	95·5	94·7
Reichert-Meissl value *	—	3·6	2·35	—
Unsaponifiable matter, *per cent.*	2·2	2·1	1·4	—
Titer test *	—	36° C.	45° C.	39·7° to 40·3° C.

* *For explanation of this term, see footnotes to table on page* 230.

The results of analysis of the fat from sample No. 3 differ somewhat from those for samples Nos. 1 and 2 and from those recorded by previous investigators, including Menon (*Journ. Soc. Chem. Ind.*, 1910, **29**. 1429). It should be pointed out, however, that the fat sent from India (sample No. 2) was dirty and had been badly prepared, whilst that extracted at the Imperial Institute from sample No. 1 was obtained from a specimen of fruits weighing only 10 oz., and can therefore hardly be regarded as representative.

The fat from sample No. 3 was found to contain glycerides of linoleic, oleic, stearic and palmitic acids. The proportions of the glycerides of the unsaturated acids (olein and linolein) and those of the saturated acids (stearin and palmitin) were about 60 per cent. of the former and 40 per cent. of the latter. The glycerides of oleic and linoleic acids appeared to be present in the proportion of approximately 6 to 1, and the fat would therefore contain about 9 per cent. of linolein.

Bassia butyracea.

No. 1. "*Bassia butyracea* fruits from Kumaun, United Provinces."

No. 2. "*Bassia butyracea* seed from Gonda Division, Eastern Circle, United Provinces."

No. 3. "*Bassia butyracea* seed from Gonda Division, Eastern Circle, United Provinces."

No. 4. "*Bassia butyracea* seed from Kumaun Division Eastern Circle, United Provinces."

No. 5. "*Bassia butyracea* seed from Kumaun Division, United Provinces."

No. 1 consisted of blackish, oblong fruits, about 1¼ inch in length, with thick, soft, sugary pericarps; they possessed a characteristic sweet smell. Each fruit contained one seed with a brown, shiny, close-fitting husk and a brownish-white kernel.

Nos. 2, 3, 4 and 5 consisted of seeds resembling those contained in the above fruits.

The fruits of No. 1 were composed of pericarp 71·7 per cent. and seed 28·3 per cent. These seeds and those of samples 2, 3 and 5 were found to be constituted as follows:—

contain glycerides of oleic and palmitic acids, which, calculating from the iodine value of the fat, appeared to be present in the proportion of about 46 per cent. of olein to 54 per cent. of palmitin. The unsaponifiable matter could not be isolated in sufficient quantity for detailed examination. In this and the preceding cases it is semi-crystalline and gives the characteristic reactions of the phytosterols.

SAMPLES FROM CEYLON.

The only species of Bassia represented in the samples from Ceylon is *B. longifolia*, which occurs commonly in the forests of the dry region of the island, but is much rarer, and probably always planted, in the moist low country. *B. latifolia* has been recorded several times for Ceylon, but according to Trimen (*Handbook of the Flora of Ceylon*, 1895, Part III, p. 79) *B. longifolia* was without doubt intended.

In Ceylon the plant is known as "Mi" or "Mee" (Sinhalese), but the Tamil name "Illupai" is also employed.

Several samples of the seed and fat were received recently at the Imperial Institute from Ceylon. It was stated that from 15,000 to 20,000 bushels of the seeds could probably be marketed in Ceylon each year, once its value became known to the villagers.

No. 1. This sample, labelled "Mee seed," was in poor condition, the kernels being moist and mostly mouldy. The seeds consisted of 30 per cent. shell and 70 per cent. kernel. The yield of oil was about 39 per cent. from the moist kernels, which contained about 24 per cent. of moisture. After exposure to the air for about a day the kernels contained only 6 to 7 per cent. of moisture and 47 to 48 per cent. of oil, which is a lower percentage than that found for *Bassia longifolia* kernels from India.

The fat was solid and yellowish in colour, having the usual appearance and properties of the fat derived from *Bassia longifolia* kernels. It was not submitted to chemical examination.

No. 2. The sample, labelled "Mee seed, *Bassia longifolia*," was in bad condition, many of the kernels showing signs of decay. Kernels in good condition picked from the sample yielded 54·2 per cent. of fat, which is normal for kernels of this species. The character of the fat was also normal.

No. 3. This sample, labelled "Mee kernels," was in rather bad condition; many of the kernels had been attacked by insects and a quantity of dust and debris was present.

The yield of oil from the kernels was 50·3 per cent., which is somewhat below that given by Indian kernels derived from this species. The character of the fat was normal.

No. 4. "Mee oil from R. M. Udaisambera Urugela." It consisted of clean, granular fat of pale-greenish-yellow colour.

No. 5. "Jaffna Illupai (Mee) oil." It was clean, semi-solid, pale-yellowish-white fat.

The following table gives the results of examination of the two samples of fat as received from Ceylon:—

	No. 4.	No. 5.
Specific gravity at $\frac{100° C.}{15·5° C.}$	0·861	0·861
Acid value *	25·7	5·8
Saponification value *	191·5	191·5
Iodine value, *per cent.*	61·2	57·6
Titer test *	40·2° C.	41° C. to 42° C.

* *For explanation of these terms see footnotes to table on page* 230.

GENERAL CONCLUSIONS.

On comparing the above results it will be seen that there is a considerable difference in the amounts of fat present in the three kinds of kernels, *B. butyracea* being richest, and *B. latifolia* the least rich in this respect. Recent analyses by Menon (*loc. cit.*) of Indian kernels from these three species gave results very similar to those now recorded, and confirm the view that the kernels of *B. latifolia* contain less fat than those of *B. longifolia*, and the latter, in turn, less than those of *B. butyracea*.

As regards the fats from these three kinds of kernels there is very little to choose between those furnished by *Bassia longifolia* and *B. latifolia*, but the fat from the kernels of *B. butyracea* is harder and whiter than those from the other two species, and should be more valuable commercially. It is understood that whilst *Bassia longifolia* and *B. latifolia* kernels are exported from India in large quantities, there is at present practically no export of *Bassia butyracea* kernels, apparently because all that are available are used locally for the production of edible fat.

Watt (*Commercial Products of India*, 1908, p. 120) mentions that the kernels of *Bassia butyracea* are regarded in India as yielding a more valuable fat than ordinary Mowra kernels, and the results now recorded confirm that view. It would seem to be desirable to encourage the export of *Bassia butyracea* kernels from India if enough are available for that purpose, and it would be well, in view of their richness in fat and the superior quality of this fat, that they should be marketed under a distinct name, so that they will not be sold in Europe as Mowra or Illipi kernels.

At present Bassia kernels are more popular with oil-crushers in Germany and France than in the United Kingdom. One reason for this appears to be that the cake left after expressing the fat is considered poisonous to cattle, owing to the saponin it contains, and consequently only fetches low prices, being used as a manure instead of as a feeding stuff. Investigations recently carried out at Liverpool (*Bio-Chemical Journal*, February 1910, p. 93) have shown that oil-cake made from the kernels of *Bassia longifolia* contains a saponin-like glucoside, which has a marked physiological action when injected subcutaneously, but does not appear to be very active when fed to animals. Careful feeding trials on a considerable scale with oil-cakes made from Bassia kernels would, however, have to be made before it would be safe to say whether or not such materials could be used as feeding stuffs for cattle, and, even if they proved harmless, it is probable that their intensely bitter taste would preclude their use in this way.

The present value of Mowra kernels is about £11 per ton (May 1911). This price appears to be paid for kernels containing about 46 per cent. of fat, and it is clear that kernels in good condition and containing 54 or more per cent. of fat, such as the *B. longifolia* kernels from India and Ceylon, should bring somewhat higher prices under present conditions.

BEESWAX FROM NORTHERN NIGERIA.

THE seven samples of beeswax which are the subject of this report were forwarded to the Imperial Institute in September

II

	Refined Wax prepared from Northern geria Samp es.							Samples previously examined at the Imperial Institute.		Samples examined by :— Dietz	Berg	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	From Gold Coast.	From Uganda.	From Angola.	From German East Africa.	From Sierra Leone.
Melting-point . . .	64·5° to 65°C.	63·5° to 64°C.	63°C.	63·5° to 64°C.	63·5° to 64°C.	63·5°C.	64°C.	64·5°C.	63·2°C.	63·5°C.	63·0° to 64·5°C.	64°C.
Acid value*	—	15·8	19·7	18·7	20·0	15·6	16·3	20·5	18·6	19·6	19·4 to 21·5	21·3
Ester value* . . .		78·0	76·3	76·6	75·3	78·4	77·2	70·3	73·8	73·0	80·7 to 80·9	80·1
Ratio of ester value to acid value	—	4·9	3·9	4·1	3·7	5·0	4·7	3·45	3·96	3·7	37 5 to 4·16	3·76
Iodine value, *per cent.* .	—	9·3	5·9	5·9	7·5	9·5	8·1	—	—	—	—	—
Weinwurm's test . . .	Clear	Cloudy	Cloudy	Clear	Clear	Cloudy	Cloudy	—	Clear	—	—	—

* *Milligrams of po ire beeswax.*

It will be seen from Table I that the samples contained only small amounts of moisture, ash, dirt, and "matter soluble in water" (probably a little honey), and they may therefore be regarded as carefully prepared.

The results of the chemical examination, as given in Table II, show that some of these samples of beeswax are slightly abnormal. Nos. 2, 6 and 7 have rather high ester values and somewhat low acid values, and consequently the "ratio" values are higher than the average recorded for pure beeswax, viz. about 3·7 to 4·2. Analyses of genuine beeswax have, however, been published, giving figures widely divergent from those which may be taken as the average, and it is therefore possible that these samples are uncontaminated wax of somewhat different character from the African waxes previously examined. The analytical figures obtained for samples 3, 4 and 5 agree with those recorded for genuine beeswax.

Samples 2, 3, 6 and 7 yield a cloudy solution with Weinwurm's test. This test was originally designed to detect the presence of paraffin wax or other adulterants in beeswax, but it is well known that certain pure beeswaxes respond to the test owing to some slight abnormality in their composition. It is quite possible that the production of a cloudy solution in the present case may be due to a similar abnormality, but probably this would not interfere in any way with the technical application of the material.

Commercial Valuation.

The samples, with the exception of No. 1, were submitted to commercial experts, who described and valued them as follows :—

Sample.	*Description.*	*Value per cwt.*
2.	Clean, palish, re-melted	£6 17*s.* 6*d.*
3.	Clean, bleached, pale yellow	£7 5*s.* to £7 10*s.*
4.	Clean, fair colour, re-melted	£6 17*s.* 6*d.*
5.	Crude, darkish to fair colour, clean	£6 15*s.*
6.	Clean, palish, re-melted	£6 17*s.* 6*d.*
7.	Clean, pale, re-melted	£7

On the date of valuation, jamaica beeswax was quoted in London at £7 5*s.* to £8 2*s.* 6*d.* per cwt., and East African at £6 5*s.* to £6 10*s.* per cwt. (March 1911). The experts stated that the present demand for beeswax in London is good, and they anticipated that prices will be maintained.

It is understood that large quantities of beeswax are available in Northern Nigeria, and in some cases, *e.g.* in the Zungeru and Lapai districts, rail transport is already available. In view, therefore, of the good prices which the material would realise in London, and the large demand which exists for beeswax in the United Kingdom, efforts should be made to establish an export trade in the product from the Protectorate. Information regarding the production of beeswax and its preparation for the market have been given already in this *Bulletin* (1910, 8. 23).

THE AROMATIC GRASS OILS.

PART I.

THE designation "Aromatic grass oils" may be conveniently used to group together the several important volatile oils derived from members of the genera Cymbopogon, Andropogon and Vetiveria, belonging to the grass order (N.O. Graminaceæ). The group includes a number of oils which are not only of very considerable commercial importance, but have presented, and indeed still present, problems of great botanical and chemical interest. The principal oils concerned are the following:—

Citronella oil.—Produced principally in Ceylon and Java.

Lemon grass oil.—Distilled chiefly in India, though important quantities are now being made in Java, Uganda, the West Indies, and elsewhere.

Palmarosa oil.—Prepared chiefly in India.

Vetiver oil.—Distilled in Réunion, but probably mostly made from vetiver grass roots imported into Europe from India, Java and elsewhere.

As a result of the revision of the genera concerned, by Dr. Stapf at Kew, supplemented to some extent by Mr. J. F. Jowitt's work in Ceylon, a number of the botanical problems connected with the exact determination of the sources of these oils have been solved, though certain points have not yet been completely cleared up (compare *Kew Bulletin*, 1906, p. 297), and, in particular, as will be shown later, there is still some difficulty in correlating the

During the last few years Mr. J. F. Jowitt, formerly of Bandarawela, Ceylon, carried on a series of cultivation experiments with these three kinds of grass and distilled from them an extensive series of oils, which were subsequently received at the Imperial Institute for examination. He also prepared herbarium specimens of each grass, and these were submitted to Dr. Stapf at the Royal Gardens, Kew, for identification. A detailed account of Mr. Jowitt's cultivation experiments has been published already in the *Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon* (Vol. IV. No. 14, p. 117), to which reference may be made for further information on this side of the subject. In the following summary of the results of the examination of the oils, Dr. Stapf's identification of the grass yielding each oil is given in the introductory paragraph relating to it.

In all cases the percentage of "total alcohols" in the oil was calculated from the acetylated oil, and the amount of geraniol present was found by the phthalic anhydride method; the percentage of citronellal recorded represents the difference between these two amounts.

The importance of the Ceylon citronella industry may be gathered from the following table giving the quantity and value of the exports of this article from the island in the last five years for which figures are available. At least half the Ceylon exports are sent to the United Kingdom.

	1905.	1906.	1907.	1908.	1909.
Quantity, cwt. . .	11,096	10,837	11,596	12,013	13,849
Value . . . £	69,417	80,318	92,405	69,577	75,559

MANA GRASS OILS.

A considerable number of varieties of mana grass are recognised by the natives of Ceylon, and Mr. Jowitt selected for cultivation eleven which were fairly distinct from each other. In many cases the differences are indicated by the common name of the plant *e.g.* "small-leaved," "very broad-leaved," "light-leaved," "glaucous-leaved," "white-stemmed," "red-stemmed" mana grasses, etc. As already mentioned, herbarium specimens were submitted to Dr. Stapf, who separated them into two groups, viz. *Cymbopogon Nardus*, Rendle, var. *Linnæi*, Stapf, (*typicus*), to which Nos. 1, 2, 5, 9, 10, 11 and 15 belong, and *C. Nardus*, Rendle, var. *confertiflorus*, Stapf, which includes Nos. 6, 7, 8 and possibly also No. 3.

Oils from Cymbopogon Nardus var. Linnæi (typicus).

(1) "*Maha-naran-pengiri*" *oil.*—The three samples consisted of pale-yellow oil having a rather pleasant citronella odour. There was in each sample a slight deposit consisting in part of needle-shaped crystals.

	No. 1.	No. 1*.	No. 1**.
Date of distillation	5/8/07 and 30/9/07	2/5/08	27/8/08
Yield of oil, *per cent.*	0·18	0·06	0·20
Specific gravity at $\frac{15°C.}{15°C.}$	0·920	0·905	0·912
Optical rotation in 100 mm. tube at 21°C.	−3°7′	−6°32′	+3°22′
Total alcohols, *per cent.*	51·6	63·2	57·2
Geraniol, *per cent.*	27·6	38·4	36·2
Citronellal, *per cent.*	24·0	24·8	21·0
Solubility in alcohol.	Gives a clear solution with its own volume of 80 per cent. alcohol, but becomes slightly opalescent on the addition of 10 volumes of the alcohol.		

(2) "*Heen-naran-pengiri*" *oils.*—The three samples consisted of pale- to deep-yellow oil with a rather pleasant odour, similar to that of No. 1. A slight deposit was present in each case.

	No. 2.	No. 2*.	No. 2**.
Date of distillation	26/6/07 and 20/9/07	5/5/08	26/8/08
Yield of oil, *per cent.*	0·20	0·10	0·25
Specific gravity at $\frac{15°C.}{15°C.}$	0·913	0·894	0·909
Optical rotation in 100 mm. tube	+2°35′ at 21° C.	−3°20′ at 22·5°C.	+2°6′ at 22°C.
Total alcohols, *per cent.*	43·5	47·7	53·5
Geraniol, *per cent.*	24·6	25·8	30·0
Citronellal, *per cent.*	18·9	21·9	23·5
Solubility in alcohol	Gives a clear solution in 1·3 volumes of 80 per cent. alcohol, but becomes opalescent with 10 volumes.	Gives a clear solution with 1·4 volumes of 80 per cent. alcohol; becomes slightly turbid with 2 volumes. The addition of 10 volumes of alcohol causes a marked turbidity.	Gives a clear solution with its own volume of 80 per cent. alcohol, but shows a slight opalescence with 10 volumes of the alcohol.

(5) "*Light-leaved mana*" *grass oil.*

No. 5. Consisted of pale-yellow oil, having a pleasant citronella odour.

No. 5*. Was a very dark-coloured oil, having a strong odour, more pungent than that of *No.* 5.

A small deposit was present in both oils.

	No. 5.	No. 5*.
Date of distillation	29/6/07 and 22/9/07	4/8/08
Yield of oil, *per cent*	0·25	0·20
Specific gravity at $\frac{15^\circ \text{ C.}}{15^\circ \text{ C.}}$	0·909	0·908
Optical rotation in 100 mm. tube	$+4^\circ 54'$ at 21° C.	$+3^\circ 30'$ at 22° C.
Total alcohols, *per cent.*	56·5	64·0
Geraniol, *per cent.*	38·6	30·2
Citronellal, *per cent.*	17·9	33·8
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol; opalescent with 10 volumes.	

(9) "*Small-leaved mana*" *grass oil.*—Both samples consisted of yellow oil with a characteristic citronella odour. A slight deposit was present in each.

	No. 9.	No. 9**.
Date of distillation	5/7/07 and 26/9/07	19/8/08
Yield of oil, *per cent.*	0·22	0·33
Specific gravity at $\frac{15^\circ \text{ C.}}{15^\circ \text{ C.}}$	0·906	0·909
Optical rotation in 100 mm. tube at 22° C.	$+3^\circ 7'$	$+3^\circ 20'$
Total alcohols, *per cent.*	57·0	56·3
Geraniol, *per cent.*	34·4	36·5
Citronellal, *per cent.*	22·6	19·8
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol, slightly opalescent with 10 volumes.	

(10) "*Sour mana*" *grass oil.*

No. 10. Consisted of rather dark oil with a pleasant odour. A small deposit was present, including some red flocculent matter.

No. 10*. Consisted of yellow oil, the odour of which was quite different in character from that of *No.* 10, and resembled somewhat that of the oil of *C. polyneuros.* A slight deposit was present.

	No. 15.	No. 15*.
Date of distillation	22/6/07 and 18/9/07	17/8/08
Yield of oil, *per cent.*	0·25	0·42
Specific gravity at $\frac{15° C.}{15° C.}$	0·912	0·909
Optical rotation in 100 mm. tube at 21° C.	− 1°38′	+ 2°18′
Total alcohols, *per cent.*	48·6	56·4
Geraniol, *per cent.*	25·5	35·8
Citronellal, *per cent.*	23·1	20·6
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol; opalescent and slightly turbid with 10 volumes.	Clear solution with own volume of 80 per cent. alcohol; very slight opalescence with 10 volumes.

Oils from Cymbopogon Nardus var. confertiflorus.

(3) *Lena-batu-pengiri* (*var.*) *oil.*—This oil was derived from a grass known as "Lena-batu-pengiri" in Galle, but not regarded as true "Lena-batu-pengiri" (see No. 4, p. 248). It has been identified by Dr. Stapf as *Cymbopogon Nardus*, Rendle, approaching var. *confertiflorus*, Stapf. The three samples consisted of pale- to deep-yellow oil, with a pleasant, not very pungent, odour. A small non-crystalline deposit was present in each case.

	No. 3.	No. 3*.	No. 3**.
Date of distillation	3/7/07 and 21/9/07	9/5/08	22/8/08
Yield of oil, *per cent.*	0·17	0·10	0·27
Specific gravity at $\frac{15° C.}{15° C.}$	0·915	0·920	0·907
Optical rotation in 100 mm. tube	+ 2° 46′ at 22° C.	− 2° 11′ at 20° C.	− 6° 6′ at 21·5° C.
Total alcohols, *per cent.*	52·0	63·1	64·2
Geraniol, *per cent.*	31·1	39·5	44·8
Citronellal, *per cent.*	20·9	23·6	19·4
Solubility in alcohol	Gives a clear solution with 1·1 volume of 80 per cent. alcohol, but becomes very slightly opalescent on the addition of 10 volumes of the alcohol.	Gives a clear solution with its own volume of 80 per cent. alcohol. Otherwise as No. 3.	As No. 3*.

(6) "*Glaucous-leaved mana*" *grass oil.*—Both samples consisted of pale-yellow oil with a pleasant odour. A slight deposit was present in each case.

	No. 6.	No. 6*.
Date of distillation	6/7/07 and 23/9/07	21/8/08
Yield of oil, *per cent.*	0·45	0·25
Specific gravity at $\frac{15° C.}{15° C.}$	0·913	0·900
Optical rotation in 100 mm. tube	+12°12′ at 21° C.	+4°0′ at 21·5° C.
Total alcohols, *per cent.*	46·5	61·2
Geraniol, *per cent.*	29·3	43·7
Citronellal, *per cent.*	17·2	17·5
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol, opalescent with 10 volumes.	

(7) "*White-stemmed mana*" *grass oil.*

No. 7. Consisted of golden-yellow oil, having a pleasant, not very pungent, odour. A slight deposit was present.

No. 7*. Consisted of dark-coloured oil, with a somewhat pungent and slightly "burnt" odour. A considerable deposit was present.

	No. 7.	No. 7*.
Date of distillation	2/7/07 and 24/9/07	12/8/08
Yield of oil, *per cent.*	0·24	0·11
Specific gravity at $\frac{15° C.}{15° C.}$	0·908	0·904
Optical rotation in 100 mm. tube	+1°27′ at 22° C.	+2°26′ at 22·5°C.
Total alcohols, *per cent.*	54·8	58·0
Geraniol, *per cent.*	30·2	24·8
Citronellal, *per cent.*	24·6	33·2
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol. Opalescent with 10 volumes.	

(8) "*Red-stemmed mana*" *grass oil.*

No. 8. Consisted of yellow oil, having a pleasant, not very pungent, odour.

No. 8*. Was a dark-coloured oil with a fairly pungent odour.

A small deposit was present in the oil in each case.

	No. 8.	No. 8*.
Date of distillation	1/7/07 and 25/9/07	14/8/08
Yield of oil, *per cent.*	0·16	0·15
Specific gravity at $\frac{15° C.}{15° C.}$	0·929	0·909
Optical rotation in 100 mm. tube	+6°19′ at 21·5°C.	+0°58′ at 22°C.
Total alcohols, *per cent.*	39·1	57·0
Geraniol, *per cent.*	19·4	28·9
Citronellal, *per cent.*	19·7	28·1
Solubility in alcohol	Clear solution with own volume of 80 per cent. alcohol; opalescent with 10 volumes.	Clear solution with own volume of 80 per cent. alcohol; opalescent and shows a slight flocculence with 10 volumes.

LENA-BATU GRASS OIL.

This oil was derived from a grass from Matara which has been identified by Dr. Stapf as *Cymbopogon Nardus*, Rendle, "Lena-batu," and is the grass ordinarily cultivated by natives in Ceylon for the production of the Ceylon citronella oil of commerce.

No. 4. Consisted of pale-lemon-yellow oil with a pleasant odour. A slight deposit was present.

No. 4*. A deep-yellow oil, quite clear, with a somewhat pungent odour. There was practically no deposit present in this instance.

No. 12. Consisted of lemon-yellow oil of typical citronella odour. A slight deposit was present.

No. 12*. Was similar in colour and odour to No. 12, but no deposit was present.

	No. 4.	No. 4*.	No. 12.	No. 12*.
Date of distillation	7/8/07 and 1/10/07	24/7/08	6/8/07 and 2/10/07	27/7/08
Yield of oil, *per cent.*	0·42	0·48	0·46	0·56
Specific gravity at $\frac{15° C}{15° C.}$	0·913	0·913	0·917	0·915
Optical rotation in 100 mm. tube	−12°26′ at 20° C.	−13°6′ at 21° C.	−11°53′ at 22° C.	−14°16′ at 21° C.
Total alcohols, *per cent.*	57·8	62·1	59·9	61·3
Geraniol, *per cent.*	31·5	37·9	26·3	34·5
Citronellal, *per cent.*	26·3	24·2	33·6	26·8
Solubility in alcohol	Gives a clear solution in its own volume of 80 per cent. alcohol, but becomes slightly opalescent with 10 volumes of the alcohol.		Clear solution with own volume of 80 per cent. alcohol; slightly turbid with 10 volumes	As Nos. 4, 4*

and pungent citronella odour. Practically no deposit was present. It gave the following results on examination:—

Date of distillation	28/8/08
Specific gravity at 15°/15° C. . . .	0·905
Optical rotation in 100 mm. tube at 20° C.	− 11° 14′
Total alcohols	59·6 *per cent.*
Geraniol	36·0 „
Citronellal	23·6 „
Solubility in alcohol:	Gives a clear solution with its own volume of 80 per cent. alcohol, and remains quite clear with 10 volumes.

The yield of oil in this distillation was 0·51 per cent.

REMARKS ON THE CITRONELLA OILS FROM CEYLON.

The citronella oils included in this series of samples belong to three groups derived from (*a*) "Mana" or wild grasses; (*b*) "Lena-batu" grass, and (*c*) "Maha-pengiri" or "Winter's grass," and it will be convenient to discuss them under these headings.

(*a*) *Mana Grass Oils.*

As already indicated Dr. Stapf has divided the Mana grasses into two varieties of *Cymbopogon Nardus*, viz., var. *Linnæi* (typicus) and var. *confertiflorus*, the former being represented in this series by oils Nos. 1, 2, 5, 9, 10, 11 and 15, and the latter by oils Nos. 3 (?), 6, 7 and 8. From this point of view it is of interest to compare the oils obtained from these two sets of grasses, with a view to ascertaining whether there is any well-marked chemical or physical difference between the two groups, corresponding with the botanical difference which leads to the separation of the grasses into two varieties.

The most striking feature in this comparison is the great variation shown by almost all the grasses in yield and character of oil obtained on distillation at different times. These differences are due probably to the influence of cultivation on the wild grasses, to the effects of manuring, and to variation in the character of the oil yielded at different seasons; and for these reasons too much stress should not be laid on the results obtained with this set of oils as bearing on the botanical classification of the grasses yielding them. It seems clear, however, that there is no well-marked line of demarcation between the oils yielded by the grasses included in Dr. Stapf's "var. *Linnæi* (typicus)" and those from the grasses regarded by him as "var. *confertiflorus*."

On the other hand, it should be noted that the oils Nos. 1, 2, 3, 6, 9 and 15 have in common on the whole the characteristic of becoming progressively richer in geraniol and poorer in citronellal with continued cultivation of the grasses yielding them; whilst Nos. 5, 7, 8 and 11 show a tendency to increase largely in citronellal and diminish in geraniol, though as regards Nos. 8 and 11 there is also a well-marked increase in geraniol in the later stages. No. 10 is abnormal in yield of oil and in "total alcohols," and it is of interest to note that the herbarium specimen No. 10 is described by Dr. Stapf as representing a rather deteriorated form of var. *Linnæi* (typicus). It should be stated that this re-grouping of the grasses according to the characters of the oils has been communicated to Dr. Stapf, but he is unable to find any support for it in the botanical characters of the herbarium specimens submitted to him. For the reasons already mentioned much stress cannot be laid on the chemical characters of this set of oils as a guide to the classification of the grasses, since there are so many factors likely to influence the nature of the oil produced. This grouping is of interest, however, since it would assimilate oils Nos. 1, 2, 3, 6, 9 and 15 to "lena-batu" grass, which yields oil rich in geraniol, and Nos. 5, 7, 8 and 11 to "maha-pengiri," which yields oil rich in citronellal.

From a commercial point of view none of these mana grass oils is of much interest. Except in the case of No. 6 the yield of oil is low, and the quality of the oil is inferior to that obtained from lena-batu grass, and much inferior to that from maha-pengiri grass.

(*b*) *Lena-batu Grass Oils.*

These are represented in this series of oils by groups Nos. 4 and 12, and possibly by No. 27. The oils resemble medium quality Ceylon citronella oil of commerce. It is worth noting that the yield of oil obtained in the case of Nos. 4* and 12* was greater than that secured in the case of Nos. 4 and 12 respectively, and that the oil was also richer in "total alcohols" (*see* table, p. 248). It cannot be stated definitely whether this is due entirely to manures applied in December 1907 (see *Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon*, Vol. IV. No. 14, p. 117) or to the collection and distillation of the second batch of grass in the case of Nos. 4* and 12* at a season when the grasses are naturally richer in oil of better quality.

(*c*) *Maha-pengiri Grass Oils.*

These are represented in this series by group No. 14. Oil No. 27, distilled from grass supplied to Mr. Jowitt as "maha-pengiri," is probably in reality from "lena-batu" grass. The three oils Nos. 14, 14a and 14* show the usual characteristics of "maha-pengiri" oils, being high in "total alcohols" and containing much citronellal (*see* table, p. 249). The best of the three oils is No. 14a, and it is noticeable that a larger yield of this fine quality oil was obtained than of either 14 or 14*. As manure was supplied to this plot in July 1906 and again in December 1907, and did not give rise to increased yields in the succeeding distillations, it would appear that the high yield of good oil in the case of No. 14a points to the season in which this batch of grass was grown and collected as a particularly favourable one for the production of oil.

The results obtained in the examination of these various citronella oils are of great interest, and it would be useful to have the experiments continued with a view to the settlement of the following points:—

1. The character and quantity of oil yielded by lena-batu and maha-pengiri grasses in Ceylon at different stages of growth and at different seasons of the year.

2. The effects of various manures on the yield and quality of oil obtained from these grasses.

These two sets of experiments would need to be conducted on independent plots, in order that the influence of age and season on the oils should not be obscured by the effects of manuring.

used in Europe as a substitute for maize, and its price on European markets fluctuates in sympathy with that of maize. So far, European supplies of dura have been derived principally from Asia Minor and India, but in recent years imports have also been received from the Union of South Africa, and the latest addition to the sources of supply is the Anglo-Egyptian Sudan. The total exports from the Sudan last year were about 30,000 tons, most of which went to Egypt and Aden, with about 4,000 tons to Europe. The plant grows like a weed in the Sudan, and with increasing transport facilities and a greater desire on the part of the natives to engage in trade, there is every reason to suppose that a large increase in the amount of Sudan dura available for export will take place. In these circumstances, it seems desirable to acquaint farmers and others in this country with this new and useful feeding stuff. The material should also be of interest to brewers and distillers, and to starch and glucose manufacturers as a source of these products, for all of which purposes maize is now largely used.

The Government of the Anglo-Egyptian Sudan is fully alive to the importance of finding new markets for dura, and at the present time arrangements are being made by the Imperial Institute for feeding trials with Sudan dura at various centres in this country, and for experiments with the grain as a raw material for the brewing and distilling industries.

Some years ago feeding trials with Sudan dura were carried out in Austria, and a copy of the report has been forwarded to the Imperial Institute by the Government of the Anglo-Egyptian Sudan and is now published in a slightly abbreviated form :—

FEEDING TRIALS WITH SUDAN DURA.

First Series.

These trials were carried out in the summer of 1907, under the direction of Herr R. Pohl, at the Hrubschitz farm, Mährisch Kromau, belonging to Prince Rudolph Liechtenstein. The object was to compare the value of Sudan dura with that of Hungarian maize for fattening oxen.

A comparison of the results of chemical analysis of Sudan dura and Hungarian maize, as given in the following table, shows that the proportion of fat in the former is low, but this is compensated for by the higher percentages of proteid and carbohydrates :—

	Sudan dura.	Hungarian maize.
	Per cent.	*Per cent.*
Water	11·45	13·0
Crude proteid	11·07	9·9
Fat	2·68	4·4
Nitrogen-free extractive matter (carbohydrates, etc.) . .	70·30	69·2
Crude fibre	1·95	2·2
Ash	2·57	1·3

At the commencement of the trial twelve "beef oxen" each received the following ration per day :—

	Kilograms.		*Kilograms.*
Barley straw . .	7	Beet cuttings . .	25
Clover hay . .	8	Broken beans . .	1
Wheat bran . .	0·5	Sesamum cake .	1
Crushed maize .	3	Molasses . . .	1
Malt dust . .	0·5		

The "nutrient ratio" of this mixture of feeding stuffs is 1 : 5·02, and according to usually accepted standards (compare Kellner, *Die Ernährung d. landw. Nutztiere*), the ration is large, and the "nutrient ratio" narrow.

Three of the animals, which represented the mean of the remainder in weight, slaughter value and other qualities were selected, and the crushed maize in their ration was gradually replaced by dura. When the maize was completely replaced, the quantity of dura given to each of the selected animals was raised to 4 kilograms per animal, per day, and at the same time the quantity of maize fed to each of the remaining nine oxen was raised to 4 kilograms per day. Observations extended over a period of three weeks, during which time the animals were weighed daily at 4.45 a.m. before being fed, and the average of the three weighings on successive days was recorded. The results are given in the following table :—

Oxen fed with Dura.

Date of observation :— *No. of animal.*	July 11	July 18 *Weight in kilograms.*	July 25
20	720	730	740
22	710	720	730
66	710	720	730
Total . . .	2140	2170	2200
Average, per head .	713	723	733
Weekly increase .		10	10

Oxen fed with Maize.

Date of observation :— *No. of animal.*	July 11	July 18 *Weight in kilograms.*	July 25
2	690	700	710
40	680	680	680
54	690	690	700
39	610	620	630
172	780	790	800
203	810	820	830
38	630	650	670
48	830	840	860
67	750	760	770
Total . . .	6470	6550	6650
Average, per head .	718	728	739
Weekly increase .		10	11

The results show that there is no appreciable difference in the values of dura and maize as feeding stuffs, but it should be noted that no accurate record of the actual weight of food consumed by the animals, nor of the excrement, could be kept, and consequently the results are less trustworthy than those which could be obtained at a properly equipped experimental station. Only 500 kilograms of dura were available for the trial; the experimental period was consequently short, and the effect of previous feeding probably vitiated the results to some extent. The period could not be lengthened, however, by using fewer animals nor by reducing the amount of dura supplied to each animal, since the former course might induce errors due to idiosyncrasy in the selected animals, and the effect of any smaller amount of dura in the daily ration would probably have been imperceptible.

*Composition of Daily Ration.**

	Crude proteid. Kilogr.	Digestible proteid. Kilogr.	Fat. Kilogr.	Nitrogen-free extractive matter. Kilogr.	Crude fibre. Kilogr.
Fundamental fodder per head, per day.					
20 kilo. beet cuttings	0·100	0·060	0·020	1·080	0·240
4·0 kilo. beet leaves	0·060	0·008	0·012	0·288	0·100
3·5 kilo. lucerne hay	0·424	0·284	0·038	0·738	0·396
1·5 kilo. good meadow hay	0·111	0·075	0·019	0·419	0·207
1·0 kilo. barley chaff	0·008	0·005	0·005	0·173	0·144
2·8 kilo. barley straw	0·025	0·017	0·014	0·532	0·596
1·0 kilo. sesamum cake	0·358	0·342	0·113	0·115	0·021
0·682 kilo. coarse wheat bran	0·077	0·067	0·021	0·253	0·018
0·5 kilo. malt dust	0·092	0·057	0·007	0·157	0·003
1·0 kilo. molasses	0·054	—	—	0·549	—
Total	1·309	0·915	0·249	4·304	1·725
Supplementary fodder per head, per day.					
Period I.					
0·955 kilo. maize	0·068	0·063	0·037	0·627	0·013
Period II.					
0·955 kilo. dura	0·069	0·064	0·029	0·537	0·017

* *It should be noted that the composition assigned by Herr Pohl to certain of the ingredients forming the ration, differ somewhat from those usually recorded for these materials.*

The following table shows the milk-yields obtained during periods I and II :—

	Period I *Maize Feeding*	Period II *Dura Feeding*
Total yield from 33 cows for 30 days	9,604 litres	10,401 litres
Fat, *per cent.*	3·85	3·81
Average yield per cow, per day	9·70 litres	10·50 litres.

The quantities were measured in the stalls at each milking. The amount of fat was estimated every 10 days by Gerber's method, and from these figures the mean given above was calculated.

It will be seen that on replacing maize by dura the milk-yield increased by 0·8 litres per head per day, whilst the percentage of fat remained almost unaltered. It must be borne in mind, however, that owing to the influence of the weather, the milk-yield is normally better in May than in April, but an increase such as that recorded above cannot be due to this cause alone, and half the increase in the yield can probably be attributed to the effect of feeding with dura. Probably the fact that cows eat dura with great relish, and much more readily than maize, is an important factor in influencing the yield.

According to Kellner (*loc. cit.*), dura is inferior to maize as a feeding stuff, but in view of the foregoing results this opinion cannot be maintained. It might still be urged that feeding with maize possibly induces larger increases in weight, but as far as the purpose of this particular trial is concerned, the conversion of feeding stuffs into milk is more profitable than its conversion into flesh and fat. Moreover, the feeding with dura was continued throughout June, and the condition of the cows for slaughter purposes was considered highly satisfactory. The only decrease in yield of milk observed was that naturally due to the period of lactation.

The conclusion arrived at, therefore, is that dura is at least equal to maize as a feeding stuff.

CULTIVATION, PRODUCTION AND UTILISATION OF SESAMUM SEED.

SESAMUM seed of commerce is the product of an annual herbaceous plant, known botanically as *Sesamum indicum*, Linn., (N.O. Pedaliaceæ,) which is widely cultivated throughout the warmer regions of the world. It is generally supposed to be indigenous to India, where it is extensively cultivated, but many authorities follow De Candolle, who considered it native to the Sunda Islands, whence it was introduced to India and the Euphrates country in very remote times. It is stated to have been found wild in Java, and several closely allied species are known to occur in Africa.

It is an erect-growing plant with 4-angled stems that attain a height of from 2 to 5 feet according to variety, soil and climatic conditions, and branch freely if allowed space for development.

The stems are clothed with alternate, lanceolate or ovate-lanceolate leaves, 3 to 5 inches long. The leaf-margin varies somewhat, the lower leaves being closely toothed and occasionally 3- or 5-lobed, whilst the upper ones are entire. The flowers, produced singly in the axils of the upper leaves, have an irregular, tubular, 5-lobed corolla, of a white or pale rose colour with a yellow lip. The plants commence to bloom when about a foot high, and a succession of flowers is produced as the stem elongates. The fruit is a narrow capsule measuring from 1 to 1½ inches in length, and dehisces by splitting at the apex into two valves. Each capsule contains numerous small seeds, arranged in four rows along a central axis. The seeds are oval or obliquely oblong in shape, flattened on two sides and pointed at one end. The red and brown kinds bear some resemblance to small forms of linseed, but are without lustre. In colour they vary greatly, and may be either white, grey, reddish-brown, dark brown or black, according to the variety. Commercial samples frequently consist of a mixture of these forms.

Sesamum seed is known by a number of common names in commerce, amongst those frequently used being "sesame," "sim-sim" or "sem-sem," "til" or "teel," "gingelly" (sometimes spelt "jinjilli") and "benne" or "benni." The seed is the source of a valuable oil, which is largely used in the countries of production as an article of food, and is extensively employed in European countries in soap-making and the preparation of edible oils and fats.

The most important European market for this product is Marseilles, which annually imports large quantities for producing oil that is principally employed as a raw material by the local manufacturers of soap and edible oils. The following table indicates the dimensions of the Marseilles import trade in sesamum seed, and also shows the principal sources of supply:—

	1905.	1906.	1907.	1908.	1909.
	tons.	*tons.*	*tons.*	*tons.*	*tons.*
India	39,660	31,618	60,556	17,470	40,852
Bassorah	10	1,281	346	732	129
China	2,400	20,444	2,616	21,818	20,290
Levant	3,696	6,665	3,486	324	1,772
Africa	830	1,408	1,472	1,405	1,044

varieties is into white- and black-seeded forms, the latter being that more commonly met with. The white variety is sown in Bengal in February and the crop gathered 3 months afterwards. As little or no rain falls at this season, the only sources of humidity are the dews and the moisture contained in the soil.

In dealing with such a large area as that occupied by sesamum in India, the dates of sowing and reaping naturally vary greatly according to locality, and there is no need, therefore, to give them in detail in a general article. The crop is grown pure, or mixed with either cotton or millet. The land is prepared by ploughing and harrowing to form a friable seed bed. Deep tillage is not essential, but a fine surface tilth is necessary owing to the smallness of the seed. About three ploughings are usually given. The seed is mixed with either sand or ashes to enable the sower to distribute it thinly and evenly on the land. It is sown either broadcast or in drills 12 to 18 inches apart according to the nature of the soil. Hand weeding is necessary in the former case, but the bullock hoe can be utilised in the latter. For a pure crop from 12 to 25 lb. of seed are required to sow an acre, and for a mixed crop, from ¼ lb. upwards, according to the will of the cultivator. When about 6 inches high the seedling plants are thinned out; they are delicate at this stage of growth, and heavy rains are liable to do them damage. If grown on irrigated land, a watering is necessary before sowing, in order to render the soil sufficiently moist to effect the germination of the seed; one subsequent watering during the development of the plants usually suffices.

In the United States, the seed is sown in drills 3 to 4 feet apart, and the plants are thinned to a distance of a foot apart in the rows. The soil is prepared by being ploughed during the cold season, and sowing takes place as soon as all frosts are over. The subsequent culture consists of hoeing to keep down weeds. The harvesting takes place in the autumn.

In the East Africa Protectorate sesamum is cultivated all along the coast belt, but it does not succeed in the highlands. It is sown at the commencement of the long rains in April or May, and the crop is ready to harvest about four months later.

In Egypt, sesamum usually follows wheat, barley, beans or berseem, as a catch crop. It is sown in June or July on well-prepared land that has been manured with farm-yard manure if a cereal crop has been taken from it. The seed is sown broadcast, and a watering is given about 40 days after sowing and is repeated at intervals of from 12 to 15 days during the period of growth, till about 20 days before the harvest, which usually takes place in October.

Harvesting.

When the seed is fit for harvesting, the leaves begin to turn yellow and the capsules become mottled. After this condition is reached the plants should not be allowed to remain long on the land, or the capsules are liable to open, and if this occurs much seed will be lost during the subsequent handling of the plants unless special precautions are taken. The usual method of harvesting is to cut down the stems close to the ground, or to uproot the plants. They are then tied into bundles, and placed on a floor or prepared piece of ground in an upright position. There is no need for protection as they are not harmed by rain. The object of stacking the bundles in this way is to permit the capsules to mature. As the capsules are produced at different stages of the plant's development, they are not all at an equal stage of ripeness when harvesting takes place. About seven days are sufficient for the first-formed capsules to mature, and the seeds these contain are collected by shaking the plants over a cloth spread on the floor. The bundles are then opened out and exposed to the sun for 2 or 3 days, and again stacked. When other capsules have ripened, the bundles are once more shaken to liberate the seeds, and after being exposed to the air and sun are re-stacked and the operations repeated until all the seed has been collected. Beating the stems with a flail is sometimes resorted to, in dealing with particular varieties, to facilitate the opening of the capsules, but in the ordinary course of events the operations of stacking, exposing to sun and air, and shaking, suffice to secure the crop. The impurities mixed with the seed consist chiefly of dust and dirt, together with portions of leaves and stems that are broken off when the plants are shaken. These are removed by hand-winnowing or by washing the seed in cold water and drying by exposure to the sun. The dried stems that remain are of no value as fodder but may be burned on the land and the ashes ploughed in. In the United States the plants are allowed to stand until the leaves fall, and are then cut down and bound into sheaves, which are stacked in the field until the capsules are mature, when they are shaken over a cloth in the manner already described.

The yield of a good average sesamum crop in India from black soil is about 450 lb. of seed per acre, but as it is frequently grown as a mixed crop the yield is somewhat difficult to estimate with accuracy, as it depends greatly upon the amount of seed sown per acre. As much as 1,230 lb. per acre has been recorded in Orissa, and a yield as low as 50 to 150 lb. per acre in the United Provinces, when mixed with cotton or millet. In the United States the yield is estimated at about 20 bushels per acre.

Fungoid and Insects Pests.

The crop appears to be attacked by few diseases, but two forms of bacterial disease have been recognised: one due to *Pseudomonas sesami* and the other to *Bacillus sesami*. The occurrence of disease is made evident by the wilting of the plants, followed by their destruction. Moist soils favour the development of disease. It is stated that treating the seed with formalin, before sowing, is a useful preventive of fungoid disease. In India the larva of *Antigastra catalaunalis*, Dup., is a common pest on sesamum plants. The larva is light-green in colour, with many black spots bearing hairs. It rolls the leaf of the plant or bores into the capsule. Although it occurs commonly only in the rains, it breeds throughout the year if the food-plant is available. The caterpillar of *Acherontia styx*, Westd., one of the larger kinds of hawk moths, has been found attacking the leaves of cold weather crops of sesamum in the Central Provinces. The moth is widely distributed throughout India and the Far East generally, and in some seasons is fairly abundant. The eggs are laid on the leaves and the caterpillar feeds on the plant during the whole of the larval stage, which lasts about two months. When full grown it is a bright-green colour with oblique yellow stripes on either side of the body, and has a prominent anal horn. When about to pass into the pupal state it assumes a deep-brown colour and

Assam), together with the estimated average annual yield, for the ten years 1899–1909 are given in the following table :—

Province.		Average area during 1899–1909. Acres.	Average yield during 1899–1909. Tons.
United Provinces	Pure	292,900	25,500
	Mixed	700,000	60,000
Central Provinces and Berar		918,000	67,900
Madras		460,000	38,000
Bombay (a)		861,900	107,600
Bengal		250,200	29,800
Punjab		148,500	14,100
Sind (b)		92,500	6,300
Hyderabad		484,000	—

(a) *Including Native States.* (b) *Excluding Hyderabad.*

The Indian sesamum crop of the season 1909–10 amounted to 516,000 tons, an increase of 58,700 tons on that of the preceding year, and the export increased 80 per cent. in quantity and 63·5 per cent. in value.

The principal countries receiving the Indian export, together with the quantity and value of seed sent to each, are shown in the following table :—

	Quantities (cwts.).			*Value (£).*		
	1907–8.	1908–9.	1909–10.	1907–8.	1908–9.	1909–10.
United Kingdom	906	—	14,089	432	—	6,553
Austro-Hungary	215,557	374,182	414,222	150,844	246,915	248,107
Belgium	401,254	258,668	723,723	309,006	171,236	441,662
France	599,225	588,288	1,315,889	422,304	374,946	765,776
Germany	172,670	152,331	240,726	131,839	103,760	145,201
Italy	90,681	197,549	192,098	61,479	128,725	115,315
Egypt	43,905	60,277	49,532	32,324	41,651	30,794
Other countries	29,180	25,997	8,556	19,590	16,839	5,048

Eastern Asia.

In French Indo-China the principal cultivation of sesamum is in Annam. The export has diminished in recent years, much of the production being now utilised by the soap-factory at Haiphong. The exports for the years 1908 and 1909 amounted to 360 tons and 453 tons respectively, the greater part of which was shipped to Hongkong. In the south of China sesamum seed is said to come mostly from the Island of Hainan, though some is also obtained from the Tongking district. The recorded export of this product through the Kiungchow maritime customs (Hainan) in 1909 was 6,863 piculs (1 *picul* = 133⅓ *lb.*). This is, however, an insignificant quantity when compared with the export passing through the port of Hankow. For the year 1909 this was 314,043 piculs to foreign countries and 1,603,118 piculs to Chinese ports.

The following table gives the quantities of Chinese seed sent to the principal European ports receiving this product during 1909:—

Name of Port.	*Quantity* (cwts.).
Rotterdam	690,640
Marseilles	404,660
Trieste	301,400
Genoa	242,500
Antwerp	230,560
Hamburg	177,470
Bremen	134,900

The United Kingdom, Japan, Canada and the United States take practically no share in this trade. The export on a large scale of sesamum seed from the Yangtse to Europe is a comparatively recent development, and although the yield of the 1909–10 crop was not so good as in the preceding year, the increased acreage, amounting to about 30 per cent. made up the deficiency. The increase in area is greatest in Honan, where railway facilities have tended to stimulate cultivation. Sesamum seed is also now being received from Patung, near the Hupeh-Szechuan frontier, where, it is stated, land formerly under opium is now being devoted to sesamum. Another Chinese port through which considerable quantities of sesamum pass is Newchwang, which receives part of the Manchurian produce. The quantity passing through the Newchwang Maritime Customs in 1909 amounted to 49,392 piculs, and through the native customs 11,093 piculs. The total export of sesamum from China to foreign countries for 1909 amounted to 2,563,306 cwts. valued at £1,520,021, and it is believed that a far larger Chinese output would find a market in Europe in view of the increased demand.

In Japan sesamum is not extensively cultivated, and seldom as a pure crop, it being usually met with in small beds or more frequently as a border to fields containing other crops.

Africa.

The sesamum plant is grown extensively in Africa, more especially on the West Coast, in the Sudan and Egypt. In Egypt it is grown in the delta, and to a less extent in Upper Egypt and in Fayum. The crop is entirely consumed locally, and there is also a large import from the Sudan (see table below).

German East Africa.—Sesamum is largely grown for local use, the oil being valued by the natives for cooking purposes; the exports for the past few years are as follows:—

Year.	*Value (£).*	*Year.*	*Value (£).*
1904	18,701	1907	6,290
1905	10,423	1908	9,650
1906	5,658	1909	14,200

Anglo-Egyptian Sudan.—In the Sudan sesamum is the most important oil-seed in cultivation. The white-seeded variety is largely grown, and this form is in great demand in Egypt, Jeddah and Beyrout for mixing with sweetmeats. It is anticipated that when the railway reaches districts along the Blue Nile where the white variety is particularly grown, the output will be greatly increased. In the White Nile districts and in Kordofan, the red-seeded form is the variety usually grown, and as this is rich in oil, it will probably find its way to the European markets in larger quantities in the future. The following table shows how much the value of the Sudan export of sesamum seed has increased during the past few years:—

Year.	*Value (£E.)*	*Year.*	*Value (£E.)*
1902	4,977	1906	3,705
1903	2,583	1907	19,736
1904	522	1908	25,084
1905	5,787	1909	63,066

The principal countries at present receiving the Sudan produce with the quantities exported to them in 1909 are as follows:—

Preparation of Sesamum Oil in Europe.

The European methods of extracting the oil are very similar to those described for ground nut oil in a previous article (this *Bulletin*, 1910, 8. 168), and in France the oil factories generally press both ground nuts and sesamum seed with the same machinery. The seeds are rich in oil, generally containing from 50 to 57 per cent., and are therefore pressed once or twice in the cold and a third time at a higher temperature. The following table shows the actual yields of oil usually obtained on a large scale from the several commercial varieties :—

Kind of seed.	Yield of oil. *Per cent.*
Bombay, yellow or red	44 to 45
" mixed	42 to 44
Levant	47 to 48
Chinese	44 to 45

The first cold pressed oil is more valuable than those obtained by the second pressing and by hot pressing ; Levant seed yields the finest edible oil. Oil from Indian seed is stated to be less pleasant in flavour than that from Levant seed, whilst Chinese and African seed yield the lower grades of oil. According to trade regulations, consignments of sesamum seed must contain less than 25 per cent. of dark seed in order to be classed as "white" seed, whilst allowances have to be made if more than 15 per cent. of dark seed is present. Mixtures of dark and white seed are classed as "bigarré," which must contain at least 35 per cent. of white seed. Mixtures of large and small seed are also subject to certain regulations and allowances. The approximate prices at Marseilles at the present time vary from £14 per ton for "black mixed" to £16 13*s*. per ton for Bombay "large seeds."

Sesamum seed is not employed in the United Kingdom as a source of oil, the small quantities of seed imported being generally used in the manufacture of compound feeding cakes for the purpose of bringing the percentage of oil up to standard.

Properties and Uses of the Oil.

Sesamum oil is a bright yellow liquid oil, possessing a pleasant flavour and scarcely any odour. It has the following constants:—

Specific gravity at 15°/15° C. . .	0·920 to 0·926
Saponification value*. . . .	187·6 to 194·6
Iodine value, *per cent.* . . .	103 to 114
Reichert-Meissl value* . . .	1·2
Hehner value,* *per cent.* . . .	95·6
Titer test*.	21·2° C. to 23·5° C.

* *For explanation of these terms see* p. 230.

It is classed as a semi-drying oil, but only exhibits a slight tendency to dry when spread out in thin films and exposed to light and air. It consists chiefly of glycerides of oleic and linoleic acids with smaller quantities of saturated acids. It also contains a phytosterol (the unsaponifiable matter usually present in vegetable oils) together with a small quantity of a resinous substance called "sesamin" and a thick red oil (of unknown composition) to which is due the very characteristic crimson colour obtained in the Baudouin test for sesamum oil. In this test the suspected oil is treated with a small quantity of sugar (or furfuraldehyde) and some hydrochloric acid; if sesamum oil is present a crimson colour is imparted to the acid layer. This test is so easily carried out and so characteristic that it has been made compulsory in Germany, Austria and Belgium that margarine should contain a certain percentage of sesamum oil in order to render discrimination between margarine and butter a matter of ease, and so prevent the fraudulent substitution of the former for the latter.

The best grades of cold-drawn sesamum oil from the finer qualities of seed, such as that of the Levant, are used as cheap substitutes for olive oil in salad oil, either alone or in admixture with other oils, and for the preparation of margarine and vegetable butters. This quality of sesamum oil is included in the Japanese, Russian and other pharmacopoeias as a substitute for olive oil in medicine. It is also used in the extraction of perfumes by the enfleurage process. The lower qualities are chiefly employed in the manufacture of soap, and also as burning or lubricating oil. The present prices of sesamum oil at Marseilles vary from £28 to £45 per ton (in barrels) according to quality.

Composition and Uses of Sesamum Cake.

The press cake usually contains from 8 to 10 per cent. of oil, and is much used as a cattle food. In the following table of analyses its composition is compared with that of other feeding cakes in common use:—

	Moisture.	Ash.	Fat.	Protein.	Carbo-hydrates.	Crude Fibre.
	per cent.	*per cent.*	*per cent.*	*per cent.*	*per cent.*	*per cent*
Sesamum seed cake 1	7·20	12·25	17·80	35·88	22·44	4·43
,, ,, 2	8·45	11·00	11·07	40·29	24·02	5·17
,, ,, 3	7·30	16·25	15·03	32·25	24·27	4·90
Cotton seed cake, decorticated	9·00	7·10	11·38	43·78	23·56	5·18
,, ,, undecorticated	13·75	4·60	6·56	24·62	29·28	21·19
Linseed cake	11·16	5·20	9·50	29·50	35·54	9·10
Soy bean cake	12·70	5·05	11·07	38·82	26·51	5·85

Feeding experiments have been made recently with sesamum cake at the South-Eastern Agricultural College, Wye. It was found to be an excellent fodder of pleasant taste; the stock liked it and took up to 7 or 8 lb. a day per cow with no ill effects. It made the butter soft and white. No trace of sesamum oil was found in the butter, whereas butter from the milk of cows fed on cotton seed cake gave the cotton seed oil reaction within 24 hours after the cake feeding began.

Cake prepared from unsound or damaged sesamum seed is not fit for use as a cattle food but is employed as a manure after removal of almost all the oil by means of solvents such as light petroleum, or carbon disulphide.

The price of the cake at Marseilles varies from £5 15*s.* per ton for cake prepared from black Indian seed to about £6 5*s.* per ton for cake from white Levant or Indian seed.

FODDER PLANTS INDIGENOUS TO AUSTRALIA.

THE pastoral industry is of such vital importance to the welfare of the Australian Commonwealth that a study of the indigenous vegetation, upon which the millions of sheep, cattle and horses depend, is of paramount importance. A memoir describing the Australian grasses, salt-bushes and pasture herbs,

loose earth they penetrate it and gradually descend, sometimes for several inches. Land sown naturally in this fashion may have the top inch or two swept away by winds during the dry season, but the deeply placed seeds are unaffected and when rain falls they germinate quickly and a good pasture is rapidly formed. Those areas which have a hard, or clayey subsoil, however, do not quickly become covered with grass after the rains, for the surface soil is blown away and the seeds cannot penetrate the rock below, so that there are few, if any, naturally sown seeds to germinate. Such areas often remain barren for a very considerable time and are known as "scalded plains."

The more typical of the native grasses include *Anthistiria ciliata*, Linn.* (kangaroo grass), widely distributed over the whole continent, but more common in the coast districts than in the interior. This species is regarded as one of the most valuable of all the Australian grasses, but, owing to the small amount of seed matured, it is not so plentiful in many districts as formerly. The Mitchell grasses, of which *Astrebla triticoides*, F.O.M., is the most vigorous growing species, are found on the fertile plains over a great part of the interior, and many pasturalists and stockmen regard them as the best of all the native grasses, both for their drought-enduring qualities and for their feeding value. The seeds are like small grains of wheat, and at one time formed an important article of food for the aborigines. *Andropogon sericeus*, R. Br. (blue grass) often grows so abundantly on the fertile plains in the interior as to give a bluish appearance to large tracts of country. Next to the Mitchell grasses this species is the most favoured of all those found commonly in the interior. It is essentially a summer grass, and usually attains a height of two feet, but occasionally is taller. If cut when the flower stems first appear it can be made into excellent hay. *Danthonia semiannularis*, R. Br. (wallaby grass) occurs commonly both in the coastal areas and in the interior. It is plentiful on some of the high mountain ranges where snow falls occasionally, but seldom

* *Probably* Anthistiria ciliata, *Cav. ex Spreng. is intended; throughout this summary the botanical names, and the authorities for them, are given as in Mr. Turner's manuscript.*

exceeds six inches in height in such places, whereas under more favourable conditions it attains a height of three feet or more. Unlike most other Australian grasses, it grows more or less all through the year.

The useful grasses indigenous to Australia may be conveniently grouped as follows according to the purposes for which they are best suited:—

I. GRASSES SUITABLE FOR GENERAL PASTURE AND FOR HAY.

Agropyrum scabrum, Beauv.
Andropogon affinis, R. Br.
A. erianthoides, F.O.M.
A. intermedius, R. Br.
A. pertusus, Willd.
A. refractus, R. Br.
A. sericeus, R. Br.
Anthistiria ciliata, Linn.
A. membranacea, Lindl.
Astrebla elymoides, F.O.M. ex Bail.
A. pectinata, F.O.M.
A triticoides, F.O.M.
A. triticoides var. *lappacea*.
Chloris acicularis, Lindl.
C. truncata, R. Br.
C. ventricosa, R. Br.
Chrysopogon gryllus, Trin.
Cynodon dactylon, Pers.
Danthonia longifolia, R. Br.
D. pallida, R. Br.
D. pilosa, R. Br.
D. semiannularis, R. Br.
Dichelachne crinata, Hook.
Eleusine ægyptiaca, Pers.
Eragrostis brownei, Nees.
E. leptostachya, Steud.
E. pilosa, Beauv.
Eriochloa annulata, Kunth.
E. punctata, Hamilt.
Ischæmum pectinatum, Trin.
Microlæna stipoides, R. Br.
Panicum decompositum, R. Br.
P. distachyum, Linn.
P. divaricatissimum, R. Br.
P. effusum, R. Br.
P. flavidum, Retz.
P. gracile, R. Br.
P. leucophæum, H.B. et K.
P. macractinium, Benth.
P. melananthum, F.O.M.
P. mitchelli, Benth.
P. prolutum, F.O.M.
P. reversum, F.O.M.
P. trachyrhachis, Benth.
P. tulcumbense, Turner.
Poa cæspitosa, Forst.
Schedonorus hookerianus, Benth.

II. SPECIES SUITABLE FOR ENSILAGE.

Anthistiria avenacea, F.O.M.
A. frondosa, R. Br.
Danthonia robusta, F.O.M.
Glyceria dives, F.O.M.
Heteropogon insignis, Thw.
Panicum colonum, Linn.
P. crus-galli, Linn.
Paspalum galmarra, Bail.
Rottbœllia exaltata, Linn.
R. ophiuroides, Benth.
Sorghum fulvum, Beauv.
S. halapense, Pers.

III. SPECIES SUITABLE FOR CULTIVATION FOR GRAIN.

Anthistiria avenacea, F.O.M.
Astrebla triticoides, var. *lappacea*.
Eragrostis pilosa, Beauv.
Leersia hexandra, Swartz.
Panicum decompositum, R. Br.
P. flavidum, Retz.
P. semialatum, R. Br.
P. trachyrhachis, Benth.
Setaria glauca, Beauv.
S. macrostachya, H.B. et K.

IV. SPECIES THAT THRIVE ON WET OR UNDRAINED LAND.

Amphibromus neesii, Steud.
Arthraxon ciliare, Palis.
Chamæraphis spinescens, Poir.
Diplachne fusca, Beauv.
Elionurus citreus, Munro.
Glyceria fluitans, R. Br.
G. fordeana, F.O.M.
G. ramigera, F.O.M.
Hemarthria compressa, R. Br.
Imperata arundinacea, Cyr.
Isachne australis, R. Br.
Ischæmum australe, R. Br.
Leersia hexandra, Swartz.
Leptochloa chinensis, Nees.
L. subdigitata, Trin.
Panicum indicum, Linn.
P. melanthum, F.O.M.
P. proliferum, Lam.
Paspalum distichum, Linn.
P. scrobiculatum, Linn.
Pennisetum compressum, R. Br.
Phragmites communis, Trin.
Pollinia fulva, Benth.
Sporobolus diander, Beauv.
S. indicus, R. Br.
S. virginicus, Kunth.

V. SPECIES THAT DO WELL ON RIDGES AND VERY DRY SOILS.

Amphipogon strictus, R. Br.
Andropogon lachnatherus, Benth.
Anisopogon avenaceus, R. Br.
Arundinella nepalensis, Trin.
Chrysopogon parviflorus, Benth.
Deyeuxia quadriseta, Benth.
Echinopogon ovatus, Beauv.
Eragrostis chætophylla, Steud.
E. eripoda, Benth.
E. falcata, Gaud.
E. lacunaria, F.O.M.
E. laniflora, Benth.
Eriachne obtusa, R. Br.
Lappago racemosa, Willd.
Neurachne mitchelliana, Nees.
Panicum gracile, R. Br.
Pappophorum nigricans, R. Br.
Spinifex paradoxus, Benth.
Tetrarrhena juncea, R. Br.

VI. GRASSES FOR BINDING LITTORAL SANDS.

Distichlis maritima, Rafin.
Imperata arundinacea, Cyr.
Lepturus repens, R. Br.
Paspalum distichum, Linn.
Schedonorus littoralis, Beauv.
Spinifex hirsutus, Labill.
Sporobolus virginicus, Kunth.
Thuarea sarmentosa, Pers.
Zoysia pungens, Willd.

4 to 6 per cent. of fat, about 2·5 per cent. of protein, 10 per cent. of digestible carbohydrates, 3 to 4 per cent. of fibre and 5 to 10 per cent. of ash, of which about half is common salt.

It has been observed that sheep have been cured of fluke and other intestinal parasites when fed on herbage containing a high percentage of salt-bushes, and as a further recommendation the succulent stems and leaves assuage the thirst of browsing animals—a most important consideration in a country where water is scarce.

Two of the most important species are *Atriplex semibaccata*, R. Br., and *A. nummularia*, Lindl. The former is a perennial with slender, herbaceous stems spreading from one to two feet or more in a wild state, but under cultivation a single plant may cover a space 16 feet in diameter. Its roots penetrate the earth to a great depth, and thus enable the plant to withstand a long period of dry weather without its growth being seriously checked. The plant has been introduced into California, and has proved valuable for cultivation on alkali land.

A. nummularia is found under a wide range of climatic conditions; the ground in which the plant grows is sometimes covered with water in winter, and in summer it becomes parched and hard, yet the growth is not checked to any appreciable extent. It attains a height of 6 to 10 or even 15 feet, and is thus more suitable for growing on a cattle run than on a sheep station. The following salt-bushes also yield good fodder for stock:—

Atriplex angulata, Benth.	*Kochia aphylla*, R.Br.
A. cinerea, Poir.	*K. appressa*, Benth.
A. halimoides, Lindl.	*K. brachyptera*, F.O.M.
A. holocarpa, F.O.M.	*K. brevifolia*, R. Br.
A. leptocarpa, F.O.M.	*K. eriantha*, F.O.M.
A. limbata, Benth.	*K. lanosa*, Lindl.
A. muelleri, Benth.	*K. planifolia*, F.O.M.
A. rhagodioides, F.O.M.	*K. pyramidata*, Benth.
A. stipitata, Benth.	*K. sedifolia*, F.O.M.
A. vesicaria, Hew.	*K. villosa*, Lindl.
Chenopodium atriplicinum, F.O.M.	*Rhagodia billardieri*, R. Br.
C. auricomum, Lindl.	*R. hastata*, R. Br.
C. microphyllum, F.O.M.	*R. nutans*, R. Br.
C. nitrariaceum, F.O.M.	*R. parabolica*, R. Br.
Enchylæna tomentosa, R. Br.	*Sclerolæna paradoxa*, R. Br.

PASTURE HERBS.

The Australian pastures owe their richness to a very large extent to the many and varied herbs, which constitute a high percentage of the indigenous herbage. The most valuable are those with succulent stems or leaves, such as *Calandrinia balonensis*, Lindl., *Erodium cygnorum*, Nees, and *Trigonella suavissima*, Lindl. The following also provide feed for stock :—

Blennodia filifolia, Benth.
B. lasiocarpa, F.O.M.
B. nasturtioides, Benth.
B. trisecta, Benth.
Boerhaavia diffusa, Linn.
Daucus brachiatus, Sieb.
Geranium dissectum, Linn.
Gossypium sturtii, F.O.M.
Lavatera plebeia, Sims.
Malvastrum spicatum, A. Gray.
Marsilea drummondii, A. Br.
Plantago varia, R.Br.
Portulaca oleracea, Linn.
Psoralea tenax, Lindl.
Sida corrugata, Lindl.
Swainsona oroboides, F.O.M.
S. phacoides, Benth.
S. procumbens, F.O.M.
Tetragonia expansa, Murr.
Thlaspi cochlearinum, F.O.M.
Trichinium erubescens, Moq.
T. nobile, Lindl.

SHRUBS AND TREES.

Drought-resisting shrubs at one time covered large areas of land in Australia, and provided good feed for stock during the dry period, when more tender herbage was scarce. But although this shrubby vegetation was at that time so highly appreciated, and is still by many experienced pastoralists, no systematic attempts have been made to conserve it on a large scale, and cattle are allowed to denude the branches indiscriminately, often to the complete destruction of the plant. A simple method of conservation could be initiated by fencing, with rabbit-proof netting, some of the areas where the shrubs are still growing fairly plentifully, and allowing stock access to them only when the grass and herbs become scarce in the pastures. The more valuable of the Australian edible shrubs are :—

Acacia aneura, F.O.M.
A. sentis, F.O.M.
Cassia artemisioides, Gaud.
C. circinnata, Benth.
C. desolata, F.O.M.
C. eremophila, A. Cunn.
C. phyllodinea, R. Br.
Daviesia corymbosa, Sm.
D. latifolia, R. Br.
Dodonæa attenuata, A. Cunn.
D. lobulata, F.O.M.
Eremophila bignoniæflora, F.O.M.
E. longifolia, F.O.M.
E. maculata, F.O.M.

E. oppositifolia, R. Br.
Hakea leucoptera, R. Br.
Heterodendron oleæfolium, Desf.
Jasminum lineare, R. Br.
Marsdenia leichhardtiana, F.O.M.
Myoporum deserti, A. Cunn.
Pittosporum phillyræoides, D.C.
Sarcostemma australe, R. Br.
Trichinium obovatum, Gaud.

The edible trees, likewise, should be systematically conserved, since they not only yield valuable fodder in time of drought, but provide shelter for stock, and when fairly plentiful mitigate the scorching effects of hot winds on the more tender herbage, prevent excessive evaporation from the soil, and in a great measure prevent wind-storms from disturbing or removing the loose surface soil. The leaves and branchlets of the following trees provide feed for stock:—

Acacia doratoxylon, A. Cunn.
A. homalophylla, A. Cunn.
A. pendula, A. Cunn.
Angophora intermedia, D.C.
Atalaya hemiglauca, F.O.M.
Casuarina glauca, Sieb.
C. stricta, Ait.
C. suberosa, Ott. et Dietr.
Codonocarpus cotinifolia, F.O.M.
Eucalyptus corynocalyx, F.O.M.
E. gunnii, Hook.
Flindersia maculosa, F.O.M.
Fusanus acuminatus, R. Br.
Geijera parviflora, Lindl.
Grevillea striata, R. Br.
Myoporum platycarpum, R. Br.
Owenia acidula, F.O.M.
Sterculia diversifolia, G. Don.
Ventilago viminalis, Hook.

EXPORT TRADE OF THE SEYCHELLES.

In an article on "Agriculture in the Seychelles," published in this *Bulletin* in 1904 (1904, **2**. 269), it was pointed out that up to that time the Colony had been largely dependent on one industry, viz. the cultivation and preparation of vanilla. The fall in price of this flavouring agent, due in part to over-production and in part to its replacement by artificial vanillin, directed attention to the necessity of finding new products for cultivation in the islands, and in subsequent articles mention was made of the success which had followed efforts in this direction (*loc. cit.*, 1909, **7**. 394 and 1910, **8**. 413), and an account was given of the results of the examination and valuation of a number of these new materials at the Imperial Institute (*loc. cit.*, 1908, **6**. 107; 1909, **7**. 262).

for 1909. For information as to the composition of some of the Seychelles guanos see this *Bulletin* (1908, **6**. 122; 1911, **9**. 39).

Vanilla, which was formerly the chief export of the Colony, now occupies the third place, the quantity shipped in 1910 being 26 tons, worth Rs. 450,289, whereas in 1904 41 tons, worth Rs. 300,026, were exported. It is not expected that the higher prices now realised will last. The droughts of recent years in the Seychelles have destroyed the vanilla orchids in the low country, and it seems probable that in the future, vanilla cultivation will be limited to a comparatively small area in the moist mountain zones. The Governor considers that it would not now make a vital difference to the Colony if the vanilla industry were entirely eliminated.

The export of soap (138 tons, valued at Rs. 60,011) shows a decline as compared with 1909, but on the whole the trade in this article is stationary. There is a small and remunerative local market for soap in neighbouring Colonies, which is not likely to expand.

Tortoiseshell is likewise stationary, having been exported to the value of Rs. 37,515 in 1910. Experiments on the artificial rearing of young carets are now in progress, and if the various obstacles are overcome the supply of tortoiseshell will not only be increased, but will be rendered certain, instead of being, as at present, merely a chance product of the sea.

The quantity of mangrove bark exported was 531 tons, valued at Rs. 16,497, the price being much higher than in 1908, when 692 tons were shipped, valued at only Rs. 6,965. In 1909 very little was exported. The chief market for the bark is Hamburg, the red colour of the leather obtained by the use of this bark preventing its being taken up by the London market. The development of this trade must for the present be capricious, as the forests are in the hands of a single lessee, and there is a special difficulty in organising labour parties to collect the bark owing to tidal action in the lagoons (*loc. cit.*, 1908, **6**. 121).

The trade in essential oils (derived from cinnamon bark, clove leaves, ylang-ylang, lemon-grass and citronella) is still capable of expansion, only 486 litres, valued at Rs. 2,268, having been exported in 1910. The labour and care required in this industry are considerable, and profits are at present too easily earned by other means to make it attractive. As pointed out in a previous number of this *Bulletin* (1909, **7**. 396), it has so far proved more profitable to export cinnamon bark from the Seychelles than to distil the bark locally for cinnamon oil, and in 1910 731 tons of this bark, valued at Rs. 50,443, were exported, as compared with 1,044 tons, valued at Rs. 72,574, in 1909. The bark is still derived mainly from old trees, which are practically wild, and as these are cut down after "peeling," the stumps throw up shoots which furnish a better quality of bark. The leaves from the felled old trees are distilled to some extent for the manufacture of cinnamon-leaf oil.

The export of calipee has now acquired some importance, and amounted to 12¾ tons, valued at Rs. 42,449, in 1910. Other smaller items of interest were cloves (Rs. 4,463), turtle bone dust (Rs. 2,500), coco-de-mer (Rs. 1,648), and vacoa mats (Rs. 1,384). It is considered that there is room for considerable development in the export of fruit, either fresh or dried, and it is of interest in this connection to note that dried bananas appear in the list of exports (1·75 tons, valued at Rs. 627).

GENERAL NOTES.

Imperial Institute Handbooks on Tropical Resources.—The Secretary of State for the Colonies has authorised the preparation of a series of handbooks to be known as "The Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with special reference to British West Africa." The series will be edited by the Director of the Imperial Institute, and will be published by Mr. John Murray, Albemarle Street, London, W. The handbooks will include volumes on cotton and other fibres, rubber, cocoa, oil-seeds, tobacco, etc., and will be written in language as non-technical as possible. They will be compiled with special reference to the needs of Government officials, tropical agriculturists and merchants, and of manufacturers and others in this country who are interested in tropical raw materials, especially those derived from West Africa.

The first volume of the series is now published on *The Agricultural and Forest Products of British West Africa*, by Mr. G. C. Dudgeon, lately Inspector of Agriculture for British West Africa and now Director-General of Agriculture in Egypt. This gives a general account of the agricultural and forest resources of the Gambia; Sierra Leone; Gold Coast, Ashanti and the Northern Territories; Southern

Nigeria and Northern Nigeria. Each of these countries is described, information being given as to the character and habits of the native population, the climate and soil, the conditions of land tenure and statistics of exports. The principal crops and forest products of each country are then dealt with, the methods of cultivation and preparation adopted being described.

The volume, which is published at 5*s*. net, is provided with coloured maps of the several countries described, and also contains a large number of photographs illustrating the chief crops and typical native industries of British West Africa.

Report on the Work of the Imperial Institute, 1910.—This report, giving a summary of the work done for the Dominions, Colonies, Protectorates and India during 1910, has now been presented to Parliament and issued as No. 687 of the Annual Series of Colonial Reports [Cd. 5467–23].

Mineral Surveys.—During the last few years Mineral Surveys have been conducted in connection with the Imperial Institute, in Ceylon, Southern Nigeria, Northern Nigeria and Nyasaland. Surveyors, appointed on the recommendation of the Director of the Imperial Institute, carry on mineralogical exploration in these Colonies and Protectorates, especially with a view to the discovery of their economic mineral resources. The minerals collected are sent to the Imperial Institute, where they are examined and their commercial value ascertained. The following reports by the Director of the Imperial Institute describing the recent work done in connection with three of these Surveys have been published recently :—

SOUTHERN NIGERIA.—The report on this Survey during 1908–9 is published in Colonial Reports, Miscellaneous Series, No. 81 [Cd. 5901]. The economic results obtained in 1908–9 were of great importance and added very considerably to our knowledge of the mineral resources of this Protectorate. New deposits of lignite were located in the Newi district, and of bituminous coal in the Udi district. In view of the construction of new railways in West Africa, these discoveries of useful fuel are of great importance. Special attention was paid during the year to deposits of limestones and clays, and a number of beds of these materials suitable for cement manufacture were located.

NORTHERN NIGERIA.—A report on the results achieved by this Survey during 1907–8 and 1908–9 has been published as No. 79, in the Miscellaneous Series of Colonial Reports [Cd. 5899]. The chief results obtained during 1907–8 were the location of important deposits of iron ore, near the junction of the Niger and Benue rivers and at other places in the Protectorate; and the discovery of pegmatite containing 20·5 per cent. tinstone in the stream-gravels and scattered as blocks on the hillside in the Eri district. Tinstone was also found in considerable quantity in concentrates from streams in the Ningi district.

found that the processes available for the estimation of the alkaloid codeine in opium are untrustworthy, and a new process has been devised, which was described by Mr. A. E. Andrews of the Scientific Staff of the Imperial Institute in a paper communicated recently to the Society of Public Analysts (*Analyst*, 1911, **36**. 489).

The process depends on the successive purification of an aqueous extract of opium (1) by means of lead acetate to remove extractive and colouring matters and the alkaloid narcotine, (2) by the addition of sodium salicylate to remove resinous matter and the alkaloid thebaine, and (3) by extraction with ether. Finally the concentrated, purified extract is made strongly alkaline to retain morphine, while the codeine is extracted by ether.

Lophira alata Seed Oil.—An account of the characters and commercial value of the fat contained in the seed-kernels of *Lophira alata*, Banks, from Sierra Leone and the Sudan, has been given in a previous volume of this *Bulletin* (1908, **6**. 243, 366). A detailed investigation of the chemistry of the fat has now been made in the laboratories of the Imperial Institute, by S. S. Pickles, D.Sc., and W. P. Hayworth, F.I.C., and an account of the results obtained has been recently communicated to the Society of Public Analysts (see *Analyst*, 1911, **36**. 493). The composition of the mixed fatty acids was found to be approximately as follows: Saturated (solid) acids 50 per cent., consisting of arachidic acid (m.p. 77·5°C.), palmitic acid (m.p. 62·5°) and probably a small quantity of an acid with a lower melting point; unsaturated (liquid) acids 50 per cent., consisting of about equal parts of oleic and linoleic acids.

Para Rubber Seed Oil—The subject of the industrial application of the seeds of the Para rubber tree (*Hevea brasiliensis*) was dealt with in a previous number of this *Bulletin* (1911, **9**. 35), when attention was again drawn to the fact that the seeds yield a liquid drying oil very similar in properties to linseed oil (see also this *Bulletin*, 1903, **1**. 156; 1904, **2**. 22). An investigation of the constituents of the oil has since been made by Messrs. Pickles and Hayworth in the laboratories of the Imperial Institute, and the results have been communicated to the Society of Public Analysts (see *Analyst*, 1911, **36**. 491). The oil used in this investigation was extracted in this country from the kernels of undecorticated seeds. The kernels yielded 48·8 per cent. of oil, which was pale-yellow in colour, liquid at ordinary temperatures, and dried to a hard varnish in about 12 days on exposure to air. On examination the oil was found to have the following constants:—

Specific gravity at 15°/15° C.	0·9239
Acid value	29·9
Saponification value	185·6
Iodine value, *per cent.*	133·3
Titer test	33°C.
Hehner value, *per cent.*	96·4
Reichert-Meissl value	0·5

The composition of the mixed fatty acids was found to be as follows: Saturated (solid) acids 14 per cent., consisting of stearic acid (m.p. 69°C.) and an acid or mixture of acids (m.p. 56·5°C.); unsaturated (liquid) acids 86 per cent., consisting of oleic acid 32·6 per cent., linoleic acid 50·9 per cent. and linolenic acid 2·5 per cent.

Camphor Cultivation in German East Africa.—In a previous number of this *Bulletin* (1907, **5**. 186) an account was given of the results of examination of camphor oil produced experimentally at Amani, and more recently the results of distillation trials carried out at the same centre have been referred to (1910, **8**. 287). These experiments have been continued, and in a recent issue of *Der Pflanzer* (1911, **7**. 133) the results of investigation of crude and steam-distilled camphors as well as of camphor oil, produced at the Biological-Agricultural Institute, Amani, are given.

A firm of drug importers in Germany to whom the samples were submitted reported that the crude camphor was rather impure, but if more carefully prepared it would fetch about the same price as crude Japanese camphor. It was regarded as being suitable for the manufacture of celluloid. The steam-distilled camphor still contained 15·7 per cent. of impurities, chiefly water, and it is stated that it would probably be more profitable to export the crude material than to re-distil it locally.

The camphor oil contained 48 per cent. of camphor and was valued at 120 marks per 100 kilos., with "light Japanese" camphor oil at 70 marks per 100 kilos.

Heveas in West Africa.—In a note on this subject in a previous number of this *Bulletin* (1910, **8**. 183) attention was drawn to a statement by M. Yves Henry that the results of experiments conducted at Porto Novo indicated that *Hevea Spruceana* is more suitable than *Hevea brasiliensis* for cultivation in West Africa. M. Henry claimed that this conclusion was supported by the results of tapping experiments made in Lagos and in the Gold Coast.

It has since been proved, however, that the supposed *Hevea Spruceana* trees at Ebute-Metta in Lagos do not belong to that species, but are a form of *Hevea brasiliensis* (*loc. cit.*, p. 342).

Recently, at the request of the Imperial Institute, flowering specimens of the supposed *Hevea Spruceana* trees at Aburi in the Gold Coast were forwarded to this country for identification. These specimens have been submitted to the Royal Botanic Gardens, Kew, and have also been pronounced to be *Hevea brasiliensis*, Müll. Arg.

It is thus established that the supposed *Hevea Spruceana* trees at Ebute-Metta and at Aburi are really *Hevea brasiliensis*, and as the trees at Porto Novo were obtained from Ebute-Metta there seems little doubt that they also are a form of the same species.

M. Henry's view regarding the value of the two species of Hevea therefore appears to have been founded on erroneously named specimens.

Sakellaridis Cotton.—A new form of cotton has recently been established in Egypt, which is known by the name of the discoverer, M. Sakellaridis, who found the plant about six years ago among a crop of Mitafifi on his estate at Birket-el-Sab in the Gharbia Province. It is stated that this cotton matures earlier than Mitafifi, and that it flourishes in those districts in which Mitafifi is usually grown but which are unsuitable for Yannovitch. The new variety was grown in 1910 on a fairly large scale in several places in the Gharbia and Sharguiia Provinces.

A sample of Sakellaridis cotton has been forwarded to the Imperial Institute by the Director-General of Agriculture in Egypt, and has been examined with the following results. The cotton was soft, silky, lustrous, cream-coloured with a faintly reddish tinge, of good strength, and about 1·4 to 1·7 inches long. It was of excellent quality, being regarded by experts as superior to the best Egyptian Yannovitch, and was valued at $14\frac{1}{2}$*d.* per lb. (with "fine" Yannovitch at $13\frac{7}{8}$*d.* per lb.). The fibre was finer and more silky than that of Yannovitch, and was slightly paler in colour.

Timber Industry of German East Africa.—In the previous number of this *Bulletin* (this vol. p. 146) reference was made to the fact that cedar wood from German East Africa is now being marketed regularly in Hamburg. This information may be supplemented by the following summary of an article by Mr. D. E. Hutchins in the *Agric. Journ. British East Africa* (1910. **3**. 258) which gives details of the area, known as the Wiese Forest, which is being worked for this and other timbers. The two timbers specially referred to, viz. pencil cedar and yellow-wood, are abundant in British East Africa, and their working qualities were determined and their commercial values ascertained at the Imperial Institute nearly seven years ago (this *Bulletin* 1906, **4**. 15).

The Wiese forest includes a timber grant of some 36,000 acres on the Western Usambàra mountains with a central station at Neu Hernow situated at an elevation of 6,306 feet. Connecting Usambàra with Tanga, the port of shipment, is an up-country railway that is being extended to Moschi, on the slopes of Kilimanjaro. In the neighbourhood of Tanga and for many miles along the railway are plantations of Ceará rubber (*Manihot Glaziovii*), Sisal hemp (*Agave americana* var. *sisalana*), teak (*Tectona grandis*), the latter not a success, coffee, cotton and sugar.

At Nsambàra, a small station on the Usambàra railway, is the terminus of a rope-way that connects the station with the top of the Usambàra mountains, some six miles distant, for the transport of timber. Plant for the preparation of timber for export has been installed at Neu Hernow.

The composition of the forest is similar to that of the forests of

question; that is to say, on the physical side to the nature of the soil particles as regards size, coherence, water-holding power, capacity for heat, etc.; and on the chemical side to the composition, especially as regards nitrogen, phosphorus, potassium and calcium, and the proportion of these that is available for absorption by the plant. Comparatively recently the biological aspect has begun to be studied, that is, the influence of low forms of plant and animal life in aiding or retarding the growth of crops.

In 1877 it was shown that the formation in the soil of the nitrates necessary for the growth of plants was the work of living organisms, later identified as bacteria, and since then soil bacteria have been closely studied. In the last few years much attention has been given to the fact noticed in earlier years, that if the soil is partially sterilised, either by heating or by the action of antiseptics, its fertility is greatly increased, and a great deal of experimental work has been done to discover the cause. This work has shown that the action is not a chemical one, but is due to the fact that after partial sterilisation certain of the bacteria multiply more rapidly and reach far higher numbers than in the untreated soils. The explanation of this is given by Russell and Hutchinson (*Journ. Agric. Science*, 1909, **3**. 119). In the soil there are present certain organisms, probably protozoa, which prey upon the bacteria and keep their numbers in check, so that equilibrium is established. If the soil is heated to 98° or is treated with toluene these organisms are killed, but bacterial spores survive and soon multiply to a much greater extent than before, now that their enemies are removed; consequently the decomposition of the organic matter goes on at a faster rate, and there is an increased supply of ammonium compounds, resulting in an increased growth of the crop. The nitrate-producing bacteria are exterminated by the sterilisation process, but the authors state that the ammonium compounds produced by the remaining bacteria can replace nitrates as a source of plant food.

These discoveries suggest an explanation of observations frequently made at Pusa (*Ann. Rep. Board of Scient. Advice for India*, 1909–10, p. 107), that hot-weather cultivation of wheat lands leads to a greatly increased yield in the following spring, and also to improvements in the milling qualities of the grain. The intense heat and dryness of the weather has a sterilising effect on the soil, and, as in Russell and Hutchinson's experiments, a luxuriant growth is obtained in the subsequent crop. It is believed that by a combination of hot-weather cultivation and occasional green manuring, the crop production of the Indo-Gangetic alluvium can be greatly increased, and that a great field for future work on agricultural improvement has been opened up.

Replacement of Cotton by Sugar-cane.—It is stated that a movement is contemplated in some parts of the United States to substitute the cultivation of sugar-cane for that of cotton, and the advantages and disadvantages of the change are discussed in the *Journ. d'Agric. Tropicale*

(1911, **11**. 104). Not only the increasing damage done by the boll-weevil but also the prospects of a greater profit seem to be the motives for the change. In Louisiana, in a good year the maximum yield of ginned cotton is 350 lb. per acre, and a yield of 300 lb. is considered satisfactory. At 10 cents per lb. this gives a gross return of $35 per acre. In the case of the sugar-cane 25 tons per acre are obtained in a good harvest: this, valued at $4 per ton as ready to be loaded, comes to $100. Thus sugar-cane appears much the more profitable crop, but it must be borne in mind that the presence of a sugar-factory within a reasonable distance is essential, and that the sugar factory involves a large capital outlay and also must be sure of an adequate supply of cane in order to yield a profit. On the other hand, the ginning and baling machinery required to deal with the cotton crop represents only a small amount of capital.

Sils.—The deficiency of certain soils of Victoria in phosphoric acid is discussed in the *Journ. Dept. Agric., Victoria* (1911, **9**. 71). As a general rule these soils do not contain more than 0·06 per cent. of phosphoric acid, and the difference between the surface soil and subsoil is not so marked as is the case in Europe and America The quantity of potash is usually large, averaging from 0·2 to 0·4 per cent., whilst nitrogen is about 0·1 per cent. The chemical examination of a number of herbs and grasses which are characteristic of these soils, showed that they contain only about one-tenth of the quantity of phosphoric acid usually found in forage plants. It is suggested that this low percentage is responsible for the diseases known as "cripples" and "coast disease" which affect animals fed for long periods on the pastures of this region.

Analyses of certain soils from Tamana, on which "Boçare immortel" is grown, but is gradually dying, are given in the *Bull. Dept. Agric., Trinidad* (1910, **9**. 237). The most notable features of the analyses are the deficiency in phosphoric acid and potash, and the very high percentage of lime.

Analyses of a number of typical forest soils are given in the *Journ. Industr. and Engin. Chem.* (1911, **3**. 246). These analyses indicate that such soils are well supplied with the mineral constituents necessary for plant nutrition, especially phosphoric acid. The soils as a whole are rather acid, although substantial quantities of calcium are present, and would benefit by the application of ground limestone.

The occurrence of barium in soils is considered in *Bull. No. 72, Bur. Soils, U.S.A. Dept. of Agric.* (1910). From the results of analysis it was found that the quantity of this element present in soils from the great plains never exceeded 0·11 per cent. and averaged 0·06 per cent. Soils from numerous other localities in the United States showed small and variable amounts of barium. Methods for the estimation of barium in soils are given.

Manures.—The following analyses of oil-cakes, not generally utilised as manures, are given in the *Ann. Rep. Dept. Agric., Bombay*, 1909–10.

	Nitrogen *Per cent.*	Potash *Per cent.*	Phosphoric acid *Per cent.*
Calophyllum inophyllum seed . .	3·7	1·5	1·7
Safflower seed	8·1	0·9	1·0
Salvadora persica seed	4·8	2·8	1·0

FOOD STUFFS.

General.—Numerous field experiments with different varieties of oats, maize, barley and wheat are described in the *Sixth Ann. Rep.*, 1909–10, *Agric. Dept.*, *Orange Free State.* The results are of interest as indicating the best varieties for sowing.

Maize.—In Southern Nigeria much damage is done to maize crops by two classes of insects: (1) the grain weevils, *Calandra oryzæ* and *C. granaria*, and (2) lepidopterous larvæ of the family Noctuidæ. It is quite rare to find a ripe cob free from attack. Remedial measures against these pests are given in a *Preliminary Report on Insects affecting Maize in Southern Nigeria*, Lagos, 1910. The weevils are the same as those causing damage to stored grain all over the world. They are not generally considered as pests of the growing crop, but in Southern Nigeria they undoubtedly are. They are never found in green unripe corn, but as soon as it begins to ripen the weevils appear in large numbers, eating the grain under the protection of the leaves which enfold the cob. To eradicate this pest it is recommended that (1) corn should be picked as soon as possible; (2) when picking, weevils and lepidopterous larvæ be searched for and killed, to prevent further damage; and (3) all stubble be burnt or buried deep in the soil. Greater activity and interest on the part of the native farmers are urged, not only to procure an increased export of maize, but to prevent insect pests assuming such overwhelming proportions as to reduce the cultivation to an unprofitable enterprise.

Wheat.—The Home-Grown Wheat Committee of the National Association of British and Irish Millers published in 1908 a summary of the results of their work since the institution of the Committee in 1901, on the improvement of the milling value of English wheat. It was then found that as a rule "strong" foreign wheats when grown in England lost their strength. Among the few exceptions "Fife Wheat" was pre-eminent for the retention of its strength. A recent report (July 1911) of the same Committee for the cereal years 1909 and 1910 confirms these results. New varieties of wheat from Australia, India, South Africa, Hungary, Sudan, Russia and Canada yielded but poor results when grown on English soil. On the other hand, the work of Mr. A. E. Humphries on "White Fife" has met with great success. Starting on the assumption that "White Fife" might be the offspring of two varieties, both of which would be strong if grown in Canada,

said to be useless, and the only method of prevention is by the selection of immune varieties. The precautions to be taken in selecting a suitable variety are described, and atmospheric temperature as a factor in seasonal immunity is considered. For an account of experiments on the breeding of rust-resistant wheats in S. Africa, see this *Bulletin* (1910, **8**. 140).

Rice.—The system of inundation introduced into the Krian district is, on account of insufficient control over the quantity of water provided, a doubtful advantage to the rice-grower (*Bulletin No.* 12, 1911, *Dept. Agric. Fed. Malay States*). All diseases of the rice plant are regarded by the Malays as due to "worms," but many of the losses are due to indiscriminate flooding. There are many undrained tracts of land in Krian which become water-logged and sour, and where only the top inch or so is available for rice, which consequently cannot secure a firm hold. In such areas thorough drainage of the soil is necessary. The Malay, basing his calculation on the inexhaustibility of his land, plants rice year after year, without aërating the soil or otherwise improving it. According to the system in vogue the land is under water for seven or eight months, and only one crop of rice is raised. By more modern methods of cultivation two crops per annum could be produced. It is pointed out that if the Malay is left to make the first move towards improved cultivation, the land is likely to become so impoverished that manuring will be necessary to ensure a fair return.

Potatoes.—The *Annual Report*, 1909–10, *Dept. Agric.*, *Bombay Presidency*, contains the results of experiments on storing potatoes to protect them from the ravages of the "potato moth" (*Lita solanella*). The potatoes may be attacked either when exposed in the field or when heaped in the store. The moth lays its eggs in the "eyes" of the potato, and the caterpillars which hatch out, rapidly penetrate the tissue and destroy it. The preventive measures suggested include (1) preliminary treatment to destroy the eggs or caterpillars, and (2) proper storage to exclude subsequent attack. The most effective preliminary treatment proved to be fumigation for 24 hours with petrol, at the rate of 4 oz. per 16 cubic feet of space. Fumigation with benzene was also found satisfactory. Steeping in kerosene did not give such good results. After fumigation the tubers should be stored in sacks, care being taken to turn them out at intervals of three weeks and to remove diseased ones. A more successful but less practical method is to spread the potatoes on racks in an insect-proof room. Storage between sand or straw proved very unsatisfactory.

Banana flour.—The *Annual Report*, 1909–10, *Dept. Agric.*, *Bombay Presidency*, states that an attempt has been made to find an outlet for banana or plantain flour, but so far without success. Growers offered to supply the material, and a sample of flour proved on analysis to be of very good quality, but no market could be found for it.

Cocoa.—In *Circular* No. 1, May 1910, *Bd. Agric.*, *Trinidad*, a full description is given of the life and habits of the cacao beetle. Various preventive measures are recommended, the most successful being to drive the beetle, by means of lead arsenate spraying, from the tree to suspended blocks of some wood of which it is very fond. These decoys are then collected and burnt. "Chataigne Maron" (*Pachira aquatica*, Aubl., N. O. Malvaceæ), the principal trapwood recommended, is obtainable everywhere in Trinidad, and the tree can be easily grown. In order to destroy the eggs inserted in the bark, and which develop into grubs that move along tunnels inside the branch, the epidermis in a suspected region is shaved off with a knife, and the eggs or worms removed. For the destruction of developed grubs carbon disulphide is injected into the borings. It is pointed out that the co-operation of all estate owners in dealing with this pest is essential to its destruction.

In an account of the cacao-thrips (*Heliothrips rubrocinctus*, Girad.), it is shown (*Cacao Thrips*, issued February 24, 1911, *Board Agric.*, *Trinidad*) that this pest cannot be disregarded by the planter, as in certain parts of Trinidad it is on the increase and occasionally does damage. Should it become troublesome, spraying with an emulsion of kerosene 2 gallons, water 1 gallon and hard soap ½ lb., is recommended. The spraying must be done thoroughly on both surfaces of the leaves, and under a pressure of about 150 to 200 lb. Fumigation by green-wood fires was recommended in the *Govt. Gazette*, *Grenada*, December 31, 1902, but its efficiency in an open field is regarded as doubtful. In severe attacks by this pest the leaves are so seriously injured that they drop off, and a so-called "change of leaf" occurs, with the result that all the young pods wither. Large numbers of cashew trees should not be allowed to grow near cocoa, as they are favourite food-plants of the thrips.

Guavas.—An account of the cultivation of this fruit near Poona and in the Sátária District is contained in *Bulletin No.* 40 (1911), *Dept. Agric.*, *Bombay*. The cultivation is started in seed-beds at the end of the fruiting season, and the seedlings planted out in the following June. Regular watering till the plants are established is essential. Though the plants may bear in the second and third years, the first crop worth marketing is that of the fourth year. The white guava is preferred to the red variety on account of its sweeter taste and better keeping properties. After fifteen years the quantity and quality of the fruit deteriorate, but some cultivators maintain a paying plantation for thirty or forty years by means of heavy manuring.

FODDERS.

The question of rations is discussed in an article on the feeding of animals in the *Sixth Annual Report*, 1909–10, *Dept. Agric.*, *Orange Free State*. The requirements of a satisfactory ration are dealt with and the method of arriving at the nutritive value of a feed explained. It is shown that the ideal ration has a narrow nutritive ratio (ratio of proteins to carbohydrates), as instanced by milk (1 : 4); also that bran (1 : 3·7) and oats (1 : 6) are preferable to maize (1 : 9·7) for the production of milk or as foods for young animals.

Leaflet No. 74, *Board of Agriculture and Fisheries*, *United Kingdom*, entitled, "The Composition and Properties of Concentrated Feeding Stuffs," first issued in 1902, has been re-written (March 1911). The object of the leaflet is to guide the farmer in the purchase of feeding stuffs. It explains the functions of the various constituents of a fodder, and describes, the composition being known, the method of determining the amount of digestible matter present, and its productive value. With these details available it is shown how the rations required by the various kinds of farm stock should be made up, and hence what feeding stuffs should be bought. The digestibility and manurial values of thirty of the commoner feeding stuffs are given, the most important of which are also discussed separately.

The *Journ. South-Eastern Agric. Coll.*, *Wye*, No. 19 (1910), contains an account of an exhaustive inquiry carried out by the College in Surrey and Kent on the cost of feeding in the production of milk. It states that the chief factor contributing to a high cost of food per gallon of milk are the excessive amounts of long hay and roots fed. As regards the former, where more than 15 lb. is fed per day, it would materially reduce the cost to replace half of it by oat-straw, and the change would have practically no effect upon the milk-yield. The more extensive use of chopped or chaffed hay would also tend towards economy. As regards roots, it was found that 13 farms fed on the average more than 100 lb. of mangel per milking cow per day. There is nothing to show that such a large quantity is necessary; a smaller quantity, 40 lb. to 70 lb., would give more satisfactory results.

It is suggested (*Ann. Rep.*, 1909–10, *Dept. Agric.*, *Bombay*) that the seeds of *Crotalaria juncea*, which contain 35 per cent. protein, might be used as a feeding stuff. Though the taste is slightly objectionable, dairy cattle were successfully fed with this material at the Government Farm.

OILS AND SEEDS.

Ground-nuts.—The area under this crop in the Bombay Deccan has diminished considerably since 1895, owing to various causes, such as prevalence of the "Tikka" disease, unfavourable seasons, deterioration of seed, lack of manure, and cultivation without proper rotation of crops (*Bull. No.* 41, *Dept. Agric.*, *Bombay*, 1911). The *Bulletin* discusses the causes and the remedial measures necessary, and records the results obtained with a number of imported varieties. The latter have been found generally to give better yields than the local variety. They ripen more rapidly, and have consequently the advantage of not

Bœrl. (N.O. Polygalaceæ), which is known to the natives of Palembang as "Sioer" seed. Grimme (*Chem. Rev. Fett. u. Harz. Ind.*, 1911, **18**. 125) compares Gorter's analyses with his own previous work on "boca sioer" seed, the botanical identity of which was unknown to him. According to Gorter (*loc. cit.*) the seeds contain 39·2 per cent. of fat, which resembles "tangkawang" fat, and which could be used for the same purposes. The residual cake contains a poisonous saponin, and it could therefore only be used as a manure, for which purpose it would not be very valuable on account of the small amount of proteins present. Large quantities of the seed are stated to be available.

The seeds of the Palo-Amarillo rubber tree (*Euphorbia elastica*) of Mexico yield an oil which is said to be suitable for soap manufacture (*Apoth. Zeit.*, 1910, 1014): the residual cake is stated to form a valuable cattle food, on account of the large amount of proteins present.

In the course of an article dealing with various oil seeds occurring in French West Africa, Hébert (*Les Matières Grasses*, 1911, **4**. 2252) calls attention to the seeds of *Saccoglottis gabonensis* (syn. *Aubrya gabonensis*, Baill., N.O. Humiriaceæ). These are rich in oil, but are enclosed in a hard shell and only constitute a small proportion of the weight of the fruit, so that it would be useless to attempt to exploit them as a source of oil. Hébert also publishes (*ibid.*, 1911, **4**. 2159) the results of an investigation of the fat of *Pentadesma butyracea*, Sabine (N.O. Guttiferæ). His analysis of the fat does not agree with analyses made at the Imperial Institute, and his statement that the fatty acids consist of 90 per cent. saturated acids and only 10 per cent. of unsaturated acid, consisting of oleic acid, cannot be reconciled with the iodine value of the fat, viz. 68·5.

Kapok seed from Venezuela has been found (*Bull. Econ. de Madagascar*, 1910, **10**. 113) to contain 18·8 per cent. of oil, ordinary kapok seed from Java containing 24·8 per cent. On being twice pressed in the cold, the seed yielded 14 per cent. of oil, the usual yield on a manufacturing scale from Java seed being 17·8 per cent. The residual cake contained 31·3 per cent. of proteins and 20 per cent. of fibre, and would form a nutritious cattle food if prepared from decorticated seed. It has been recommended that attempts be made to acclimatise the tree in Madagascar.

RUBBER.

(1) *Rubber Plants.*

Castilloa spp.—The *Bull. Dept. Agric., Jamaica* (1911, **1**. 253) contains an account of the proceedings of the Conference on Castilloa rubber held there in January 1911. The identity of the Castilloa species at present growing in Jamaica was dealt with by W. Harris, who, after giving an historical survey of the introduction of rubber trees into the island, concluded that the majority of the older Castilloa trees in Jamaica are *C. guatemalensis*, Pittier. It is also considered probable that some of the trees recently raised from seed are *C. elastica*, Cerv., and *C. costaricana*, Liebm. (see this *Bulletin*, 1911, **9.** 163). One of the trees identified as *C. guatemalensis* growing at Burlington in Portland, estimated to be 23 years old, recently yielded 4 lb. 6 oz. crude rubber and 7 oz. scrap in one tapping. Two large trees of the same species growing at Castleton gave 4 lb. rubber in 5 tappings. Further particulars of yields were given, and the opinion was expressed by L. Wates that 3 or 4 tappings per year will be the maximum desirable, and that, when 10 years old, the tree should be 45 inches in girth and yield 4–5 oz. of rubber at the first tapping. He considers that 225 lb. rubber per acre per annum can reasonably be expected from 9-year old trees. The "Thompson" tapping tool was generally recommended by members of the conference for Castilloa trees.

In a report to the Board of Agriculture, Trinidad, H. S. Smith gives an account of the Castilloa rubber industry of Mexico. It is a record of observations made during a recent tour, the object of which was to study and compare the methods of cultivation in Mexico with those in vogue in Trinidad. The conclusions arrived at are that (1) the Castilloa grown in Trinidad is the same as that cultivated with success in Mexico; (2) the climatic and economic conditions are equally favourable; (3) in all probability the yields of rubber from 10 to 12-year old Castilloa trees (*e.g.* 2 lb. per tree) have been overstated, everything indicating that the average is more nearly ½ lb. per tree; (4) by tapping on the Mexican plan, higher up the tree, the yields in the West Indies can be considerably increased, and, by adopting modifications of the Mexican methods of tapping and collecting, the cost of production reduced; (5) the proportion of resin in rubber from trees of similar ages is the same in both places.

The "Rubber Plantations of Mexico" is the subject of an article in *La Chronique Coloniale* (1911, **8.** 109). Apart from the figures indicating the progress of the rubber industry in the State of Chiapas few facts of general interest are given. One statement worthy of note is that it has been proved by experience that Castilloa trees 3 to 4 years old give the best seeds for reproduction.

Ficus spp.—The acclimatisation of *Ficus elastica* and of *F. magnolioides* in Sicily is of interest, though probably of little economic importance. Experiments made with *F. elastica* in the Botanic Gardens at Palermo by Prof. Borzi (*Le Caoutchouc et la Gutta-percha*, 1911, **8.** 5144) are said to have yielded satisfactory results. A sample of raw rubber obtained from the Sicilian trees contained 74·43 per cent. pure caoutchouc.

Funtumia spp.—The *Southern Nigeria Gazette* (1911, **6.** No. 17) contains particulars of the Native Council Rules relating to the tapping of rubber trees in the various districts of Southern Nigeria. They have for their aim the protection of the trees and the promotion of rational methods of tapping, collection and preparation of rubber. The more important of the regulations are the following: No tree shall be tapped at a greater height than 10 feet from the ground; the trees must have a girth of at least 18 inches and must be tapped on the full herring-bone system, the incisions to extend not more than half-way round the tree; no tree must be tapped later than 8 a.m. nor oftener than once per annum; the rubber must be collected in clean basins or calabashes, and be manufactured into biscuit form only.

An account of the more important insect and fungoid diseases that attack Funtumia is given in an article in *Tropical Life* (1911, **7**. 92). Amongst the insect pests are the larvæ of a moth, probably *Glyphodes ocellata*, which attack the leaves of the plant and bring about defoliation. Spraying with Bordeaux mixture has been found an effective treatment. More serious are the attacks of "girdling beetles" (Cerambycides), which feed on the bark of young stems; the larvæ of the beetle attack the roots of the plant. White ants (*Termes Gestroi*) also attack Funtumia trees; destruction of their nests, either by digging out or by treatment with kerosene or hot water, is advised. The fungoid diseases include "stem disease," caused by *Nectria funtumiæ*, "root disease" (*Hymenochæte* sp., probably *noxia*) and leaf fungus (*Meliola* sp.). Another troublesome pest is mistletoe (*Loranthus* sp.), which should be cut away and burned.

Hevea brasiliensis.—*Circular* No. 16 of the *Circ. and Agric. Journ. Roy. Bot. Gard., Ceylon* (1911, Vol. **5**) is a report on the chemical and physical properties of samples of Hevea rubber from Heneratgoda Gardens. The samples were obtained in a series of experiments on the effect of tapping trees at varying intervals. Dr. Lock and Mr. Bamber, the authors of the circular, suggest general conclusions from the results of the chemical examination and mechanical tests of the rubbers. In the case of rubber obtained in the later stages of the tapping experiments, the "breaking strain" tests showed that the strongest rubbers were obtained from the trees that were most frequently tapped, whilst the "resin content" was slightly less in such cases, and the "organic matter" larger. They conclude that tapping stimulates the tree both to the production of primary materials and their conversion into rubber. With frequent tapping, primary materials are produced faster than they are converted; with less frequent tapping the reverse is the case. Comparing the results of the breaking strain tests with the other figures obtained, it is noted that within certain limits greater strength appears to be associated with a higher proportion of ash and organic matter, other than caoutchouc or resin.

G. Vernet, continuing his articles on experiments with Hevea trees (*Journ. d'Agric. Trop.*, 1911, **11**. 73), deals with "length of incisions" and "frequency of tapping." In the course of the article he puts forward the view that there exist in the cells of the bark substances which are natural coagulants of the latex and which pass into the latex

prevent the production of flame. The rubber is stretched over thin rattans running between wooden posts fixed in the ground, and is moved from time to time to ensure even smoking. The windows of the smoking house are kept closed so that little of the smoke is lost. The advantages of this style of house are said to be: low cost, economy of smoke, dryness and safety from fire, with complete efficiency.

An account of the rubber industry of French Indo-China is contained in the *Bulletin de l'Office Colonial* (1911, **4**. 65). The history of the growth of the plantation industry in Cochin-China shows that considerable activity has been displayed in the cultivation of *Hevea brasiliensis* in that district in recent years. It is estimated that up to 1910 one million Hevea trees had been planted. A considerable quantity of rubber is also exported from Laos, but this is obtained mostly from wild plants (vines). The culture of Hevea in Annam has not, on the whole, given satisfactory results, but on one plantation at Suôi Giao 80,000 trees have already been planted. Definite results have not been obtained from the cultivation experiments at Tonkin; the rubber exported thence is native-gathered wild rubber. It is stated that the culture of Hevea is the only one which has given definite and encouraging results in Indo-china; its cultivation should, however, be limited to Cochin-China and South Annam.

Landolphia spp.—The forests of the Masoala Peninsula in Madagascar form the subject of an article by M. Louvel in the *Bull. Écon. de Madagascar* (1910, **10**. 30). It is stated that the forests contain numerous laticiferous plants, being particularly rich in Landolphia vines, of which the following are described. "Ravinengitra" (*Landolphia sp.*) occurs principally in the mountainous districts. It possesses small leaves, and the stems attain a length of 30–40 metres and a thickness of 7 to 8 centimetres. It secretes an abundant and fluid latex which, on coagulation with sulphuric or citric acid, yields a good rubber, that on drying becomes reddish-brown in colour. The "talandoho" (probably *L. madagascariensis*) occurs near the coast and its description agrees with that of a similar plant found on the south-west coast of Madagascar. On treating the latex with citric or sulphuric acid a rubber is obtained which has slight "nerve" and becomes resinous on drying. "Fingimena" and "fingipotsy" are also Landolphias; they are rare at the present time. The rubber obtained from the latices becomes brown on drying. "Fingibaona" is a variety of "fingimena." "Manandriamboa" latex, on coagulation with sulphuric acid, gives a sticky inelastic rubber. The cultivation of Landolphia vines in forest reserves is discussed.

The Landolphia vines of Portuguese East Africa are referred to in an account of the rubber industry of that country in the *India Rubber Journal* (1911, **41**. 718) and a reference is made to a rubber plant occurring in the Matadane country. Although a Landolphia, it differs from the species growing south of the Zambesi, and is essentially a root producer, the size of the root being large in proportion to the plant itself. The latex, which is plentiful and yields a good rubber, occurs in the bark of the roots and is extracted by the native method of beating the bark and heating in water. This plant is reported to spring up again if only a small portion of the root is left in the ground.

Manihot spp.—The large yields of rubber from Ceará trees reported from East Africa, as *e.g.*, 12 lb. per tree per annum, are called in question in an article in the *India Rubber Journal* (1911, **41.** 716). The opinion is expressed by a planter in German East Africa that the yield will probably never be more than ½ lb. rubber per tree per annum.

The profitableness of Ceará rubber cultivation has been considered in detail by the Rubber Commission of the German Colonial Economic Committee, and a report of their deliberations on the subject is contained in a *Beihefte zum "Tropenpflanzer"* (1911, **12.** 218).

(2) *Rubber Testing.*

The standardisation of the methods of testing rubber and rubber goods has been frequently proposed, and some time ago an International Rubber Testing Committee was formed to consider the various proposals put forward having this end in view. Dr. Fritz Frank has recently made certain recommendations to the German Section of the Committee on the testing of raw rubber (*Gummi Zeitung*, 1911, **25.** 990; also *India Rubber Journal*, 1911, **41.** 709). The chief of these is the proposal to adopt a method of comparing rubbers by measuring the viscosity of their solutions in an organic solvent. A standard apparatus for this purpose is described. A sample of rubber to be tested is selected, cut up and softened in hot water for 30 minutes. It is then rolled into a thin sheet in the rolling machine, dried and dissolved in commercial xylol (sp. gr. 0·867–0·869) and made into a 3 per cent. solution. The comparative viscosity of this solution is estimated by noting the time in seconds required for a certain volume (100-200 c.c.) to pass through an orifice of standard size in the apparatus. The determination is repeated with the solution after standing for 8 to 10 days in the dark.

A vulcanisation test is also proposed by Dr. Frank. The vulcanisation is done on the same sample of washed and dried sheet as is used in the viscosity test, the rubber being mixed in the usual manner with 8–10 per cent. sulphur, made into sheets 5 mm. thick, and vulcanised for 1 hour at 3–4 atmospheres pressure. The vulcanised sheet is then tested (1) chemically, when the ratio of free and combined sulphur is estimated, and (2) mechanically, by testing the sample in the form of cut rings having a cross section of 5 × 4 mm. on some machine such as the Schopper-Dalen apparatus.

The proposals of Frank are criticised in *Le Caoutchouc et la Gutta-percha* (1911, **8.** 5019) by Prof. P. Breuil, who proposes alternative methods of conducting mechanical tests based on the work of Bouasse, Schwartz and others. In criticising Frank's viscosity method it is pointed out that the method and period of washing proposed are arbitrary, the only stipulation being that the washing shall not be prolonged more than 20 minutes. The results recently obtained by Boutaric are quoted to show that in masticating a specimen of Ceylon rubber the viscosity of a solution decreases rapidly on progressive treatment. After 2½ minutes' mastication the viscosity was represented by 1900, whilst after 20 minutes' mastication it had fallen to 90. Other factors which have been shown to influence the viscosity of rubber solutions are (1) the method of drying, and (2) the temperature at which the solution is made up. According to Breuil there is no reason why Frank's apparatus, which gives arbitrary figures, should be adopted rather than those of Boutaric or Victor Henry, which are simpler. Finally, the opinion is expressed that it is not at present opportune to make viscosity a criterion of the quality of a rubber.

Pontio (*Le Caoutchouc et la Gutta-percha*, 1911, **8.** 5108) also criticises the viscosity method for the valuation of rubber. He has for several years tried similar methods and has described in *Les Matières Grasses* (1908, **1.** 1238) an apparatus for use in this connection, but owing to the extreme precautions which are necessary in order to avoid errors it was found impossible to obtain even approximately comparable results.

The various objections raised to the viscosity tests have been dealt with by Dr. Frank in a letter to the *Gummi Zeitung* (1911, **25.** 1278).

FIBRES.

Cotton.

Egypt.—The report of a Commission appointed by the Government of Egypt to investigate questions connected with cotton-growing has been issued, and is summarised in the *Report on the Finances, Administration and Condition of Egypt and the Sudan in* 1910 [Cd. 5633]. An account is also given of the measures which have already been taken to give effect to the recommendations of the Commission.

Attention is drawn to the dangers of over-watering, and it is recommended that cultivators should be given instruction on this point; that to minimise the infiltration of water from the canals, the levels should always be kept as low as possible; that, where the soil is permeable, catch drains should be laid along both sides of the canals to prevent infiltration; and that the whole drainage system of the country ought to be extended and improved. Circulars have been addressed to all the Moudirs on this subject, and meetings have been held to emphasise its importance. The canal levels are being kept low whenever possible, and many canals have been re-designed and their levels reduced as far as consistent with the needs of irrigation. Extensive schemes are under consideration for the improvement and enlargement of existing systems

variety. The seed from these plants has been sown in Tobago, and has produced large plants which give good yields of cotton of similar type to Sea Island. The experiment is being continued on Mendelian lines. Seed of this new cotton is being supplied gratuitously to growers by the Trinidad Department of Agriculture.

United States.—The cultivation of Egyptian cotton is being attempted on the Pacific Coast from the Imperial Valley in Southern California to Klamath Falls in the State of Oregon. It is stated in the *Diplomatic and Consular Reports, United States,* 1910, No. 4650, *Annual Series* [Cd. 5465–43], that the work is progressing favourably and that Egyptian cotton has been found much less susceptible to cold than the varieties usually grown in the United States.

Manila Hemp and Banana Fibre.

East Africa Protectorate.—It is stated in the *Annual Report of the Department of Agriculture, British East Africa, for* 1909–10, that Manila hemp plants are being experimentally cultivated at Mazeras and have made satisfactory growth. Several acres at Cainville, Limoru, have been planted with the indigenous banana, and the plants are now ready to be cut for fibre. This banana is also being grown on several other estates in the Highlands. Trials have been made at Nairobi with a "Carlyle" fibre machine, and encouraging results have been obtained. Samples of the indigenous banana fibre have been examined at the Imperial Institute and are described in this *Bulletin* (1907, **5**. 228).

Sisal Hemp.

East Africa Protectorate.—Experiments in Sisal hemp cultivation were commenced in 1903–4 in the Nairobi district, and a little later in other districts. It was stated in the *Annual Report of the Department of Agriculture, British East Africa, for* 1909–10, that 1500 acres were then under cultivation, and that the most advanced plantation in the Protectorate was situated at Punda Milia, where a factory was shortly to be erected.

Fiji.—Sisal hemp is now being grown in Fiji, and information on the cultivation of the crop has been issued as *Bulletin No. 1 of the Department of Agriculture.* Experiments have been made at the Nasinu and Lautoka Experiment Stations with encouraging results. A specimen of the fibre extracted from plants grown in the grounds of Government House, Suva, was examined at the Imperial Institute in 1908. It was of excellent quality, very strong, of good length, and was regarded by experts as worth £34 to £35 per ton, when Mexican Sisal hemp was quoted at £25 to £27 per ton.

Broom Millet.

Australia.—The cultivation of broom millet (*Sorghum vulgare*), the stems of which are used for the manufacture of brooms and brushes, is increasing largely in New South Wales and Queensland. A full and interesting account of the industry has been published in New South Wales in the form of a bulletin and has been reprinted in the *Queensland Agricultural Journal* (1911, **26.** 231).

Silk.

Philippine Islands.—Efforts are being made to establish a silk industry in the Philippines, and accounts of the progress have been given in the *8th and 9th Annual Reports of the Bureau of Science at Manila,* 1909–10. The silkworm was introduced from Ceylon, and for four years has been submitted to experiments in breeding and in hybridisation with the Japanese variety. Both the silkworms and cocoons show a continuous improvement in appearance, and no sign of disease has been observed. Instruction in silk culture is now being given in the industrial schools. The "Eri" silkworm has also been successfully introduced.

ESSENTIAL OILS.

Andropogon (Cymbopogon) Oil.—In their last report (April 1911) Messrs. Schimmel & Co. state that the grass *Andropogon Schœnanthus* var. *nervatus* grown in the Sudan yielded 1·9 per cent. of a brownish-coloured oil, having an odour somewhat resembling that of commercial ginger-grass oil but much fainter. The constants of the oil were as follows: specific gravity at 15° C., 0·9405; optical rotation, α_D + 26° 22′, refractive index, $n_D 20°$ 1·49469; saponification value, 4·6; ester value, 9·3; ester value after acetylation, 99·1. The oil was soluble in ½ its volume or more of 80 per cent. alcohol, but a paraffin separates out on dilution.

Camphor.—The exports of camphor from Japan and Formosa for the year 1909 amounted to 90,537 piculs (107,782 cwt.), having a value of 7,847,214 yen (£801,070). This is an increase in quantity of over 100 per cent. on the previous year's export, but owing to a fall in price the increase in value is lower in proportion. According to a report in the *Deutsches Hand. Arch.*, February 1911, p. 137, the increase is attributable to some extent to the reduction in price that had to be made by the Japanese Government in order to get rid of its surplus stock, which had accumulated owing to restriction of sales over a prolonged period. It is stated by a Japanese publication (vide *Schimmel & Co.'s Report,* April 1911, p. 31) that the net profits of the Formosan Camphor Monopoly Bureau increased in 1909 to £250,000, and that a further increase was anticipated in 1910. The Chinese product is said to be in low demand, and apparently synthetic camphor has disappeared from the market.

Caraway Seed Oil.—The caraway seed industry in Holland forms the subject of an article in the *Journal of the Board of Agriculture* (1911,

18. 134). Most of the seed imported into this country is from Holland, where, in 1910, there were 19,500 acres under caraway cultivation. A memorandum on the methods of cultivation has lately been issued by the Dutch Ministry for Foreign Affairs, from which it appears that caraway can be grown in various kinds of soils, the most favourable being deeply tilled, fertile soil, rich in humus and free from weeds. Being a biennial plant, it is sown under cover of other plants, usually peas, which do not choke the caraway, and ripen much earlier than the latter. In some districts it is also grown under mustard and poppy, field and other beans, and in some cases with flax and clover. The seed is generally sown with, or immediately after, the seed of the covering plant in late March or early April, usually in rows 12 to 16 inches apart, 5 to 8½ lb. per acre being used. The caraway thrives well after the covering plant has been cut. Weeds are carefully removed, and in the winter the rows are covered with earth or dressed with stable manure. Manuring with nitrate of soda is also practised in order to obtain a luxuriant crop the first year. In the following spring the soil is loosened and the weeds removed by harrowing and hoeing. The caraway grows quickly, blossoms in May, and is ripe about the beginning of July, when the fruit turns brown and falls off easily. If allowed to remain in the ground some of the plants produce seed-stalks in the third year, though this harvest is smaller than the first. The worst enemy of the caraway is the caterpillar of the "caraway moth" (*Depressaria nervosa*, Haw.), which often destroys whole fields of the plant.

The harvesting should be done carefully and rather early on account of the tendency of the fruits to fall off when ripe. The plants are cut with sickles or mowing machines, either in early morning or late evening, and the sheaves are built together into small stacks, which after two or three weeks are ready for storage or threshing. The yield of seed varies from 6 to 16 cwt. per acre, the average for the whole of Holland in 1909 being 9½ cwt. per acre. In addition 16 to 24 cwt. of straw per acre is obtained, which can be used as cattle fodder or litter. The price of caraway seed fluctuates considerably: in 1910 it varied between 21*s*. 6*d*. and 24*s*. per cwt.

Eucalyptus Oil.—Reference is made to the use of eucalyptus oils, poor in cineol, in ore dressing in Australia in the *Chemist and Druggist* (1910, **77.** 724 and 811). Sulphide ores of which the separation of the constituents offers difficulty are crushed with water to which a little eucalyptus oil has been added. The particles of the metallic minerals are thus brought to the surface, and a separation can be effected. It is estimated that in the near future 20 tons of eucalyptus oil per month will be required for this purpose.

Origanum Oil.—Messrs. Schimmel & Co. have recently examined the oil from *Majorana Onites* (L.), Benth., (syn. *Origanum Onites*, L., *Origanum smyrnæum*, L.), from Smyrna (*Semi-annnal Report*, April 1911, p. 84). The plant gave a yield of 2 per cent. of a dark brown oil,

as the bottom leaves suffer comparatively slight injury or deterioration in the climate of Ireland.

FORESTRY.

General.

Forestry in Southern Nigeria.—In the *Annual Report of the Colony of Southern Nigeria* (1909) the Conservator of Forests gives an account of a tour through the Meko and Shaki districts of the hinterland. The journey was undertaken to ascertain the suitability or otherwise of these areas for forest reserves, it being considered that in general climatic conditions they would be specially adapted for the establishment of teak (*Tectona grandis*) plantations.

The investigation has confirmed this opinion, more especially in the case of the Meko district, and recommendations have been made for the establishment of reserve areas. The forest is of the savannah type, rich in the more important plant species characteristic of the hinterland, and containing a fair number of plants of economic importance. The most important timber trees met with are mahogany (*Khaya senegalensis*), apa (*Afzelia africana*), cedar (*Pseudocedrela Kotschyi*), African oak (*Lophira alata*) and rosewood (*Pterocarpus erinaceus*), all of which are suitable for export; others of value for local purposes are abundant. The shea-butter tree (*Butyrospermum Parkii*) is found in great numbers, and the immediate exploitation of this valuable asset is recommended. Reference is made to the relative ease with which savannah forests can be exploited. It should be possible to open up the forests of the hinterland at comparatively small cost by the construction of mono-rails and forest tramways. Natural regeneration is good and easily controlled, but adequate fire-protection is a *sine qua non* in any development work undertaken.

Re-afforestation in New South Wales.—In the *Annual Report of the Department of Forestry, New South Wales*, 1909–10, attention is drawn to the transference of the Department from the administration of the Secretary of Lands to that of the Department of Agriculture. The work recorded is to some extent of a preliminary character. In connection with afforestation, inquiries have been made of neighbouring states and foreign countries as to the most suitable species for special conditions. Useful information has been obtained, the species recommended being, in large measure, exotic. The activities of the State forest nurseries are being extended. Under the heading "Re-afforestation," reference is made to the work in this direction already carried out by the departmental authorities, and a series of fine photographs illustrates some of the results obtained. The total area of the reserves is 186,510 acres, of which 104,290 acres have now been improved by re-afforestation. A Forest Act came into force on January 1, 1910, and is the first measure in the history of the State passed to deal exclusively with the question of forestry. It deals with the establishment of State forests and timber reserves; the questions of licences, timber rights and permits, and the establishment of a Department of Forestry.

A paper on "Re-afforestation in the Tropics," communicated by the Director of Forests to the International Congress of Tropical Agriculture and Colonial Development, held at Brussels in 1910, is printed as an appendix (see this *Bulletin*, 1910, **8.** 147).

Insect Pests of the Deodar.—The insect pests that infest the deodar (*Cedrus Deodara*) in the Himalayas are described in *Indian Forest Memoirs, For. Zool. Ser.* (1911, **3.** Pt. I). The memoir contains descriptions of the various insects, together with accounts of their life histories, the damage committed by them in the forests, and suitable preventive and remedial measures. Notes are also given on the insects predaceous or parasitic on the deodar pests. The descriptive matter is accompanied by drawings of the insects and by reproductions of photographs illustrating the injuries to the deodar caused by the pests.

FOREST PRODUCTS.

Timbers.

Burma Teak.—The results of tests carried out at the Civil Engineering College, at Sibpur, to ascertain the relative strengths of natural- and plantation-grown teak, are published in *Forest Bulletin,* 1911, No. 3. The plantation-teak used was obtained from a plantation made in 1863-4 in the Myodwin Reserve, Zigon Division, and was cut green. The natural-grown teak was also obtained from the Zigon Division, but in this case the trees were girdled before being felled. The point to which timber is seasoned has an influence on its strength, and it is possible that this may be partly responsible for the belief that plantation-grown teak is less strong than the natural-grown timber. At the time of experiment, the plantation-teak showed an average of 10·83 per cent. of moisture as against 9·89 per cent. in the natural-grown teak.

The results of comparative shearing tests along the grain showed the plantation-teak to be slightly stronger. The compression tests, along the grain, were also slightly in its favour. In the tests for transverse strength the natural-grown teak exhibited greater strength than timber grown in plantations, the difference being 0·45 ton per square inch. This may be due to some extent to the slight difference in the amount of moisture in the two timbers. The conclusions drawn were that there is little difference in the strengths of the two timbers, and that, although the natural-grown teak was proved to be superior in the tests for transverse strength, the strength of the plantation-teak was so high that it may be regarded as of excellent quality.

Tea-box Timber.—According to the *Progress Report of the Forest Administration of Eastern Bengal and Assam for* 1909–10, two selected areas have been reserved in Sadiya for the growth of "Simul" (*Bombax malabaricum*), to supply timber for the tea-box industry. The Simul tree is said to reproduce itself freely here and there in the unclassed forests, but in the existing reserved forests it is not sufficiently plentiful to be dealt with satisfactorily. In view of the importance of the tea-box industry, expenditure involved in improving the supply of timber for this purpose seems to be amply justified. Mill-owners who work tea-box timber are under contract with the Government to pay royalty on the number of boxes produced. The amount of royalty paid in 1909–10 was Rs. 26,961.

Timber Industry of French Indo-China.—In the *Bulletin de l'Office Colonial* (1911, **41**, 156) an account is given of the present position of the timber industry in French Indo-China. It is estimated that fully 33 per cent. of the area of the colony is covered with forest, and that 25 million hectares are available for exploitation. Upwards of 600 varieties of timber are known, a large proportion of which are used locally in the native carpentry and wood-working trades, or as fuel. The attention of European concerns is now being directed towards the utilisation of these timber resources. Certain areas have been established by the authorities as forest reserves in which cutting is allowed under restriction. The bulk of the timber-getting, however, is carried on in concessions granted for long periods upon terms of free cutting. Several firms are engaged in the work, and modern felling appliances and transport are employed to bring the lumber to the saw-mills, which are provided with up-to-date machinery. A company is exploiting the teak forests of the Mekong river under licence from the Siamese Government, the timber being dressed at the mills at Saigon. Similar mills are established in Cochin-China, and an undertaking at Trang-Bom specialises in wood-distillation products. Another important company is established at Chlong, where timber obtained from Laos and northern Cambodia is prepared, chiefly for the French market. It is estimated that the annual value of the timber handled at the various European mills is 15 million francs.

A brief account of the more valuable timbers is given. The most important timber of Tonkin is *lim*, a hard, reddish-brown wood of great durability. It is extensively used locally for carpentry and building purposes, and is known in Paris as a good parquetry wood. Trials as a paving material in the streets of Paris have been unfavourable, since the wood, owing to its hardness, becomes smooth with wear, thus rendering a safe foothold impossible. As a timber for railway waggons *lim* has been used with success. Other Tonkin woods described are *gu*, suitable for furniture and general joinery; *xoan-dao*, resembling mahogany and recommended for furniture; *caoi*, a strong wood, suitable for artillery limbers; and *sangi-le*, a durable timber of moderate weight, recommended for railway sleepers. Of Annam woods, quantities of *huynh* have for some years been sold in London and Liverpool as a high-class "mahogany." *Dau*, obtained from Cochin and Cambodia, is recommended as a substitute for teak; while *sao*, regarded as the best timber of Cochin, is similar in character to *lim*.

ECONOMIC MINERALS.

Alum Shale.—In the *Records Geol. Surv. India* (1910, **40.** 265), Mr. N. D. Daru gives an account of "Alum Shale and Alum Manufacture at and near Kalabagh, Mianwali District, Punjab." The shale is of Eocene age. The shale bed is from 7 to 10 feet thick near Kalabagh, and 25 to 40 feet thick at Kotki. The average amount of sulphur in the shale, chiefly in the condition of iron pyrites, is about 9·5 per cent. The iron pyrites is as a rule so finely divided that it is scarcely visible except with a microscope. The shale is too poor for the manufacture of sulphuric acid, and is used chiefly for making soda-alum, and a small amount of potash-alum.

Coal.—Mr. H. H. Hayden (*loc. cit.*, p. 283), in an account of "Some Coal-fields in North-Eastern Assam," deals with three fields in the Safrai valley and one in the valley of the Tichak river, and supplements the work on the Jaipur and Nazira coal-fields carried out by Mr. R. R. Simpson in 1906 (*ibid.*, 1906, **34.** 199).

Of the three Safrai fields the most promising is that in the neighbourhood of the Chota Taukok river. It comprises at least four seams, one of which attains a thickness of 15 feet, whilst others are respectively 5 and 9 feet thick. The coal-measures are of Tertiary age. The coal is very friable and contains a considerable amount of sulphur, but in other respects it is of good quality. The actual extent of this field has not been determined; but its width is defined by two boundary faults, and is known to be less than 400 yards. Of the other two fields in the Safrai valley that to the north-east of Kongan is small and worthless; the other, which is situated near the path from Charaido to Pudkung, is not known to contain more than two workable seams, and the extent of these is unknown. The Tichak valley coal-field is not more than 1½ miles long and about 300 feet wide. It contains a thick seam of coal of good quality, but the total amount available is insignificant and the field is difficult of access. It appears unlikely that either of the promising fields of the Safrai valley will be exploited in the near future, as they would be severely handicapped in competition with other more accessible and more readily worked fields.

In a paper on "The Geology of the Andaman Islands, with references to the Nicobars" (*Memoirs Geol. Surv. India*, 1911, **35.** 195), Mr. G. H. Tipper states that coal has been known for many years to occur in the Andamans. It occurs in pockets in sandstone, and so far no continuous seam has been found. It is usually of poor quality. The rocks of the Andamans are of the same age as the coal-bearing formations of Baluchistan, and for that reason the author suggests that seams of coal may possibly occur; but they are more likely to be found in the South Andamans than in the conglomerate series of the North and Middle Islands.

Flint.—According to the United States' Consul at Copenhagen

(*Mining World*, 1911, June 17), Denmark has a considerable flint-pebble industry. The flint-pebbles have been thrown up by the waves along the coasts of certain of the Danish Isles, where they have been accumulating for long periods. They occur mixed with large quantities of sand. The pebbles selected for sale have diameters of from about one to 5½ inches. They are collected at various depôts on the coast, and shipped to Copenhagen, where they are sorted.

Gold.—*Bulletin No.* 80 *of the Institute of Mining and Metallurgy* (1911, May 24) contains a paper on "Future Economies in Rand Reduction Plants," by Mr. C. O. Schmitt. The writer points out the increase in cost of ore-raising consequent upon the ever-increasing depth of the mines. He gives an estimate of the screen values of ore at various depths, showing that the value at an average depth of 5,000 feet is only half that at an average depth of 1,000 feet. He estimates that the average depth at which ore is mined at present is in the neighbourhood of 2,400 feet, and that, if working-costs are maintained at the present standard, mining will cease to be profitable at or before a vertical depth of 5,000 feet has been reached. Hence the significance of any reduction in working-costs which it may be possible to effect. The writer discusses at considerable length (1) sorting and breaking plant, (2) the milling and crushing plant; and indicates lines along which economies may be effected.

Manganese Ore.—In a paper "On the Age and Continuation in Depth of the Manganese Ores of the Nagpur-Balaghat Area, Central Provinces" (*Records Geol. Surv. India*, 1911, **41**. 1), Dr. L. L. Fermor states that the majority of the manganese ores of the Central Provinces were formed in Archæan times, prior to the formation of the pre-Cambrian sediments known as the Puranas. Most of the ores have been formed either in a direct manner by the compression of the purest of the original manganese-oxide sediments, or by alteration of manganese silicates produced by the metamorphism of the manganiferous sediments. From a consideration of the evidence he concludes that the alteration of the manganese silicates took place at considerable depths, and that the manganese ores may be expected to extend in some places to as great a depth as the rocks of the gondite series in which they occur. In some cases he suspects that the gondite rocks and associated ores may persist to a depth of 1,000 feet.

The same author (*loc. cit.*, p. 12) contributes "Notes on the Manganese Ore Deposits of Gangpur State, Bengal, and on the Distribution of the Gondite Series in India." The ores of the Gangpur deposits consist chiefly of psilomelane and braunite, mixed in various proportions. A bulk sample of about 200 tons of Gariajhor ore gave the following analysis: manganese 51·81 per cent., iron 6·38, silica 3·52, and phosphorus 0·09. Another sample, representing 545 tons of ore, gave 49·44 per cent. of manganese. The manganese silicate rocks of Gangpur belong to the group known in the Central Provinces as the gondite series. "This series of manganese silicate rocks is now known to occur over a total distance of 700 miles, measuring along a west-to-east line from Jothvad in the Narukot State, Bombay Presidency, and Jhabua in Central India (the western area), through Chhindwara, Nagpur, Seoni, Bhandara, and Balaghat in the Central Provinces (the central area) to Gangpur in Western Bengal (the eastern area)."

Mercury.—In "A Review of Mining Operations in the State of South Australia during the half-year ended December 31, 1910," the Assistant Government Geologist, reporting on a discovery of mercury (quicksilver) at Myponga, about eight miles S.E. of Willunga, states that the country rock consists of clay-slate, graphite-slate, phyllite, and mica-schist. The metal was found distributed over the surface of the rock in certain tunnels. Although the country is auriferous, and there are several abandoned gold mines in the vicinity, no definite lode or ore-body was observed in the rocks on which the mercury occurs. The mercury is said to "sweat out" of the rock when a freshly broken surface is left exposed to the air for some time. No cinnabar or other mercury mineral could be found, and though the occurrence of the native mercury appears to be genuine, the author states that no scientific explanation of it can at present be given.

Petroleum.—According to *The Petroleum World* (1911, May), the first cargo of petroleum to leave Trinidad was loaded at Brighton on April 26, by the tank steamer *Prudencia.* The refinery in use is capable of treating 3,000 to 3,500 barrels of crude oil per day if all the crude oil is fractionated, and from 4,000 to 5,000 barrels per day if only the top oils are taken off. The *Prudencia* left with a cargo of some 3,800 tons of crude petroleum for Perth Amboy, New York. *The Petroleum World* for July 1911 states that, according to latest advices from Trinidad, five steamers have been dispatched with cargoes of petroleum, making a total of 19,000 tons shipped from the island.

In an article on "The Marine Organic Origin of Petroleum" (*Mining World,* 1911, June 17), Mr. A. Laker suggests that marine algæ constitute an important possible source from which oil may be derived. Algæ are extremely abundant in some areas, *e.g.* the Sargossa sea in the North Atlantic Ocean, where, during the late summer, after the stormy season in the Gulf of Mexico, there is a very dense accumulation of Fucaceæ, which float at the surface for five or six months before they sink to the bottom. Algæ were undoubtedly abundant in the oceans of former geological periods, and it may be that, under certain conditions, petroleum results from the decay of their widespread remains.

Precious Stones.—According to the Assistant Government Geologist for Queensland (*Queensland Govt. Mining Journal,* 1911, March 15), olivine of gem value is found and worked to a slight extent among the basalts of the Toowoomba Range. The stones so far obtained have been of the paler green peridote and yellow chrysolite varieties,

referred to this section. Hitherto much difficulty has resulted from the fact that while the West African native recognises a sharp distinction between various kinds of cola nut, European systematists (working, however, upon admittedly incomplete and unsatisfactory material) have recognised but a small number of species of cola whose diagnoses are, in practice, found to be inaccurate and often valueless. The question has been further complicated by a confused synonymy. The work of the present authors amounts to a revision of the section Eucola. A careful comparison has been made of type specimens in European herbaria, and abundant material collected over a period of five years, from nearly all parts of French and British West Africa, has been available for examination, frequently in the fresh condition. The result of the investigation has been to establish five well-defined species of cola, of which one, with certain of its varieties, furnishes the bulk of the cola of commerce. The species are:—

1. *Cola nitida* (Vent.), A. Chev. (*Cola vera*, K. Schum.). The species most generally cultivated and yielding the great bulk of commercial cola. Occurs from Portuguese Guinea to Togoland. Cotyledons, two. Considerable variation, with variants referable to four new sub-species:—

   (a) *C. rubra*, A. Chev. Red nuts exclusively.
   (b) *C. alba*, A. Chev. White nuts exclusively.
   (c) *C. mixta*, A. Chev. Nuts red and white in the same fruit. The most common form in cultivation.
   (d) *C. pallida*, A. Chev. Nuts small, often rose-coloured. Occurs in the forests of the Ivory Coast.

2. *Cola acuminata* (Pal. Beauv.), Schott. et Endl. Occurs from Togoland to Angola and inland to the Bahr-el-Ghazal. Nuts esteemed less than preceding. Cotyledons, more than two, mucilaginous.
3. *Cola Ballayi*, Cornu (*C. acuminata* var. *kamerunensis*, K. Schum.; *C. sub-verticillata*, De Wild.). Occurs chiefly in the Kamerun and Congo forests. Cotyledons, more than two. Plant distinguished by its large leaves arranged in false whorls.
4. *Cola verticillata* (Thoun. in Schum.), Stapf. Occurs in the Gold Coast, Dahomey, Nigeria, and Kamerun. Leaves 3 or 4, whorled. Nuts red, mucilaginous. Cotyledons, more than two. Rarely cultivated, and considered of inferior value.
5. *Cola sphaerocarpa*, A. Chev. Occurs in San Thomé; incompletely known. Nuts, large, white, probably not edible. Cotyledons, more than two.

The species are illustrated by sixteen phototype reproductions, and the geographical distribution of the two species most important from the commercial standpoint (*C. nitida* and *C. acuminata*) is indicated in two excellent coloured maps.

CACAO: A MANUAL ON THE CULTIVATION AND CURING OF CACAO. By John Hinchley Hart, F.L.S., Late Superintendent of the Royal Botanic Gardens, Trinidad. Pp. x + 307. (London: Duckworth & Co., 1911.)

A sad interest attaches to this work, the proofs of which were revised during the last illness of the author, by whose death in February of this year Trinidad has lost a prominent botanist and tropical agriculturist. It is fortunate that he lived to complete the present volume, in which all the sections of the industry of cocoa growing and curing are treated of from the selection of the land to the preparation of the "beans" for sale.

In forming the plantation the author is greatly in favour of the practice of grafting, on the grounds that a product of uniform character can thereby be secured instead of a harvest of beans of varied quality such as is inevitably produced from ungrafted trees. In 1898 the author discovered that cocoa can be easily grafted by approach, and thus the planter can now secure a crop of one particular kind, and it is stated that the practices of grafting and budding are steadily coming into use. With this resource at his disposal it is claimed that the planter can now produce trees yielding a high coloured cocoa, a cocoa with a fine break, a cocoa with a good aroma and flavour, or a cocoa having "body" or weight, qualities that are in demand by the manufacturer in making his blends for cocoa powder or chocolate. No single variety of cocoa seems to meet all the requirements of the European or American consumer, and the manufacturer exercises great skill in blending the different varieties so as to attain a standard character maintained from year to year. This peculiarity of the industry hinders the development of local factories, and if these are to succeed the planters must grow the various kinds necessary for producing the approved blends.

As regards manuring the author's views accord with those given in the Reports of the Dominican Experiments (this *Bulletin*, 1911, **9**. 60), namely, that "mulching" or covering the ground with fresh or decaying vegetable material is of the greatest value for cocoa. The benefits of this practice are that it keeps down weeds, prevents evaporation and keeps the soil moist, furnishes manurial constituents in gradual supplies, and attracts earth-worms which aerate the soil and carry decomposing matter into their burrows. It is especially valuable on land that suffers in the dry season. In growing the crops of temperate climates the manure can be thoroughly mixed with the soil before the crops are planted, but with the cocoa tree although a deep rich soil is suitable yet it is a surface-feeding plant, and any stirring of the soil has to be done with the greatest caution to avoid injuring the roots.

The chapter on the agricultural chemistry of cocoa is mostly due to Harrison, and very full analyses are given comparing the composition of the cocoa fruit and its husks, cuticles and pulp, and kernels, both when fresh and after fermentation; this is done for both the

Calabacillo and Forastero varieties of cocoa Analyses of cocoa soils are also given.

The work is characterised by discussions of the merits and disadvantages of various procedures, and by an endeavour to prevent the planter from relying blindly on some operation without considering the precise way in which it acts and the circumstances in which it is of value.

EENIGE GEGEVENS VOOR DE KATOENCULTUUR IN NEDERLANSCH-OOST-INDIE. By D. J. G. van Setten. Pp. 73. (Batavia: G. Kolff & Co., 1911.)

This work gives a short general account of cotton and its cultivation with special reference to the conditions and requirements of the Dutch East Indies. A diagram is appended which records the quantities of cotton (ginned and unginned) exported respectively from Palembang, Java, and Bali and Lombok, during the years 1904–1909 inclusive, as well as the total amounts exported from the Dutch East Indies during the same period.

THE AGRICULTURAL AND OTHER INDUSTRIAL POSSIBILITIES OF THE GOLD COAST. By J. A. Barbour James. Pp. 109. (London: St. Bride's Press, Ltd., 1911.)

The basis of this pamphlet is a lecture delivered by the author at Cape Coast Castle in 1905. The lecture is now published in a somewhat modified form and the opportunity has been taken of bringing together a number of articles, which should be useful to those interested in the agriculture of the Gold Coast. The author lays much stress on the advantage of organisation in agriculture, and urges the native farmers to take the utmost advantage of the facilities for agricultural instruction now offered by the Government. The special articles include a detailed account of the cultivation of cotton, with particulars of the profits and costs of production on a series of West Indian plantations. At the present time, however, it is doubtful whether cotton offers much prospect of success in the Gold Coast, where cocoa and other products occupy so much attention. A memorandum on cocoa cultivation by Mr. W. H. Johnson is printed in full and supplemented by extracts from West Indian sources. A useful feature is the inclusion of the official reports on the Agricultural Exhibitions held at Accra (1905), Cape Coast (1906), Sekondi (1907) and Coomassie (1908).

CATALOGUE OF THE ECONOMIC MUSEUM OF THE IMPERIAL FOREST RESEARCH INSTITUTE AND FOREST COLLEGE, DEHRA DUN. Pp. 265. (Calcutta: The Government Printer, 1911.)

The contents of the Museum consist principally of botanical specimens, together with a few animal products such as lac, honey and wax, horns, feathers and silk.

HISTORICAL GEOGRAPHY OF THE BRITISH COLONIES. Vol. V. Part IV, NEWFOUNDLAND. By J. D. Rogers. Pp. xii + 274. With 4 maps. (Oxford: Frowde, Clarendon Press, 1911.)

This volume has been written on a somewhat different plan from that adopted for the preceding parts, Newfoundland being treated in much more detail than its sister colonies which have united to form the Dominion of Canada.

The history of Newfoundland is in many respects unique. Perhaps in no other country is the life-story so largely one of constant quarrelling. Its earliest settlers devoted themselves to hunting and fishing, so that for many years after its first foundation the residents were outnumbered by those who came for the summer season only; consequently in addition to the struggle between French and English for mastery in the island, there were troubles over fishing rights, and also disagreements between those who looked upon the country as one suitable for permanent colonisation and those who regarded it mainly as a place for making money to be spent elsewhere. Mr. Rogers has carefully followed out the course of all these differences from the earliest mention of Newfoundland to the Atlantic Fisheries Arbitration and the award of the Hague Tribunal as published in 1910. Although this naturally takes up the greater part of the book, he does not neglect the remainder of its history. How largely the sea has been the main consideration in the development of Newfoundland can be gathered from the fact that it was not until 1822 that exploration of the interior was commenced by Europeans, though Indian settlers had carried on hunting there for many years. Since then laws for the protection of sport and the fur trade have been numerous. Lumbering and pulp-making are increasing industries, and with the development of roads and railways, agriculture and mining are becoming more important, though fishing is still far and away the most important industry. Statistics showing the relative importance of these are given.

Appended to the book are reprints of various State-papers, etc., relating to Newfoundland, the last being the text of the award of the Hague Tribunal in 1910, on the Atlantic Fisheries Arbitration.

Full references are given to the original authorities consulted, and there is an ample index. The maps include a copy of John Mason's map of Newfoundland, published in 1626, as well as those showing the island and Labrador as they exist to-day.

THE FAIR DOMINION: A RECORD OF CANADIAN IMPRESSIONS. By R. E. Vernède. Pp. xii + 296. (London: Kegan Paul, Trench, Trübner & Co., 1911.)

The author of this work was Canadian correspondent to the *Bystander*, and in the course of his duties travelled over the greater part of the Dominion from Quebec in the east to the Rockies and Vancouver in the west, visiting not only the usual tourist resorts and centres of political and social life, but other places, such as the Saguenay, the

French River, the Columbia Valley and the Selkirks, which are but little known to the ordinary visitor. His impressions of the places visited and the people he met are recorded in a very readable manner.

The volume is embellished with a number of illustrations in colour from drawings by Cyrus Cuneo.

PAPUA: A HANDBOOK TO ITS HISTORY, INHABITANTS, PHYSICAL FEATURES, AND RESOURCES, etc. By Charles Pritchard, M.A., D.D., with an appendix on the Health Conditions of Papua by R. Fleming Jones, M.D. Pp. 96. (London: Society for Promoting Christian Knowledge, 1911.)

The increasing commercial importance of British New Guinea, now better known as Papua, makes a handbook such as this a necessity. Its somewhat comprehensive title gives a clue to the scope of the book, which contains in a small compass a great deal of information respecting this fertile tropical region, the administration of which has been taken over by the Australian Commonwealth Government. The book is divided into four sections, the first dealing with the history of New Guinea, which is only second in size to Australia among the islands of the world. The succeeding chapters give interesting accounts of the Papuans, the physical features of the country, and its resources. Dr. Jones' appendix contains some useful advice on hygiene which settlers in Papua will do well to follow.

A number of photographs of the natives, their homes and water-craft are included, as well as a small sketch-map of New Guinea and the neighbouring islands. The absence of an index makes reference to the contents difficult.

BURMA: A HANDBOOK OF PRACTICAL INFORMATION. By Sir J. George Scott, K.C.I.E. New and revised edition. Pp. x + 520. (London: Alexander Moring, Ltd., 1911.)

The first edition of this book was published in 1906 and was noticed in this *Bulletin* (1907, **5**. 201). The second edition appears to be little more than a reprint of the first, except that the appendix relating to the Shan States has been brought up to date, and a publisher's note added, giving a short list of corrections and additions. With the exception of the table relating to the sea-borne trade of Burma, on p. 289, the figures quoted to illustrate the importance of the various industries do not appear to have been revised, and this is to be regretted in view of the fact that statistics relating to the trade of Burma are published annually. Other particulars such as those referring to the late Sir Dietrich Brandis, on p. 225, also stand in need of revision. Apart from such matters as these, the book contains in small compass a large amount of information regarding this interesting country, its peoples, natural resources, arts and industries.

THE ECONOMIC TRANSITION IN INDIA. By Sir Theodore Morison, K.C.I.E. Pp. 251. (London: John Murray, 1911.)

This book contains the substance of a course of lectures delivered at the London School of Economics and Political Science in 1910. The author attempts to show that the changes in the organisation of industry which are taking place in India at the present time are the same as marked the industrial revolution in Western Europe.

Side by side with these changes India retains to a large extent the characteristics of the old economic order. The agricultural industry largely preponderates and gives support to no less than 70 per cent. of the people. The land is minutely subdivided, and the people for the most part dwell in villages, which, owing to the absence of means of communication and transport, are isolated and economically independent. These conditions prevent the subdivision of labour and restrict the market for local produce and manufactures. Railways and roads are, however, rapidly changing this order of things. The villages are becoming less isolated owing to improved means of communication, and the failure of a local harvest is no longer followed by widespread starvation, as food can be imported from other sources. For the same reason the cultivator is no longer ruined owing to low prices following an abundant harvest, as access to other markets enables him to dispose of surplus produce at a fair remuneration. Of all the village artisans the weaver is probably the most affected by modern industrial conditions. At the present time some five millions of persons in India are supported by the hand-loom weaving of cotton, and the industry is conducted on lines that formerly characterised the woollen industry in England. In spite of attempts to improve the country looms by the introduction of the fly-shuttle and other modern improvements, the hand-loom weaver, who is slow to adopt modern methods, is being gradually ousted by the competition of the power-looms, not only of Lancashire but also of Bombay.

It is not, however, to the villages that one must look for the greatest changes; these are to be sought in such industrial centres as Bombay, Cawnpore, and the banks of the Hugli. There capital has been freely spent on machinery, and production is carried on according to Western ideas and under the supervision of managers who have had a European training. Statistics show that during the past twenty-five years the progress made has been very rapid. Amongst the more important modern Indian industries are cotton, jute, paper and woollen mills, breweries and mining undertakings.

In the last two chapters of the book the author discusses the so-called "drain" upon the resources of India, which the payments for interest on loans and for services rendered are supposed to make. It is shown that for the "drain" or foreign payments, India receives as an economic equivalent the equipment of modern industry, freedom from external aggression, and peace and order within her borders, without which conditions industrial development would be impossible.

and schists) and associated basic igneous rocks (gabbros, dolerites and serpentines). No fossils have been found in these sediments, and their age is doubtful, but it appears probable that they are older than the associated basic rocks. These oldest rocks are extensively penetrated and metamorphosed by acid intrusions (granites and felsites). Geologically younger than these are the strata of the Nullagine series, which cover a large area, and consist of thick sheets of basic lava overlaid by argillaceous flags, quartzites and conglomerates of sedimentary origin.

The ore deposits occur in the oldest rocks, viz. the metamorphic sediments and associated basic igneous rocks. Quartz is the usual gangue, for both gold and copper ores. The ores of gold and copper worked at present owe their value to secondary enrichment. The gold ore does not pay to work below the water level; but it is considered probable that the mining of the copper ore will continue to be profitable below the zone of secondary enrichment.

Alluvial deposits cover considerable areas, but no auriferous leads have been met with in them, and they are of little economic value. A small amount of tin-ore (cassiterite) has been produced by working the alluvium which occurs in small streams along the contact of granite and schist.

The Bulletin is illustrated and includes five geological maps.

PORCUPINE MINING DISTRICT. Pp. 86. (Toronto: Canadian Mining Journal, 1911.)

This book comprises a series of articles, most of which have already appeared in the *Canadian Mining Journal,* dealing with the geology and mining of the Porcupine district. An account is given of the discovery and development of the gold deposits. Mr. J. Stansfield gives the results of a microscopic examination of some typical specimens of Porcupine rocks and vein matter. The sampling of the Porcupine ore-bodies is discussed by Mr. H. E. T. Haultain; and Mr. W. E. Segsworth deals with the factors to be considered in reporting on mine prospects. There is an article on the "Porcupine Gold Area" by Mr. W. E. H. Carter; and Mr. R. E. Hore gives an account of the "Porcupine Gold Deposits," in which he groups the deposits into four classes, as follows: (1) single-fissure fillings or veins, (2) vein systems, (3) ferro-dolomite lodes, (4) irregular masses of quartz. Notes on the geology are given by Mr. W. G. Miller. The ore-bodies occur in rocks of Keewatin and Huronian age. They are supposed to be connected with the great granite intrusions which took place in post-Lower Huronian times, the ore-bearing quartz having been deposited from the magmatic waters which traversed the rocks after the intrusion of the granite.

The book contains numerous illustrations, including a geological map and a township map of the Porcupine gold area.

THE MINERAL INDUSTRY OF RHODESIA. By J. P. Johnson. Pp. 90. (London: Longmans, Green & Co., 1911.)

This book consists of some 180 pages, half of which are left blank for the insertion of notes by the reader. The first chapter of six pages is devoted to general considerations of petrology and ore-genesis, and is scarcely necessary in a small book of this description. The theory of the magmatic origin of ores is illustrated by the "Bushveld Laccolith," which is not in Rhodesia.

Chapters II and III on "Gold" and "The Small Mine Industry," respectively, may fairly claim to deal with the mineral industry of Rhodesia; but that claim cannot be made for much of the rest of the book.

Under molybdenite, the reader is given a long paragraph on the mode of occurrence of the mineral in the Potgietersrust tin-field; whilst its occurrence in Rhodesia is dismissed in a few words. With regard to vanadium, the reader is supplied with information as to the occurrence of the mineral patronite in South America, and vanadinite in the Iberian peninsula; but this information has no obvious bearing on the mineral industry of Rhodesia.

In a page devoted to tin, the author expresses surprise that no tinstone deposits have yet been discovered in Rhodesia. This being the case, it is curious that he devotes the whole of Chapter V (18 pages) to a description of the tin-deposits of the Transvaal and other parts of South Africa.

The book concludes with a useful chapter of hints to Rhodesian prospectors.

FABRICATION ET EMPLOI DES MATÉRIAUX ET PRODUITS RÉFRACTAIRES UTILISÉS DANS L'INDUSTRIE. By Albert Granger. Pp. iv + 378. (Paris: Ch. Béranger, 1910.)

This book, written by the lecturer on ceramic technology in the school of the State Porcelain Works at Sèvres, is one of the most complete that has been produced on this subject. The source, preparation and properties of the many varieties of refractory materials, including magnesia, lime, sand, chromium sesquioxide, carbon, silica, alumina, etc., are dealt with, and special attention is given to those more commonly employed. A chapter is devoted to kilns and methods of firing, and drawings are reproduced of gas-fired kilns. Good descriptions are given of the various forms of pyrometer in use, together with a discussion of the merits of the Seger-cone. Subsequent chapters deal with the relation between chemical composition and fusibility, methods of analysis of refractory materials, etc. The book should prove of value to all those interested in refractory materials, whether from the producing or manufacturing standpoint.

HANDBOOK OF THE DESTRUCTIVE INSECTS OF VICTORIA. Prepared by Order of the Victorian Department of Agriculture, by C. French, F.E.S., Government Entomologist. Part V. Pp. 169. (Melbourne: J. Kemp, 1911.)

The present part of this valuable handbook is written on much the same lines as Part IV, already noticed in this *Bulletin* (1910, 8. 331).

The life histories of 30 insects are recorded and illustrated in colour. Information is given also as to the best methods of dealing with these pests. As in the previous part, much attention is given to insects attacking forest trees. Some additional insect-destroying birds are also described in the present volume. As these birds are of great value to agriculturists and foresters, it is necessary that they should be distinguished from the destructive fruit- and grain-eating kinds. The descriptions and coloured plates given should help considerably towards this end. Following the preface is a Report by J. G. Turner, Senior Inspector of Fruit Exports and Imports, embodying the regulations now in operation concerning the import of fruit, plants, potatoes, etc., into the State. At the end of the volume is a short summary of information regarding spraying materials and the newest forms of spraying machines on the market.

LIBRARY.—RECENT ADDITIONS.

Books, etc., exclusive of periodical Government publications, presented to the Library of the Imperial Institute since August 30, 1910. The names of donors are printed in italics.

INDIA :—Report of the Bengal Chamber of Commerce for 1909 and 1910. (*The Secretary.*) Official Handbook of the United Provinces Exhibition, Allahabad, 1910–11. (*The Superintendent, Government Press.*) Fauna of British India, including Ceylon and Burma. Rhynchota.—Vol. V. Heteroptera: Appendix. By W. L. Distant. The "Times of India" Calendar and Directory for 1911. The Asylum Press Almanac of Madras and Southern India, 1911. Thacker's Indian Directory for 1911. (*The Secretary of State for India.*) Report of the Burma Chamber of Commerce for 1910. (*The Secretary.*) Report of the Karachi Chamber of Commerce for 1910. (*The Secretary.*) Report of the Madras Chamber of Commerce for 1910. (*he Secretary.*)

CEYLON :—Ceylon Manual for 1911. Ferguson's Ceylon Handbook and Directory for 1910–1911. (*The Crown Agents for the Colonies.*) Report of the Ceylon Chamber of Commerce for the half-year ended December 31, 1910. (*The Secretary.*)

STRAITS SETTLEMENTS :—Report of the Singapore Chamber of Commerce, 1910. (*The Secretary.*)

FEDERATED MALAY STATES :—Grenier's Rubber Annual, 1910. (*The Publishers.*) An Illustrated Guide to the Federated Malay States. Edited by C. W. Harrison. (*The Publishers.*)

AUSTRALIA :—Memoirs of the Royal Society of Australia, Vol. II, Part 2.—Archæocyathinæ from the Cambrian of South Australia.

Year Book, 1910–1911. (*The Secretary.*) Kalendar of the Royal Institute of British Architects, 1910–1911. (*The Secretary.*) National Museum of Wales: Third Annual Report, 1909–1910. (*The Director.*) Annual Report of the Central and Associated Chambers of Agriculture, 1910. (*The Secretary.*) Review of the Frozen Meat Trade, 1910. (*Messrs. W. Weddel and Co.*) Proceedings of the Anglo-Russian Literary Society. Oct.–Dec., 1910 and Feb.–April 1911. (*The President.*) Royal Society of Edinburgh: Proceedings.—Vols. XXX, Part 3, and XXXI, Parts 1, 2, 3 and 4. Transactions.—Vol. XLIV, Parts 1, 2 and 3. (*The Secretary.*) University of Leeds: Seventh Annual Report, 1909–1910. (*The Registrar.*) The Newspaper Press Directory, 1911. (*The Publishers.*) Report of the Leeds Incorporated Chamber of Commerce, 1910. (*The Secretary*). British South Africa Company: Directors' Report and Accounts, 1909–1910. (*The Secretary.*) My Life among the Bluejackets. By Agnes Weston. (*The Author.*) Directory of Paper Makers, 1911. (*The Publishers.*) Proceedings of the Royal Institution of Great Britain, Vol. XIX, Part 1. (*The Secretary.*) Gas Manufacture and Lighting. By H. O'Connor. (*The Royal Scottish Society of Arts.*) Transactions of the Highland and Agricultural Society of Scotland. Fifth Series. Vol. XXIII, 1911. (*The Secretary.*) The Stock Exchange Official Intelligence, 1911. (*The Secretary of the Stock Exchange.*) Crown and Realm: A Review of the British Empire, its Builders and Rulers. A Souvenir of the Coronation of King George V. (*Messrs. Burroughs and Wellcome.*) Edinburgh and East of Scotland College of Agriculture: Reports: XXIII.—Experiments in the Improvement of Old Pasture, 1908–1910; XXIV.—Experiments with Potatoes, 1910. (*The Secretary.*) Initia Amharica: An Introduction to spoken Amharic. By C. H. Armbruster, M.A. (*The Syndics of the Cambridge University Press.*)

CHILE: Estadística Minera de Chile en 1906 i 1907. (*J. W. Evans, D.Sc., F.G.S.*)

FRANCE:—Les Plantes à Caoutchouc du Nord de Madagascar, and Le Palmier à Huile à Madagascar. By H. Jumelle et H. Perrier de la Bathie. (*The Authors.*) Annales du Musée Colonial de Marseille, Vol. VIII, 1910. (*The Director.*) Étude sur la Langue Mossi. By F. Froyer. (*Le Gouverneur des Colonies Sénégal.*)

GERMANY:—Jahresbericht der Deutschen Gerberschule zu Freiberg in Sachsen, 1910–1911. (*The Secretary.*)

HOLLAND:—Catalogus van s'Rijks Ethnographisch Museum: Deel III.—Catalogus der Bibliotheek. Katalog des Ethnographischen Reischmuseums: Band II.—Borneo. (*Director of the Museums.*)

JAPAN :—Report of the Yokohama Foreign Board of Trade for 1910. (*The Secretary.*)

PORTUGAL :—The Delagoa Directory, 1911. (*The Publishers.*) Associação Commercial do Porto—Relatorio da Direcção no anno de 1910. (*The Secretary.*)

UNITED STATES :—Twenty-fifth Annual Report of the Missouri Botanical Garden. (*The Director.*) Annual Report of the Smithsonian Institution, 1909. (*The Secretary.*) Textile Industries of Philadelphia. By J. J. Macfarlane. (*Philadelphia Commercial Museum.*)

conditions, and in at least one case, viz. in Uganda, this work has resulted in the establishment of lemon grass oil distillation on an industrial basis.

LEMON GRASS OILS.

These oils are derived mainly from two kinds of lemon grass, viz. *Cymbopogon flexuosus* and *C. citratus*. The former yields an oil which is soluble to a clear solution in two or more times its own volume of 70 per cent. alcohol, and is consequently spoken of as "soluble" lemon grass oil. The oil from *C. citratus*, as a rule, is not completely soluble even in 10 times its volume of 90 per cent. alcohol, and consequently is spoken of as "insoluble" lemon grass oil. The "soluble" oil is suitable for a greater variety of purposes than the "insoluble" oil, and consequently fetches a higher price than the latter, when it is equally rich in the odoriferous constituent citral.

Recently a third kind of lemon grass has been recorded, viz. *Cymbopogon pendulus*, Stapf, which is grown in certain districts of India, and, like *Cymbopogon citratus*, yields an "insoluble" oil.

Lemon grass oil is chiefly produced in India, though small quantities are now also obtained from Ceylon, Java, and in the last two years from Uganda.

The price of lemon grass oil has risen considerably in recent years. At present good oil is worth 4¾*d.* per oz. as against 3¾*d.* to 4*d.* in November 1910, and 2*d.* to 2½*d.* in November 1909.

LEMON GRASS OILS FROM CEYLON.

Several samples of lemon grass oils were forwarded to the Imperial Institute by Mr. J. F. Jowitt in October 1908, along with the citronella oils already mentioned (this *Bulletin*, 1911, **9**. 241).

The grass yielding oils Nos. 13, 13a and 13* was identified by Dr. Stapf as *Cymbopogon citratus*. These are typical lemon grass oils of the "insoluble" class.

No. 13 consisted of very dark-coloured oil with a characteristic pleasant lemon grass odour.

No. 13a was a yellow oil with a pleasant odour. This sample was rather light-coloured for a lemon grass oil. A slight deposit was present.

No. 13* consisted of clear, deep-yellow oil, with a good lemon grass odour, rather more intense than in Nos. 13 and 13a.

	No. 13.	No. 13a.	No. 13*.
Date of distillation	17/6/07	14/10/07	5/8/08
Yield of oil, *per cent.* . . .	0·22	0·25	0·37
Specific gravity at $\frac{15° \text{ C.}}{15° \text{ C.}}$.	0·892	0·891	0·893
Optical rotation in 100 mm. tube at 20° C.	− 0°25′	− 0°39′	+ 1°7′
Citral by sodium bisulphite method; *per cent.* . . .	75·0	74·0	76·0
Solubility in alcohol . . .	Not soluble to a clear solution even in 10 volumes of 70, 80, or 90 per cent. alcohol.		

Two other samples of lemon grass oils from Ceylon were forwarded to the Imperial Institute as *Cymbopogon flexuosus* oils.

No. 19 consisted of golden-yellow oil, with a somewhat pungent odour resembling that of citronella. A slight deposit was present. The grass yielding this oil was supplied to Mr. Jowitt as that used for the distillation of lemon grass oil in Palghat, Southern India, which should be *Cymbopogon flexuosus.* The herbarium specimen supplied to the Imperial Institute, however, was identified by Dr. Stapf as *Cymbopogon nardus,* Rendle, var. *confertiflorus,* Stapf. This sample of oil behaves like a mixture of citronella and lemon grass oils, and was probably distilled from a mixture of grasses.

No. 19* consisted of yellow oil with a lemon grass odour which, however, differed slightly from that of Nos. 13, 13a and 13*. This oil differs very markedly from No. 19, and has assumed the "soluble" lemon grass type. It seems likely that the grass originally used by Mr. Jowitt was a mixture of a "mana" grass with true *Cymbopogon flexuosus,* and that on further cultivation the latter suppressed the "mana" grass to a large extent, so that in the second distillation almost pure *Cymbopogon flexuosus* grass was used. A specimen of grass from the same plot subsequently received from Mr. Jowitt was identified at Kew as *Cymbopogon flexuosus.* The oil as received is a rather poor sample of "soluble" lemon grass oil.

	No. 19.	No. 19*.
Date of distillation	8/8/07	1/8/08
Yield of oil, *per cent.*	0·34	0·31
Specific gravity at $\frac{15° C.}{15° C.}$	0·917	0·916
Optical rotation in 100 mm. tube at 20° C.	−7°29′	+0°35′
Citral by sodium bisulphite method, *per cent.*	35·0	67·5
Total alcohols, *per cent.*	57·8	58·5
Geraniol, *per cent.*	13·9	2·3
Solubility in alcohol	Gives a clear solution with its own volume of 80 per cent. alcohol and becomes slightly turbid with 10 volumes. Insoluble even in 10 volumes of 70 per cent. alcohol.	Gives a clear solution in 2·2 volumes of 70 per cent. alcohol. Easily soluble in all proportions of 80 or 90 per cent. alcohol. No opalescence with 10 volumes of alcohol.

Remarks on the Lemon Grass Oils from Ceylon.

These oils are represented by groups Nos. 13 and 19. The first of these is yielded by *Cymbopogon citratus*, and the three oils, Nos. 13, 13a and 13* are typical so-called "insoluble" lemon grass oils. Group No. 13 is therefore of especial interest as confirming Dr. Stapf's statement (see *Kew Bulletin*, 1906, p. 335) that *Cymbopogon citratus* is the source of the so-called "insoluble" lemon grass oil. Group No. 19 is abnormal, as noted on page 335. No. 19* is mostly composed of a "soluble" lemon grass oil, and it may be supposed that the grass from which it was distilled was mainly *C. flexuosus*, though the oil contains a rather low percentage of citral for a *C. flexuosus* oil.

If this experimental cultivation of Cymbopogon grasses is continued in Ceylon it would be worth while to extend the experiments suggested for citronella grasses (this *Bulletin*, 1911, 9. 252) to the two lemon grasses from which these oils were distilled.

LEMON GRASS OILS FROM INDIA.

These samples were forwarded to the Imperial Institute by the Economist Botanist at Dacca in October 1910.

No. 1. "Tyrna lemon grass oil," a deep-yellow oil having the usual odour of lemon grass oil.

These four oils all contained a satisfactory amount of citral, but the "Cochin" oil was particularly rich in this constituent, containing 84·5 per cent. Most lemon grass oils of commerce contain from 70 to 75 per cent. of citral. If, therefore, the "Cochin" grass grows well and gives a good yield of leaves, it will be desirable to encourage its cultivation rather than that of the other varieties.

LEMON GRASS OILS FROM UGANDA.

Several samples and consignments of lemon grass oil have been forwarded to the Imperial Institute from Uganda in recent years.

No. 1. This consisted of dark-coloured and rather cloudy oil. After filtration it was much clearer, but still dark in colour. It had a pleasant lemon grass odour.

Results of Examination of Lemon Grass Oils from Uganda.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5a.	No. 5b.
pecific gravity at 15° C.	0·870	0·8720	0·881	0·8834	0·8857	0·894
ptical rotation at 20° C. in 100 mm. tube	− 0° 10′	− 0° 7′	+ 0° 10′	− 0° 8′	− 0° 15′	− 0° 24′
ldehydes (by sodium bisulphite method) *per cent.*	67	64·5	70·5	70·25	66·5	75
olubility	Not completely soluble even in 10 volumes of 80 per cent. alcohol. Gave a clear solution with 90 per cent. alcohol, but on addition of more alcohol became turbid.	As No. 1	As No. 1, but remains clear until its own volume of 90 per cent. alcohol has been added.	Insoluble in 10 volumes of 70 per cent. alcohol, and did not give a clear solution with 10 volumes of 80 or 90 per cent. alcohol.	Insoluble even in 10 volumes of 70 per cent. alcohol.	As No. 5
alue	Less than 2*d.* per oz.*	As No. 1	As No. 1	Sold at 2*s.* 3*d.* per lb. in London (August, 1909).	Sold in London at 2*s.* 8 per lb. (Nov., 1909).	

* *The value of good East Indian lemon grass oil, containing 75 per cent. of aldehydes, at the time of the report (Sept. 1909) was 2d. per oz. This oil from Uganda containing only 67 per cent. of aldehydes, and being less soluble in alcohol, would realise a lower price. Prices were then very low, a year previously the best lemon grass oil realised 6d. to 7d. per oz.*

No. 2. The sample was obtained from grass 1 year 3 months old, grown at Entebbe. It consisted of dark-brown oil, having a pleasant lemon grass odour.

No. 3. This was labelled "No. 3 from grass one year nine months old, grown at Entebbe." The sample consisted of light-brown oil, rather paler than No. 4 sent at the same time. It had a pleasant lemon grass odour.

No. 4. This consisted of 15 cases, each containing 12 bottles The oil was golden-brown in colour, and had a pleasant, characteristic lemon grass odour.

No. 5. This consisted of 20 cases, each containing 12 bottles The oil was golden-yellow in colour, and had the characteristic odour and sharp taste of lemon grass oil. It was slightly turbid, owing to the presence of a small quantity of water.

The results of the chemical examination of this Uganda lemon grass oil indicated that it was of the "insoluble" type, and this was confirmed later by the identification of the Uganda lemon grass at the Royal Gardens, Kew, as *Cymbopogon citratus*.

Lemon grass oil distillation in Uganda was at first undertaken under Government control, and in 1909–10 the exports amounted to 16,063 oz., valued at £72. The industry has now been taken over by a commercial firm.

LEMON GRASS OILS FROM BERMUDA AND MONTSERRAT.

A sample of lemon grass oil, derived from *Cymbopogon citratus* was sent for examination to the Imperial Institute from Bermuda in December, 1907. The oil possessed the usual odour of lemon grass oil, but was lighter in colour.

Chemical examination of the sample gave the following results:—

Citral, *per cent.*	40
Specific gravity at 15° C.	0·8689
Optical rotation in 100 mm. tube at 20° C.	— 0° 21′
Solubility	The oil was not completely soluble in 70 or 80 per cent. alcohol.

This oil contains a much lower percentage of citral than is usually present in lemon grass oil. For this reason it is unlikely that it could compete with the much richer oils from India, Ceylon and elsewhere containing up to 80 per cent. of citral, at any rate under the conditions existing at the date of the report (March 1908), when the price of lemon grass oil was very low, owing to over-production.

A report on lemon grass oil from Montserrat has been published already in this *Bulletin* (1904, 2. 166). It was of the "insoluble" type, but contained over 74 per cent. of citral, and was valued at 4½*d.* per oz. in 1904, when "soluble" lemon grass oil containing 70 to 75 per cent. of citral was quoted at 5*d.* to 6*d.* per oz.

(*To be continued.*)

THE "IBEAN CAMPHOR" TREE OF THE EAST AFRICA PROTECTORATE.

IN a Report on the Forests of Kenia, East Africa Protectorate, by Mr. D. E. Hutchins (Colonial Reports, Miscellaneous, No. 41 [Cd. 3561], 1907), attention was drawn to this tree, concerning which the following statements were made (p. 18):—

"The most valuable species in the Kenia Forest is a tree about which little has been known up to the present, and which for convenience may be termed Ibean camphor. The Kikuyu name is Mozaiti or Mozite. . . . The green bark, green wood, and all the herbaceous parts of the tree have a camphoraceous smell. The structure of the timber and the seed vessel point to the tree being allied botanically to the true camphor (*Cinnamomum Camphora*)."

The possible occurrence of a new camphor-yielding species in East Africa was a matter of considerable economic importance, and in response to a request from the Imperial Institute, specimens of the wood were sent from East Africa in June, 1908. They included two different kinds of wood: (*a*) planks 2½ inches thick, 9 inches wide and 5 feet 6 inches long, and (*b*) boards ¾ to 1 inch thick, 5 to 9 inches wide, and 2 to 3 feet long.

The thick planks were open-grained in structure and almost white, and when freshly scraped they had a slight odour recalling that of pine wood. The planks appeared to consist of sapwood, and should therefore, according to Mr. Hutchins'

	Oil from sapwood Sample No. 1.	Oil from branches and twigs Sample No. 2.	Oil from branches and twigs (pollard shoots) Sample No. 3.	Oil from the bark (Schmidt and Weilinger).
Yield of oil, *per cent.*	0·4	0·52	0·14	0·15
Specific gravity at $\frac{15^\circ C.}{15^\circ C.}$	0·9641	0·9681	0·9327	0·913 at 20° C.
Optical rotation in 100 mm. tube . .	$-7^\circ 30'$	$-7^\circ 30'$	$-0^\circ 28'$	$-11^\circ 12'$
Saponification value	30·1	30·1	13·3	13·7
Solubility in alcohol	Soluble in 1·1 volumes of 80 per cent. alcohol.	As No. 1.	Insoluble even in 10 volumes of 80 per cent. alcohol.	—

The oils obtained from samples No. 1 and No. 2 were pale-yellow and had an odour recalling that of eucalyptus oil. They were found to contain a comparatively small amount of cineol, whilst camphor could not be detected.

The oil from sample No. 3 was more mobile than the other two specimens. It was similar to them in colour and odour, but possessed a stronger eucalyptus odour, and probably contained a larger proportion of cineol, but the amount of oil obtained was too small to permit of the estimation of cineol.

In the oil from the bark Schmidt and Weilinger (*loc. cit.*) found cineol, *l*-terpineol, myristic aldehyde, esters, a sesquiterpene and minute amounts of a ketone and terpenes; the first two substances forming 80 per cent. of the whole oil.

Conclusions.

The results of the investigation show that the younger parts of the "Ibean camphor" tree, such as the twigs, leaves, branches and sapwood, yield small quantities of volatile oil containing cineol, the characteristic constituent of eucalyptus oil. The quantity of oil obtained is too small to make the wood of value as a source of volatile oil, and in any case the latter would only be a poor substitute for eucalyptus oil. Its presence in the wood, however, no doubt exerts a certain antiseptic and preservative action, so that "Ibean camphor" wood should have the property of lasting well, and should be less susceptible to decay than woods free from volatile oils of this type.

From a mechanical point of view, the timber is of good quality and well suited for use for various purposes in East Africa.

It is a little unfortunate that the name "Ibean Camphor" has been adopted for this tree, since it at first gave rise to the impression that the true camphor tree had been found in East Africa (compare *Chemist and Druggist* 1907, **70**. 974), and this still continues (*ibid.* 1911, **79**. 18, and *Schimmel & Co.*, *Semi-annual Rep.*, Oct. 1911, p. 27). With a view to correcting this impression it seems worth while to place the above facts on record.

PARA RUBBER FROM SEYCHELLES.

The Para rubber tree (*Hevea brasiliensis*) was introduced into Seychelles some years ago for experimental purposes, and, as the trials gave very promising results, it was generally adopted for cultivation in the islands. It was estimated that 70,585 Para trees were growing in Seychelles at the end of 1910, of which 4,511 had reached a tappable size. The oldest trees in the islands are now being tapped, and the first consignment of the rubber has been recently sold on the London market. In these circumstances it will be of interest to record the results of the examination at the Imperial Institute of specimens of Para rubber from Seychelles.

No. 1. "*Para rubber from Praslin.*" This sample weighed 4 oz., and consisted of a small biscuit of rubber, brown externally but white and very moist within; it had a strong sour odour when freshly cut. The rubber was weak and tore readily when stretched.

No. 2. "*Para rubber from Victoria.*" One biscuit of rubber weighing 7 oz. It closely resembled the preceding specimen No. 1 in appearance and physical properties.

No. 3. "*Para rubber from Cascade.*" One biscuit of rubber weighing 11 oz. It was very similar in all respects to the other two specimens.

The results of the chemical examination are given in the table on the following page.

These samples of Para rubber were stated to have been obtained from a small number of trees less than five years old, which had reached a tappable size. The results of the investigation showed that, so far as chemical composition is concerned, the rubber was very satisfactory, as the analytical figures com-

	Rubber as received.			*Composition of dry rubber.*		
	Praslin. *Per cent.*	Victoria. *Per cent.*	Cascade. *Per cent.*	Praslin. *Per cent.*	Victoria. *Per cent.*	Cascade. *Per cent.*
Moisture	17·2	12·7	12·6	—	—	—
Caoutchouc	77·7	82·1	81·7	93·9	94·1	93·6
Resin	2·3	2·0	2·7	2·8	2·3	3·1
Proteid	1·8	2·0	2·8	2·1	2·3	3·1
Insoluble matter	1·0	1·2	0·2	1·2	1·3	0·2
Ash	0·1	0·3	0·1	0·1	0·3	0·1

pare favourably with those obtained for Para rubber from Ceylon and the Federated Malay States. In physical properties, however, the rubber was very defective, being exceedingly weak. This defect was, no doubt, due in part to the fact that the rubber had been prepared from young trees, but it seemed probable that the very moist condition of the biscuits had also contributed to the result.

The two further specimens referred to in the following paragraphs were stated to have been prepared from young Para trees four to six years old growing at the Botanic Station and at Government House in Seychelles.

No. 4. Large cakes of rubber from $\frac{3}{8}$ to 1 inch in thickness, light brown externally but almost white internally. The rubber was rather moist, and its elasticity and tenacity were poor.

No. 5. Large biscuit of rubber, $\frac{3}{8}$ to $\frac{1}{2}$ inch thick, almost black externally but light within. The rubber was much drier than the preceding specimen, but rather weak.

The chemical examination gave the following results:—

	Rubber as received.		*Composition of dry rubber.*	
	No. 4. *Per cent.*	No. 5. *Per cent.*	No. 4. *Per cent.*	No. 5. *Per cent.*
Moisture	12·4	3·1	—	—
Caoutchouc	81·5	90·9	93·1	93·8
Resin	3·3	2·5	3·7	2·6
Proteid	2·6	3·4	3·0	3·5
Ash	0·2	0·1	0·2	0·1

The samples were valued at about 6*s.* per lb. in London, with fine hard Para quoted at 8*s.* 6*d.* per lb.

These results show that the rubber is very satisfactory in chemical composition, the figures given above agreeing closely with those found for previous samples of Para rubber from Seychelles, and comparing favourably with those recorded for plantation Para from Ceylon and Malaya.

The rubber was submitted to brokers, who valued the light biscuits at about *7s.* per lb. and the dark biscuits at *6s.* 11*d.* per lb. in London, with fine hard Para quoted at *6s.* 11*d.* per lb. and fine plantation Para at *6s.* 11*d.* to *7s.* 10*d.* per lb.

The physical properties of this sample show a considerable improvement on those of the previous specimens from Seychelles, and there is little doubt that the Para trees in Seychelles, when mature, will yield rubber of excellent quality.

The results of the sale in London of the first small consignment of Para rubber in biscuits and scrap from Seychelles fully confirm the above conclusion regarding the quality of the product. The biscuits realised *4s.* $2\frac{1}{2}$*d.* per lb., with fine hard Para at the same price, and it was stated that when the rubber is available in larger quantities the price obtained will be equal to that of the finest plantation Para.

THE CAUSATION OF MOLTENO, PICTOU OR WINTON DISEASE IN CATTLE AND HORSES.

FOR some years past attention has been directed in certain districts of the Union of South Africa, Canada and New Zealand to a disease affecting horses and cattle and inducing hepatic cirrhosis.

In each of these countries the disease is known by a different name, associating it with the locality in which it is most common; thus in South Africa it is called "Molteno disease," in Canada "Pictou disease," and in New Zealand "Winton disease." In all three cases it has been more or less clearly proved that the disease is associated with the occurrence in the grazing grounds of plants belonging to the genus Senecio, a genus to which the common "groundsel" (*Senecio vulgaris*) and the "ragwort"

(*S. Jacobœa*) of this country belong. In the Pictou district of Nova Scotia, to which the disease is confined in Canada, the species incriminated is *Senecio Jacobœa*, and it is this species, also, which is believed to cause the disease in New Zealand. In South Africa two other species, viz. *Senecio latifolius* and *S. Burchellii*, are concerned.

With the object of ascertaining definitely whether the consumption of *Senecio latifolius* by horses and cattle caused "Molteno disease," the Government of Cape Colony forwarded a consignment of this plant to the Imperial Institute in 1907, with a request that it might be examined to ascertain whether it contained any noxious constituent likely to be the cause of this disease.

An investigation of this kind involves two kinds of work; in the first place, the plant must be examined chemically and any unusual constituents it contains isolated in a pure state, and, in the second place, these unusual constituents must be examined physiologically to ascertain whether they possess noxious properties. The chemical examination of *Senecio latifolius* was made in the Scientific and Technical Department of the Imperial Institute by Dr. H. E. Watt, whose results were published in the *Transactions of the Chemical Society* (1909, **95**. 466); whilst the physiological examination of the pure materials prepared by Dr. Watt was undertaken for the Imperial Institute by Dr. A. R. Cushny, F.R.S., of University College, London, who has published a summary of his results in the *Proceedings of the Royal Society* (1911, B, **84**. 188) and in the *Journal of Pharmacology and Experimental Therapeutics* (1911, **2**. 531).

The results recorded in these papers leave no doubt that the "Molteno disease" of South Africa can be caused by the consumption of *Senecio latifolius*, and, as the matter is one of very considerable economic importance to stock-owners, it seems worth while to give a summary of the results obtained in these investigations in this *Bulletin*. It may be added that, since the examination of *Senecio latifolius* from South Africa was undertaken, two consignments of *Senecio Jacobœa* have been received at the Imperial Institute from Canada for investigation on the lines adopted in the case of *S. latifolius*, and considerable progress has been made with this work.

The symptoms of the disease as described in the three localities concerned are practically identical. Cattle are observed to be "unthrifty" for some time, but definite symptoms appear only three or four days before death, and commence often in diarrhœa, diminished milk, dry and staring coat, and disinclination to feed. The diarrhœa is not necessarily severe, but is often followed by straining, which increases in intensity and frequency, and may lead to eversion of the rectum and rupture of its vessels. Considerable pain appears to be felt, the cattle groaning and lying down or becoming frenzied and charging any one who approaches. Eventually unconsciousness sets in and death follows in two to four days after the first definite symptoms are observed. *Post-mortem* investigation generally shows marked pathological changes in the liver, gall-bladder, fourth stomach and intestine, especially at the openings of the bile ducts and sometimes also in other organs.

The economic importance of the disease may be gathered from the fact that in Nova Scotia it is believed to have caused the loss of several thousand head of stock (*Special Report on Pictou Cattle Disease, Dept. Agric. Canada*, 1906, p. 8), and in the East London district of South Africa it has rendered horse-breeding impossible, as the mares contract the disease after two years or more grazing (*Rept. Dir. Agric. Cape Colony*, 1906, p. 41).

Senecio Jacobæa has long been regarded as the cause of the disease in Canada, but experiments carried out there in 1882 seemed to negative this idea, and for some time "hepatic cirrhosis" in cattle was regarded as a contagious disease, and investigations into the pathology of the disease seemed to confirm that conclusion to some extent (compare especially Adami, *Montreal Medical Journal*, February 1902).

In 1902 Gilruth (*Tenth Rept. Dep. Agric. N.Z.* 1902, p. 300), observing that cattle affected with "Winton disease" had been eating *Senecio Jacobæa*, fed two healthy calves on a ration containing this weed and found that they both became ill after about eighteen days and died on the twenty-eighth and thirtieth day of the experiment. The symptoms and *post-mortem* appearanees were typical of "Winton disease."

were prepared and eventually separated into their components, which proved to be two new alkaloids, which have been named *senecifoline* and *senecifolidine* respectively. Both alkaloids crystallise well, and yield crystalline salts, and for the physiological experiments crystallised specimens of senecifoline nitrate and senecifolidine nitrate were used. Full details of the chemistry of these alkaloids, so far as this has been studied, are given in the paper on this subject already referred to.

Results of Physiological Experiments with the Alkaloids of Senecio latifolius.

The details of the physiological experiments conducted with these alkaloids are given in the papers on this subject already mentioned, and it is only necessary to reproduce here Dr. Cushny's conclusions that the symptoms and *post-mortem* findings in animals poisoned by senecifoline nitrate or senecifolidine nitrate resemble so closely those described by Gilruth, Chase, Pethick and others in cattle and horses, that there can be no question that the cause is the same in each, and that the Molteno, Pictou or Winton disease is really more or less chronic poisoning with Senecio alkaloids. The hepatic cirrhosis obtained in these experiments with Senecio alkaloids was less complete than has been observed in cattle, but this is explained by the shorter duration of poisoning in the laboratory animals employed

PREVENTION OF POISONING BY SENECIO SPECIES.

The causation of Molteno, Pictou or Winton disease by Senecio species may now be regarded as so clearly established that it is worth while to consider the practical possibilities of avoiding loss of cattle from this cause. In Canada, where the subject has received more attention perhaps than elsewhere, the extermination of ragwort has been attempted with a considerable degree of success. The attention of farmers has been directed to the connection of ragwort (*Senecio Jacobæa*) with Pictou disease by means of simply-worded leaflets and by addresses delivered by experts at village meetings of farmers and in other like ways. In these leaflets and addresses farmers have been recommended to clear this plant from their lands by (1) adopting a shorter rotation of crops; (2) more thorough cultivation; (3) the use of weed-destroying implements; (4) cutting ragwort before the seed forms; (5) grazing sheep on land infested with ragwort. These measures have proved so successful that there has been a very marked decrease in the number of cases as compared with former years. In several districts where a few years ago the disease was prevalent not a case was reported in 1908–9 (Pethick, *Rept. Vet. Dir. Gen.* 1908–9, p. 113, *Dept Agric. Canada*). Though conditions in South Africa are very different from those prevailing in Nova Scotia, and the eradication of the Senecio species indigenous there a still more difficult problem, it would seem advisable that action on the lines which have proved so successful in Canada should be attempted wherever Senecio species are present in large quantity on grazing land.

THE IRRITANT ACTION OF SATINWOOD.

Two varieties of satinwood come into commerce distinguished according to their origin as East Indian and West Indian. The former is derived from *Chloroxylon Swietenia*, D.C., and the latter from *Zanthoxylum flavum*, Vahl. Both woods are used in cabinet- and furniture-making, and in the decoration of ships' cabins, and for other similar ornamental work. In 1898 and again in 1904 there were complaints from workmen using satinwood in this country that it produced severe skin eruptions, and at that time a number of articles dealing with the skin irritation produced by satinwood were published by medical men who had come into contact with such cases (Jones, *British Medical Journal*, June 25, 1904; Bidie, *ibid.*, January 14, 1905; Graham, *ibid.*, April 15, 1905).

At first there was some doubt as to whether one or both varieties of satinwood produced these effects, but in the *Annual Report of the Chief Inspector of Factories* for 1907 it is made clear that the outbreaks which have occurred in East London, Glasgow and Bristol, were all due to East Indian satinwood, and that the West Indian wood has not so far caused trouble of this kind.

The attention of the Imperial Institute was directed to this question in 1904 by Mr. J. Whitton, Superintendent of Parks, and Curator of Botanic Gardens, Glasgow, who forwarded small supplies of the wood which was then producing trouble of this kind in shipyards in Glasgow.

The investigation of both kinds of satinwood was undertaken at the Imperial Institute, and a short note on the constituents of the East Indian satinwood was published in this *Bulletin* (1909, 7. 93) fuller details of the scientific work being given in the *Transactions of the Chemical Society* (1909, **95**. 964) in a paper by Dr. Auld of this Department. In this it was shown that the East Indian satinwood contains an alkaloid (*chloroxylonine*), two resins, one amorphous and the other crystalline, and a fixed oil, and the chief characters of these substances were described.

The pharmacological action of the timber and of the constituents referred to above, prepared at the Imperial Institute, has been investigated by Prof. J. T. Cash, F.R.S., of Aberdeen University, and the results of his experiments have been published recently in the *British Medical Journal* (Oct. 7, 1911).

Damp satinwood sawdust was kept applied to the arm for 15 hours daily. On the morning of the fourth day there was considerable irritation, with redness. The irritation increased, especially at night, and after six days, desquamation ensued, and was very evident for the succeeding ten days. Irritation continued at intervals for three weeks after its first development; it was worst after exercise, or under the influence of warmth. Sawdust moistened with almond-oil proved rather more effective in its action than that moistened with water, whilst the dry dust was less rapid than either of the foregoing in producing its action.

The alkaloid chloroxylonine and its salts (the hydrochloride and nitrate), applied either as an ointment or in alcoholic solution, proved, towards two out of three individuals, insidious but powerful irritants. In neither case was there any effect on the first application, but definite symptoms appeared after an interval of four days in one case and twenty-two days in the other, from the date of a second application. Subsequent applications acted with much greater rapidity.

STRÜVERITE, A RARE TANTALUM MINERAL FROM THE FEDERATED MALAY STATES.

A SPECIMEN of a lustrous, black mineral, found in the Kuala Kangsar District, Perak, Federated Malay States, was sent to the Imperial Institute for examination late in 1909, by the Government Geologist, Mr. J. B. Scrivenor. A second supply was forwarded in March 1911.

It proved to be strüverite, a rare mineral consisting essentially of an isomorphous mixture of tapiolite (iron tantalate) and rutile (titanium dioxide).

As strüverite had previously been described from only one locality, the opportunity was taken to make a complete examination of the specimen from the Federated Malay States, and a paper giving a complete account of the results obtained has been communicated to the Mineralogical Society of London by Messrs. Crook and Johnstone, Senior Assistants in the Scientific and Technical Department of the Imperial Institute. This paper will be published in due course in the *Mineralogical Magazine*, and may be consulted for details of scientific importance.

The strüverite, as received, was mixed with cassiterite and quartz, from which it was separated in as clean a state as possible, and then on analysis gave the following percentage results:—

Titanium dioxide	TiO_2	45·74
Tantalic oxide	Ta_2O_5	35·96
Niobic oxide	Nb_2O_5	6·90
Ferrous oxide	FeO	8·27
Manganous oxide	MnO	trace
Stannic oxide	SnO_2	2·67
Silica	SiO_2	0·20
Water (above 105° C.)		0·42
Moisture (at 105° C.)		0·08

The only constituent of the mineral which is likely to be of commercial value is the tantalic oxide.

At present there is a small demand for tantalum for the manufacture of filaments for incandescent electric lamps, but it is also known that it can be used for hardening steel (see this

Bulletin, 1907, 5. 429). The principal obstacle to the use of tantalum for this latter purpose hitherto, has been the high price demanded for its chief ore, tantalite; but this ore has been offered recently at a lower price, and it is possible that in the future tantalum may be used in steel manufacture. In view of this possibility, makers of ferro-tantalum alloys were consulted as to the feasibility of using strüverite for their purposes, should the mineral prove to be obtainable in quantity. They were of opinion that it would be possible to utilise strüverite as a source of tantalum.

Strüverite, however, would have to be offered at a relatively lower rate than tantalite, since it contains a lower percentage of tantalic acid and would be more expensive to smelt.

GENERAL NOTICES RESPECTING ECONOMIC PRODUCTS AND THEIR DEVELOPMENT.

CULTIVATION, PREPARATION AND PRODUCTION OF FLAX AND LINSEED

THE flax-plant is an annual herb known botanically as *Linum usitatissimum* Linn. belonging to the N. O. Linaceæ. It has been grown from very remote times in European countries and in India and Egypt on account of the valuable fibre, known as flax, which is obtained from its stems. In common with many plants which have long been in cultivation, the flax-plant has produced many local forms, and its geographical origin is doubtful. Most authorities agree with De Candolle, who considered it indigenous to certain localities situated between the Persian Gulf and the Caspian and Black Seas. At the present time its cultivation, either for the sake of its seed, which is known in commerce as linseed, or for flax fibre, extends over wide areas in the temperate and warm-temperate regions of both hemispheres. In European countries the flax-plant is cultivated chiefly for fibre, but in Russia both the seed and the fibre are produced on a large scale. In India and Canada, the United States of America and Argentina, which together with Russia produce the bulk of the world's supply of linseed, the fibre is of little importance, or at most it occupies a secondary position. A company has, however, recently been formed in Argentina for the purpose of preparing fibre from flax-straw after the seed capsules have been cut off. This fibre is short, and is used chiefly for making fine paper, but a German firm has invented and patented a process for spinning it, which is said to have given good results. The present output is about 100 tons a month, but a new factory is being set up near Rosario which is expected to produce 10,000 tons a year. The total annual output of flax-straw in Argentina is estimated at 3,500,000 tons, which has hitherto been burnt as useless. From this quantity it is believed that 850,000 tons of fibre can be prepared. Although a certain amount of linseed is obtained as a by-product of flax cultivation, attempts to produce both linseed and flax of good quality from the same crop usually result in the production of inferior samples of both. As a general rule the cultivation of the flax-plant for the production of linseed is an undertaking distinct from its cultivation for flax.

The flax-plant, as known under cultivation, is an erect-growing annual with a slender stem rising to a height of from 20 to 40 or more inches, branching only at the top and furnished with entire, narrow, lance-shaped leaves. Each branch or branchlet terminates in a bright-blue or sometimes whitish flower, about 1 inch in diameter when fully expanded, borne on a slender erect pedicel about 1 to 1¼ inch long. The flower is symmetrical and composed of five sepals that are small, persistent, and have a membranous ciliated margin. The petals, five in number, are twice as long as the sepals and fall very early. The five stamens are united at the base, and alternate with five minute staminodes. The styles are free and five in number. The fruit or "boll" is a five-celled capsule, each cell of which is divided into two by a spurious partition, so that there are ten divisions each containing one seed. The seeds are heavy, about ⅛ inch long, smooth, glossy, pear-shaped in outline and oval in cross section; of a reddish or chestnut-brown colour, or in the case of "white" linseed, pale straw-yellow. The outer seed-coat or testa contains an abundance of mucilage, and lining the inner coat is a thin layer of albumen. The embryo has two fleshy cotyledons, rich in oil. Linseed produced

heat and drought are moderate. For the production of the finest fibre of uniform quality it is essential that the plant should be able to maintain a regular development with few, if any, checks from the time the seed germinates until harvesting takes place. Belts of coast land subject to cloudy skies and a moisture-laden atmosphere, and possessing soil that is moist and well-drained, are the localities in which the flax-plant attains its greatest perfection. The littoral from the south of Spain northwards by France, Belgium, Holland, Scandinavia, the Baltic and the White Sea districts as well as parts of Ireland comprise the principal flax-producing countries. A somewhat warmer and drier climate, provided the soil is sufficiently retentive of moisture, is well suited to the flax-plant when grown for the production of seed.

SOILS.

As the flax crop occupies the land for but a short period and has a delicate and relatively small root-system, it demands a soil that is moist and rich in organic matter. A medium soil of good depth that is in a good state of cultivation is found to be the most suitable. The soil requirements are, however, found to vary somewhat with the prevailing climatic conditions, a lighter soil being more suitable where the rainfall is heavy and a heavier soil where drier conditions prevail. For the fibre crop it is important that the texture of the surface soil should be such as to give a fairly compact seed-bed, well-drained, but of a sufficiently sandy or loamy nature to prevent cracking during drought, and to form a suitable medium for the rapid spread of the roots of the seedling plants. A feature of the greatest importance is that there should be a heavy, rather compact sub-soil, capable of retaining moisture and of supplying it by capillarity to the soil above. Cold, wet or heavy clays are unsuitable as also are dry, calcareous soils, peaty soils with a clay subsoil and sandy soil resting on gravel. In Russia the flax-plant is grown for seed chiefly in black soil and for fibre in the common soil. In India, Bengal has usually a large area under linseed, which is produced most abundantly in the indigo districts. In this Province it is said to prefer well-drained, heavy, loamy soils especially if rich in lime, such as are suitable for wheat and gram. In the Central Provinces and Berar and in the United Provinces of Agra and Oudh the crop is largely sown as a secondary crop to rice, advantage being taken of any moisture retained in the soil after the rice crop is cut, to sow linseed, which is sometimes mixed with barley and gram. In Bombay and Sind the linseed crop is usually cultivated in the deep moisture-holding black soil, being rotated chiefly with wheat, gram or safflower and sometimes "juar" (*Sorghum vulgare*). In Egypt linseed succeeds well on black loamy soils. In Upper Egypt the seed is usually sown on the mud when the water leaves the basins, and may or may not be watered afterwards. In Lower Egypt the land is divided into small areas by ridges; into these areas water is admitted and immediately run off again; sowing then takes place and subsequently two waterings are given, one when the crop is 8 to 10 inches high and another just before the plants commence flowering. In the United States of America, Canada and Argentina the linseed crop is largely grown as a pioneer crop on virgin land.

Preparation of the Soil.

The tillage necessary to render the soil suitable for growing a flax crop depends on the nature of the soil and the locality. Lands that have been under a cereal crop and which are of a compact nature are usually ploughed to a depth of from 6 to 8 inches in the autumn, and this is followed in spring by harrowing and rolling to produce a fine but shallow and compact seed-bed. In the case of heavy lands an additional ploughing is given in the spring, and this should be done not less than two months before sowing takes place. This second ploughing should be shallow, not more 3 or 4 inches in depth, and should be followed by harrowing and rolling to produce a finely pulverised surface soil. In the case of light soils deep cultivation is sometimes harmful, and in dealing with these attention should be devoted to surface tillage for the destruction of weeds, leaving the sub-soil undisturbed. If of a stony nature the larger stones should be removed by hand-picking after each harrowing. The flax-plant succeeds well on virgin prairie land that has been newly broken. In dealing with such land the sod should be broken by shallow ploughing about July or August, followed later in autumn by a cross-ploughing of a greater depth. In the following spring it should be worked by the disk plough or harrowed. By this means the decayed turf is broken up and covered with a layer of fine soil, which forms a suitable rooting medium for the seedling plants, and produces heavy yields of seed. In some parts of northern Russia a system of cultivation prevails analogous to that known in the tropics as "chena" cultivation. Land covered with scrub and timber is cleared and the fellings burned on the soil, and a crop of flax taken from the clearing. The land is then abandoned to pasture, and ultimately is re-covered with scrub growth. After ten or fifteen years it is again cleared and cropped with flax. Small areas in Europe are frequently spade cultivated and the soil brought to the condition of that of a garden.

Manuring.

Good land that will produce a crop without direct manuring is preferable, but where this is not available the land must be manured, as it is useless to attempt the cultivation of the flax-plant on soil that is poor or impoverished. It is usually supposed that the flax crop is an exhausting one, but analysis of the plant ash shows that it is no more so than most cereal crops. The plant gives about 3 per cent. of ash containing potash 20·32, lime 19·88 and phosphoric acid 10·24 per cent. It is estimated that the crop extracts from an acre of land about 50 lb. alkalis (chiefly potash) and 24 lb. phosphoric acid. When grown for the production of fibre, direct manuring with farmyard manure is not recommended, as it is liable to produce an uneven crop and coarse stems. This objection, however, does not apply when the crop is grown solely for linseed. In using farmyard manure for the fibre crop it is best to apply it indirectly by taking some other crop from the land manured before planting with flax. In Belgium, where the finest flax is produced, farmyard manure from stall-fed cattle is applied to the land for the preceding cereal crop, and just before the flax-crop is sown a dressing of liquid manure is given. The latter usually consists of town

obtained by cropping flax once in two cycles of a short-course rotation, thus—

Year.	*Rotations with Flax.* Field No. 1.	Field No. 2.	Field No. 3.	Field No. 4.
1.	Maize	Oats	Clover	Flax
2.	Oats	Clover	Flax	Maize
3	Clover	Flax	Maize	Oats
4.	Flax	Maize	Oats	Clover
1.	Maize	Oats	Clover	Wheat
2.	Oats	Clover	Wheat	Maize
3.	Clover	Wheat	Maize	Oats
4.	Wheat	Maize	Oats	Clover
1.	Maize	Oats	Clover	Flax
2.	Oats	Clover	Flax	Maize

As an abundance of humus, or decayed organic matter, in the soil is required by the flax-crop, it succeeds well after cereals or potatoes that have been manured with farmyard manure. On light lands a leguminous crop is found to be of great benefit to flax, and clover is considered one of the best crops to precede it. Flax also grows well after a fallow, or following old pastures or on virgin prairie land; such soils have a further advantage in that they are usually free from troublesome weeds. Different countries favour different crops for rotating with flax, and no hard-and-fast rule appears to be followed. The usual cereal, leguminous, root and green crops are grown, and flax generally follows either potatoes, pasture or legumes.

DISEASES AND PESTS.

One of the most injurious of all the diseases to which the flax plant is subject is known as "flax-wilt," a fungoid disease due to *Fusarium lini*, Bolley. Soils infected with this fungus are common in the United States of America, and are said to be "flax-sick." The presence of this disease is made known by the wilting of the young plants. The disease usually occurs in patches at first limited in size to 3 or 4 feet in diameter, but if unchecked it gradually spreads until the whole crop is affected. It is most prevalent on land continuously cropped with flax. Unlike many fungoid diseases, the flax-wilt fungus appears to be able to live saprophytically for a considerable time in the soil, in the absence of a flax-crop to serve as host. Its chief means of distribution is by spores that attach themselves to the flax seeds, and with them are transported to new areas. By treating seed intended for sowing with formalin solution, consisting of 1 pint of commercial formalin to 40 gallons of water, any spores that may be present on the seeds are killed. The best method to follow in applying the solution is to spread the seeds on a stretched canvas, and to spray the solution through a fine nozzle or by means of an ordinary sprinkling pot. Whilst being sprayed the seed should be kept constantly turned over by a shovel or rake, so that it may be uniformly moistened. Great care should be taken only to moisten the seeds and not to make them wet, as owing to the mucilaginous nature of the seed-coat the seeds in excess of moisture are liable to stick together. If carefully done the seed should be sufficiently dry to sow within a few hours after treatment.

"Flax-rust," another fungoid disease, is due to *Melampsora lini*, Tul., that occurs over wide areas in Europe, in the United States of America, and also in Australia. Various species of Linum are attacked, as, for instance, the "purging flax." *L. catharticum*, which is abundant in many British pastures. Spores from wild species growing in the neighbourhood of cultivated flax readily infect the latter. The rust may be detected by the presence of small orange spots (the uredospores) that occur on the stems, leaves or sometimes sepals; or smooth blackish patches (the teleutospores) on the stem, sometimes covering it and blackening it all over. Affected plants should be uprooted and burned to prevent the spread of the disease.

Alternaria sp., and *Colletotrichum* sp., are other species of fungus recorded as attacking young flax plants in the United States of America.

The flax dodder (*Cuscuta epilinum*) is a parasitic plant belonging to the N.O. Campanulaceæ. Its seeds are frequently found mixed with those of flax, and the two kinds may thus be sown together. The seeds of the dodder take a longer time to germinate than those of the flax, so that the host plant is always available. On germination, the shoot of the dodder attaches itself to the young stem of the flax; its own root dies away, and it lives thenceforth at the expense of the flax plant, drawing food from the latter by means of "haustoria." This pest checks the growth of the flax plant and renders the stems unfit for fibre-production. Flax seed which is suspected to contain dodder seed should be carefully examined, and, if necessary, sifted to eliminate the latter as far as possible. The dodder seeds are considerably smaller than those of flax, somewhat oval in outline, grey or light brown in colour, with a rough or sometimes scurfy surface. They can be removed from flax seed with very little loss by the use of a sieve of fourteen meshes to the linear inch. Plants that are affected with dodder should be uprooted and burned, before the dodder flowers, to prevent its spread. Spraying the plants with a solution of ferrous sulphate has also been suggested as a remedy.

CULTIVATION FOR THE PRODUCTION OF SEED.

Sowing.—The land having been prepared as indicated above, sowing may take place as soon as late frosts are over. Care should be taken to select for planting plump, well-developed seed that has been properly stored in a cool, dry place. As is the case with many oil-seeds, the vitality of linseed is easily affected by "heating," during storage in bulk, by exposure to high temperatures, or to low temperatures in a moist atmosphere. Before sowing, the seed should be carefully examined, and sifted, if necessary, to remove any dodder seed that may be present; it should then be sprayed with formalin solution as a preventive of flax-wilt disease. Calcutta seed is generally considered the best to sow for the production of linseed. The seed is usually sown broadcast at the rate of from 2 to 3 pecks (25 to 40 lb.) per acre. A dry, calm day should be chosen for sowing, so that the seed may be evenly distributed over the land. Sowing is best done on a rolled surface, but some growers prefer a surface that has been lightly harrowed. After sowing, two strokes of the seed harrow should be given at right angles to each other. If the soil is dry, a light rolling across the field may follow; extra rolling should be given if the soil is light. In countries where the production of linseed is the chief object in cultivating the flax plant, machine drills are used for sowing. As broadcast sowing by hand requires experience on the part of the sower, machine drills possess a distinct advantage where experienced labour is not available. Care

are frequently introduced to the soil with imperfectly decomposed farmyard manure and other vegetable refuse, and one of the objections to the use of such manures for direct application to the flax crop is that thereby the cost of hand-weeding is greatly increased.

Harvesting.—When the capsules or seed bolls are mature and the straw ripe and yellow, the crop is ready to harvest. This is usually from three to four months, according to locality and climate, from the time of sowing. If no attempt is to be made to use the "straw" for producing fibre, the stems may be cut, as in the case of an ordinary cereal crop, by means of a sickle, or by a reaping machine or binder. If the last-named machine is used, the sheaves should be left as they fall until well dried on the upper side, when they should be turned with a pitch-fork, and the other side exposed to the sun. When cut with a sickle or by means of an ordinary reaping machine, the stems should be tied up into small bundles and stood in loose shocks to dry. When thoroughly dry, the crop should not be allowed to remain long in the field, or considerable loss of seed will follow during handling, or damage may ensue from mould owing to the successive wetting and drying to which the seed is exposed. If an outfit is available, the seed may be threshed as soon as dry, but if storage is necessary the crop should be carted and stacked.

An ordinary threshing machine properly adjusted may be used to obtain the seed, but when grown on a small scale the flail or flat mallet is frequently employed.

Yield.—The yield of linseed per acre varies considerably in different countries, on different soils, and from year to year. When obtained as a by-product of the fibre crop it naturally varies with the methods of cultivation adopted, and the season. Very little, if any, seed is obtained in Ireland as the fibre crop is pulled before the seed bolls mature.

The average yields of linseed in bushels per acre, in the United States of America, for the years 1905–9 are given in the official returns as follows:—

1905 . . .	11·2	1908 . . .	9·6
1906 . . .	10·2	1909 . . .	9·4
1907 . . .	9·0		

In Canada, the best variety of linseed is said to have produced an average yield of 21·3 bushels per acre in Manitoba during the past three years. The average of all varieties is, however, very much less than this amount, as shown in the following table :—

Yield per acre (bushels *).

Year.	*Manitoba.*	*Saskatchewan.*	*Alberta.*
1905	13·2	15·73	14·34
1906	14·6	9·35	10·65
1907	12·25	10·62	7·87
1908	11·8	9·78	7·96
1909	12·29	13·9	8·5
1910	9·97	7·68	3·02

* *1 bushel of linseed* = 52 *lb.* (*approx.*).

In India the yield is from about 500 to 700 lb. per acre from good, deep soil, but the crop is precarious and the yield may be very much less.

PRODUCTION OF LINSEED.

The following table taken from the *Year-book of the United States Department of Agriculture* for 1910 gives the countries producing linseed and the quantity produced during the years 1907–9 :—

Country.	1907. *Bushels.*	1908. *Bushels.*	1909. *Bushels.*
Austro-Hungary	1,510,000	1,156,000	1,086,000
Belgium	300,000	300,000	300,000
Bulgaria	2,000	2,000	2,000
France	613,000	722,000	436,000
Italy	*	*	281,000
Netherlands	392,000	341,000	219,000
Roumania	159,000	180,000	205,000
Russia (European)	20,568,000	18,639,000	21,298,000
Sweden	22,000	22,000	22,000
United States	25,851,000	25,805,000	25,856,000
Canada	1,732,000	1,499,000	2,213,000
Mexico	150,000	150,000	150,000
Argentina	32,502,000	43,333,000	41,291,000
Uruguay	863,000	723,000	522,000
India, including such native states as report	17,008,000	6,528,000	11,908,000
Russia (Asiatic)	1,276,000	1,442,000	1,844,000
Algeria	12,000	8,000	10,000
Total	102,960,000	100,850,000	107,643,000

* *Figures not available.*

Japan has recently become a linseed-producing country. The centre of the industry is in Otaru, Hokkaido. The latest particulars obtainable as to acreage and yield are as follows :—

	Area under Flax-plant. Acres.	*Production of Linseed.* Bushels.
1905 . . .	—	67,350
1906 . . .	13,700	101,000
1907 . . .	19,850	157,000

The latest crop is estimated at about 200,000 bushels.

The quantities and values of the linseed imported into the United Kingdom during the years 1908–10, together with the countries consigning the imports, are shown in the following table :—

	*Quantities (in quarters *).*			*Value (£).*		
	1908.	1909.	1910.	1908.	1909.	1910.
Russia	269,868	179,377	229,504	557,306	425,138	713,246
Germany	4,656	3,028	7,273	9,825	6,348	23,246
Netherlands	10,542	10,472	11,470	30,512	29,240	38,302
Belgium	13,016	7,097	4,788	28,693	15,792	14,365
France	1,650	19	1,038	3,372	43	3,268
Italy	260	406	185	568	903	474
Turkey (European)	967	1,623	14,242	2,066	4,139	50,874
,, (Asiatic)	279	468	1,277	625	1,165	4,941
Morocco	2,721	3,318	4,737	6,335	7,965	14,364
Persia	214	982	916	462	2,147	2,667
United States, America	71,488	35,293	22,643	154,486	86,558	59,528
Uruguay	24,692	12,362	308	50,409	26,721	895
Argentina	1,205,147	873,617	398,962	2,443,427	1,829,989	1,139,651
Cyprus	189	695	7	440	1,840	20
British India	409,010	540,161	774,665	907,712	1,250,918	2,409,281
Canada	47,199	25,808	7,028	97,668	67,764	20,214
Other Countries	6,097	2,702	116	13,108	5,521	382
Total	2,067,195	1,697,428	1,478,259	4,397,014	3,762,191	4,495,718

* 1 *quarter of linseed* = 416*lb.* (*approx.*).

LINSEED CULTIVATION IN BRITISH TERRITORY.

India and Canada are the principal linseed-producing countries in the British Empire. In India linseed is cultivated only as a "rabi" or spring crop. It is generally grown alone, except in parts of Bengal and the United Provinces, where it is sometimes mixed with wheat, rape or pulses. It is most important in the Central Provinces (including Berar), and is also extensively grown in Bengal, the United Provinces and Bombay. The crop holds the third position in point of area amongst the oil-seed crops of India, being in this respect less important than sesamum

The countries receiving the Cyprus export are France, the United Kingdom, Egypt and Turkey.

Experimental cultivation of linseed has also been undertaken in various parts of Africa, and the following notes on samples of linseed received for examination at the Imperial Institute from the Anglo-Egyptian Sudan, the East Africa Protectorate and Natal indicate that in all these places linseed of excellent quality can be produced.

Anglo-Egyptian Sudan.—This was a fine sample which was valued by experts at 47*s.* 6*d.* per quarter if marketed in limited quantities and at about 44*s.* 0*d.* per quarter if imported in large supplies (May 1906).

East Africa Protectorate.—This sample was received in 1905 and was described by experts as of good quality and worth 40*s.* 0*d* to 42*s.* 6*d.* per quarter (December 1905).

Natal.—This linseed was received in December 1908. It consisted of large, rather thin seed with a few perished grains but practically free from foreign seed and impurities. It was valued by experts at £11 per ton if delivered in small lots of 50 to 100 tons, or at £10. 10*s.* per ton if imported in quantities of 500 to 1,000 tons (March 1909).

CULTIVATION FOR THE PRODUCTION OF FIBRE.

The methods of cultivating the flax-plant for fibre differ from those adopted when it is grown for linseed, chiefly in the sowing and harvesting operations. The soil suitable for the flax crop has already been described, and if prepared in the same manner as for the seed cultivation (omitting farmyard manure) it is suitable for the fibre crop. For the production of the finest fibre, tall, thin, unbranched stems of even length are required, therefore anything that conduces to coarseness of growth is to be avoided. Should the land intended for the fibre crop be considered too fertile and likely to produce rank growth, it is advisable to take off some other crop before planting with flax, as the latter does best in a soil in a fresh but not too rich condition. The land should be flat, as an undulating surface, by exposing some of the plants and shading others, tends to produce uneven stems and varying qualities of fibre.

The seed should not be sown until all danger from frost is over, as young plants touched by frost are liable to branch, and are then of little value for fibre production. The method of sowing is to broadcast by hand, and in order to effect an equal distribution of the seed it is sometimes mixed with dry earth or ashes to facilitate handling. When sown on small areas the seed is hand-raked in to further assist in distributing it equally; on a larger scale the sowing is followed by harrowing and rolling. The quantity of seed allowed for sowing the fibre crop is usually about 3 bushels per acre. This amount of seed should result in a stand of plants sufficiently crowded to produce tall, unbranched stems with but little woody matter. Care should be taken to sow only fresh, plump seed that has been carefully stored and well sifted. Russian seed is usually considered best for fibre production, and the varieties known as Pernau Crown and Riga Child are the most sought after. Dutch and Belgian stocks are sometimes preferred; these also are of Russian origin, but have been grown for one year in Holland or Belgium. After the third year the seed is said to deteriorate and has to be renewed by fresh stocks from Russia.

Attention should be given to hand weeding as soon as the young plants are above ground. This is an important part of flax cultivation and requires to be taken in hand early, as after the plants are about 7 inches high the stems are liable to be damaged by the workers, and weeding must then cease. The presence of large weeds in the flax-crop causes unequal development of the stems, and increases the labour involved in the subsequent handling of the crop.

The time for harvesting the flax-crop has arrived when that portion of the stem nearest the ground commences to assume a yellow tint, the leaves at from 8 to 10 inches from the ground fall off and the top seed bolls show a brownish hue. The fibre crop is usually harvested by being pulled by hand. The pulling is effected by seizing the stems just below the bolls and jerking the plant upwards. Bending, twisting or pulling the stems obliquely should be avoided. The pulling is best done during dry weather. Care should be taken to exclude weeds and to keep the root-ends of the stems even and the stalks parallel. Stalks of an equal length and quality should be kept together as far as possible, and any plants of coarse or branched growth should be kept apart to be used for binding the stems into bundles. Attention to these details facilitates handling during subsequent processes. The pulled stems are made up into small bundles, tied with a wisp of coarse flax-straw and stood on end in "shocks" to dry. The foregoing is the usual method adopted in Europe where the acreage worked by each farmer is small and labour plentiful and cheap. In countries where labour is scarce and dear the cost of hand pulling is prohibitive, and the stems are usually cut with a reaping machine set low to procure as great a length of stem as possible. Although it is claimed that fairly good fibre is obtained by this method, there are certain objections to the practice. For instance, the fibre is shorter, and, owing to the ends being cut, is said to lack some of the spinning qualities of the hand-pulled fibre. The sorting above described, which is practised during hand pulling, is not practicable where machines are used, and the fibre is therefore variable in quality. It is further said that the stems keep less satisfactorily when stacked, as the cut ends admit moisture.

PREPARATION OF FLAX FIBRE.

Flax fibre consists of the bast tissues of the stem, and is situated immediately beneath the epidermis and surrounds the woody core. The fibrous filaments are naturally united to one another by gummy substances, known as pectoses, and in order to effect the isolation of the fibre in a suitable condition for the manufacturer, these substances must be removed.

Rippling.—The first step in the treatment of the flax stalks or "straw" is the removal of the seed bolls, which is effected by the process of "rippling" or "seeding." A handful of the straw, held in such a manner that the upper ends are spread out, is pulled through the teeth of the rippling-comb which consists of a vertical row of round steel teeth, firmly fixed in a block of wood. In the best rippling-combs the teeth are about 18 inches long, $\frac{3}{16}$ inch apart at the bottom and $\frac{1}{2}$ inch at the top, the tapering being confined to the last three inches. The process is sometimes carried out by means of the seeding-machine, which consists of two heavy cast-iron rollers, revolving within a cast-iron frame; the lower cylinder is driven from

piled in order to keep the flax submerged. As fermentation proceeds, the gases which are evolved tend to raise the flax above the surface of the water, and at this point therefore it must be more heavily weighted. On the other hand, as the fermentation subsides the flax begins to sink, and some of the load must be removed. The straw must be examined from time to time in order to ascertain whether the retting has proceeded far enough. The determination of the exact point at which to stop the process requires considerable experience and judgment. In general, it may be said that when the fibre can be readily and completely separated from the woody core, it is time to withdraw the fibre from the pools. After their removal from the pool, the bundles of straw are stood on end to dry, and are then stacked for a few weeks. In some places, the bundles are drained and then "grassed," *i.e.* spread evenly over a grassy meadow to dry.

The water used for retting should be as soft as possible, and should not contain much iron or other substances likely to discolour the fibre.

In some parts of Russia, a combination of dew-retting and pool-retting is practised, the straw being first immersed for some time in shallow pools and afterwards spread out on the grass and exposed to the action of the dew.

The process of retting in running water is carried out in the Courtrai district of Belgium, and yields flax of the finest commercial grades. The bundles of flax straw are packed root-end downwards in wooden crates which are about 12 feet square and have a solid floor but open sides. A strip of jute sacking is bound round the sides, and the crate is placed in the river Lys and loaded with stones until the water just covers it. From four to fifteen days are required for the necessary amount of fermentation to take place, the actual time depending on the temperature, the condition of the straw and other factors. When the retting is completed, the crates are withdrawn from the stream, and the bundles of straw are removed and dried in the air. In some cases the straw is again packed in the crates and immersed for a second time.

Many attempts have been made to improve the retting process by carrying it out in tanks or vats containing warm water. The first invention of this kind was made in 1846 by R. B. Schenk, who designed large wooden vats, in which the flax straw was packed with the root-ends downwards. Water was introduced into the vats and maintained at a temperature of 75°–95° F. Fermentation rapidly ensues under these conditions; and the entire process only occupies about fifty or sixty hours. An improvement was suggested by Pownall, which consists in passing the straw, immediately after its removal from the vats, between heavy rollers over which a continuous stream of water is made to flow. This operation frees the straw from the slimy matter adhering to it, and also facilitates the subsequent breaking and scutching operations.

A further development of this method is embodied in the Legrand process, which was patented in the United Kingdom in 1904. The straw is packed, root-end downwards, in wooden crates similar to those used in the Courtrai district. A series of three tanks is employed, in which the water is maintained at 86°–88° F. These tanks are termed the "scouring" tank (A), the "retting" tank (B) and the "rinsing" tank (C). The crates are lowered into tank A by means of an overhead travelling crane, and allowed to remain there for 24 hours. During this time, however, they are occasionally raised by means of the crane and held over the tank for a few minutes to allow the water to drip through the bundles, and then again plunged into the water, so that the latter rises right through the straw and ensures that the steeping is even throughout. The crates are then transferred to tank B, and allowed to remain, with occasional lifting and re-lowering, until the retting is completed; this takes from 2½ days in the case of poor straw, to 3½–4 days with good, heavy straw. Finally the crates are placed in tank C, in which the straw is rinsed and the adhering impurities washed away. The process requires to be carefully watched in order that the flax may be withdrawn from the retting tank at the right moment. The clean, warm water is admitted in a slow and continuous stream at the bottom of tank C, and is siphoned over successively into tanks B and A. After the crates have been taken from the rinsing tanks they are placed on trucks and left for a day or two to drain. The trucks are then run out into a meadow, where the flax is taken out of the crates, and the bundles are opened and stood up in sheaves to dry and harden. The Legrand method has several advantages over the older methods. Owing to the regular manner in which the straw is treated, the flax is more even in strength and colour than that produced in other ways. Moreover, the time is reduced to three or four days, much less labour is required, and the process can be carried on all the year round without cessation.

In the retting process, whatever method is employed, it is of great importance that the fermentation should be stopped at the right point, since over-retting weakens the fibre and increases the amount of tow, or "codilla," produced on scutching, whilst under-retting causes part of the gummy encrusting matter to be retained, and interferes with the subsequent manufacturing processes.

Various efforts have been made to replace the retting process by treating the straw with chemical reagents such as dilute caustic alkali, but such methods have not yet proved successful on the large scale.

Methods have also been suggested for preparing the fibre by purely mechanical means without retting, but, these involve the loss of much of the fibre, and yield a rough, hard product, which is of much poorer spinning quality than that obtained by the retting process.

Breaking.—The dry, retted stalks are passed between pairs of grooved or fluted rollers in order to break the woody core into small pieces. There are usually from six to twelve pairs of such rollers, which are so adjusted that each pair works more closely than the preceding pair.

Scutching.—The fragments of wood resulting from the "breaking" process are removed by scutching. The fibre is suspended in a machine which is provided with a revolving cylinder, or drum, bearing tough, flexible wooden blades on its periphery. As the cylinder revolves the blades strike the flax and thus expel the broken wood, which is termed the "shieve" or "boon." The operation necessarily causes a considerable waste of fibre, some being broken by the scutching blades and some adhering to the shieve. This waste, known as "codilla" or "scutching tow," is used for spinning yarns for twines, canvas

Flax (dressed or undressed).

From	Quantity.							
	1907. Tons.	1908. Tons.	1909. Tons.	1910. Tons.	1907. £.	1908. £.	1909. £.	1910 £.
Russia	63,661	60,756	50,059	51,185	2,150 970	1,804,244	1,633,801	1,892 61
Germany	110	365	310	220	5,603	17,135	12,680	12.29
Netherlands	2,400	2,379	2,634	2,159	138,587	136,796	152,588	130,90
Belgium	16,817	15,870	19,037	15,452	1,148,718	1,102,218	1,302,610	1,133,85
France	201	150	333	166	10,682	8,187	16,565	8,08
Turkey	2	1	22	5	62	18	550	15
Other countries	31	44	36	80	1,303	1,732	1,623	2,82
Total	83,222	79,565	72,431	69,267	3,455,925	3,070,330	3,120,417	3,180,

From	Quantity.				Value.			
	1907. Tons.	1908. Tons.	1909. Tons.	1910. Tons.	1907. £.	1908. £.	1909. £.	1910. £.
Russia	12,889	11,746	12,447	11,188	354,102	280,835	334,991	329,268
Germany	77	300	147	478	1,602	4.508	4,296	14,853
Netherlands	190	75	214	356	5,159	1,801	5.434	9.511
Belgium	5,976	2,823	4,024	5,639	108,372	42,720	61.331	100,624
France	716	177	426	690	8,113	1,911	4,106	6.972
Other countries	1	42	90	79	25	.715	1,977	2,533
Total	19,849	15,163	17,318	18,430	477,373	332,490	412,135	463,

FLAX CULTIVATION IN BRITISH TERRITORY.

Ireland and Canada are the only parts of the British Empire in which flax fibre is produced on a commercial scale.

The Irish flax-growing industry attained its maximum in 1864, when 301,693 acres were devoted to the crop, but rapidly declined, until in 1872 only 122,003 acres were planted. During 1906–10 the average area under flax amounted to 46,169 acres. Reference to the present position of the industry has been made in a recent issue of this *Bulletin* (1911, **9.** 170).

In Canada flax has been grown for many years in the western part of Ontario and certain other districts. The exports amounted to about 594 tons, of value £29,120, in 1909, and about 439 tons, of value £17,507, in 1910, the whole of which was consigned to the United States.

There is no doubt that flax could be grown successfully in some other parts of the Empire. Experiments have been made in Cyprus, East Africa Protectorate, Transvaal and the Orange Free State, and specimens of the fibre produced in these countries have been described in this *Bulletin* (1908, **6**. 4). Trials on a more extensive scale have been carried out in Behar, India, and an account of these has been given in this *Bulletin* (1908, **6**. 401; 1910, **8**. 304). Experiments which have been conducted in Victoria, New South Wales, Queensland and Tasmania have indicated that the soils and climatic conditions of these countries are suited to the requirements of the plant, and that the cultivation could probably be undertaken in certain parts of Australia with considerable success.

STRUCTURE AND PROPERTIES OF FLAX FIBRE.

Flax consists of long filaments, each composed of a group of bast fibres. The length of the filaments varies from 12 to 36 in., and the diameter from 0·0018 to 0·025 in., with an average of about 0·006 in. The best flax is of a pale yellow colour; dew-retted flax is usually grey, and incompletely retted flax has a greenish tint. The fibre is soft, flexible, and lustrous, and is stronger and more durable than cotton; it is also a better conductor of heat than cotton, and it is for this reason that linen fabrics feel cold to the touch.

The ultimate fibres of which the filaments are composed are of regular, more or less cylindrical, form, and taper towards the ends. The walls are so thick that the central cavity or lumen is either very small or almost obliterated, and to this peculiarity the remarkable tenacity of the fibre is due. The outer surfaces of the walls bear transverse markings, which are of value in preventing the fibres from slipping over one another in the spinning process, and also contribute to the durability of linen fabrics. The length of the ultimate fibres ranges from 0·3 to 1·5 in., and the diameter from 0·0005 to 0·001 in.

The yield of flax obtained in different countries varies from 8 to 20 per cent. of the weight of the rippled straw.

A few words may be added with reference to some of the chief commercial varieties. The Belgian grades are fine, long, and of excellent colour. Irish flax is renowned for its good colour, softness, and fineness. Italian flax is more lustrous than most other kinds. The best French and Dutch grades are also of very satisfactory quality. Russian flax is mostly of good length, but only of medium or low quality. A series of specimens of Belgian, Irish and Russian flax is on exhibition at the Imperial Institute in the Reference Collection of Standard Commercial Products.

AGRICULTURAL DEVELOPMENT OF NYASALAND.

THE Report of the Director of Agriculture in Nyasaland for 1910–11 has been issued recently, and a summary of the portions relating to the most important crops is given below, together with the results of experimental cultivation of some crops new to the country. For an account of the progress made in cotton growing and rubber planting during 1909–10, see this *Bulletin* (1910, **8**. 372).

COTTON.—Cotton cultivation has undergone considerable extension, the area under European management having increased from 8,975 acres in 1909–10 to 12,752 acres in 1910–11, whilst the crop produced by the natives has advanced from 220 tons of seed-cotton to 692 tons. The total exports (in 400 lb. bales of ginned cotton) amounted to 2,147 bales, of value £26,208 16*s*. in 1909–10, and 4,342 bales, of value £32,478 9*s*. 10*d*. in 1910–11. In the latter season the seed was not sown until the end of December or the beginning of January owing to the lateness of the rains, and it was feared that the bolls would not be matured sufficiently before the advent of the cold weather in March. Fortunately, however, good ripening weather was experienced and an excellent crop was obtained. This successful result has encouraged planters to extend the area devoted to cotton, and during the present season no less than 23,314 acres have been planted. The area under European cultivation gave an average yield of 81 lb. of lint per acre in 1909–10, and 103 lb. in 1910–11. Several of the best cotton estates, however, are yielding from 150 lb. to 200 lb. per acre; in these cases the land has been carefully selected, exposed situations being avoided, and careful attention is given to the cultivation and to the destruction of insect pests. During the year under review

Official Gazette with a view to safeguarding the industry and maintaining the quality of the cotton produced. The industry is now thoroughly organised, planting operations are superintended by trained natives, districts are inspected by Agricultural Officers, the crop is purchased by licensees under the Cotton Ordinance, and valuable statistics are collected with regard to every phase of the industry.

The rebate from the taxes, which was formerly granted to all natives who produced a certain quantity of seed-cotton was withdrawn in the Lower Shiré District before the commencement of the season under report, since it was considered that the industry was sufficiently established to justify this step. This action did not lead to any restriction of the area cultivated, but, on the contrary, the demand for seed increased greatly, 45 tons being distributed as compared with 30 tons in the previous year.

Experiments have been carried out at the Agricultural Experiment Stations with various exotic cottons, and it has been found that the Griffin variety is the only long-stapled Upland cotton which can compare with the acclimatised Nyasaland-Upland. It is considered that at elevations below 1,000 feet, the former kind will produce a stronger staple and retain its silkiness in a greater degree than does Nyasaland-Upland.

The selection experiments with Nyasaland-Upland cotton have been continued on the lines indicated in the Report for 1909–10 (*loc. cit.*, p. 374).

Hybrids have been obtained by the pollination of Nyasaland-Upland plants with Egyptian Abassi, but as these have proved unsatisfactory the experiments have been abandoned.

RUBBER.—During 1910–11 59,471½ lb. of rubber, of the local value £10,659, was exported, which is more than twice the quantity exported in the preceding year. This large increase is due principally to more vigorous exploitation of indigenous rubber, and in a minor degree to an increase in the output of plantation rubber. The acreage devoted to the latter has increased steadily in recent years, and in June 1911 there were 8,346 acres under rubber as compared with 5,260 acres in the previous year.

The most important development in connection with wild rubber during the past season was the exploitation by machinery of *Landolphia parvifolia* in the West Nyasa District. The rubber is contained in the cortical tissue of the underground stems, and is extracted by passing the bark through a series of rollers which alternate with water jets. Water at a temperature of 90° F. issues from the latter under strong pressure and washes the rubber free from bark. By this method a comparatively pure rubber is obtained, which is exported as crêpe. The product is of superior quality, and samples examined at the Imperial Institute in January 1911 were valued at 3*s.* 9*d.* to 4*s.* 4*d.* per lb., with fine hard Para quoted at 5*s.* 2½*d.* The plant is very abundant in the West Nyasa District, and since the smaller underground stems do not re-pay the cost of collection, they are left in the ground after being severed from the parent plant, and rapidly form new shoots and roots. For this reason it is considered that there is no danger of exterminating this valuable species.

As stated in the Report for 1909–10 (*loc. cit.*, p. 381), the only district with climatic conditions suited to the Para rubber tree is West Nyasa, where an area of 762½ acres is at present under this species. The trees are healthy and are making good growth. The average girth measurements of trees on the Chombe Estate, taken at 3 ft. from the ground, are as follows: 85 1½-year old trees, 3·27 in.; 100 2½-year old trees, 4·26 in.; 100 3½-year old trees, 8·98 in.; 102 4½-year old trees, 9·61 in. No tapping experiments on Para rubber trees have yet been made, and tapping on a commercial scale will not commence until the trees are seven years old.

The cultivation of the Ceará rubber tree continues to be successful in districts where the soil and climate are favourable, as in West Nyasa, South East M'lanje and a few places in the Shiré Highlands and on the Upper River. Two- and three-year old trees in the M'lanje District were tapped during the season and yielded good rubber, which sold at a price only slightly inferior to "fine hard Para." On one estate in this district the average yield from 45 trees, 9 in. and over in diameter, tapped on alternate days during a period of some weeks, was a little more than ¼ lb. of dry rubber per tapping. The Director of Agriculture assumes from these results that if tapping could be carried on for 6 months during the year, from

5 to 6 oz. of dry rubber per tree per annum could be obtained, which is considerably higher than that given in experiments conducted at Zomba and elsewhere in the previous year (*loc. cit.*, p. 382).

TOBACCO.—The year under review was not so favourable for tobacco-growing in the Shiré Highlands as the preceding year, owing to the belated rains and the consequent short growing period. In the M'lanje District, however, where the main crop is obtained from late planting, it was an exceptionally good season, and this crop, together with other late-planted tobacco, compensated for the decreased returns in the Shiré Highlands.

The acreage under tobacco was 3,274, as compared with 2,368 in the previous year, whilst the crop being harvested at the beginning of 1911 covered an area of 4,507 acres. The exports of cured tobacco for 1910–11 amounted to 1,704,637 lb., valued locally at £42,626, showing an increase in local value of £15,506 as compared with the preceding year. The average export of cured tobacco per acre in 1910–11 was 520 lb., and in 1909–10 458 lb. The quality of the crop was not as good as in the preceding year, owing to the smaller proportion of first quality "brights" tobacco; the plants in the field suffered badly from mildew and the leaves were more spotted than usual.

As in previous years the greater part of the crop was flue-cured, but a considerable amount of native-grown sun-cured tobacco, produced chiefly on the heavy soils near Blantyre and Zomba, was exported. Although sun-cured tobacco does not realise such good prices as flue-cured tobacco, it has obvious advantages on new estates where barn accommodation is insufficient to cure the crop as it ripens.

Nearly all the tobacco seed is imported from the United States, but owing to the different climatic conditions of Nyasaland considerable deviation from the type has been exhibited. This is especially the case with the most popular variety, "Raglan's Conqueror." The investigation of this subject is to be undertaken by the Department of Agriculture during the coming season, and it is hoped that by careful selection in the field a variety will be obtained which will be better suited to the climatic conditions of Nyasaland, and which will remain fixed in character.

decrease in its export, although it is anticipated that the coming season will show an increase over the year under report, on account of exceptionally favourable rains.

TEA.—Considerable attention has been paid to the cultivation of tea in south-east and south M'lanje during the past season, and the area under cultivation has increased from 518 acres in 1909–10 to 1,190. The exports amounted to 42,042 lb. Tea is regarded as specially suited to parts of the M'lanje district where the heavy rainfall prevents the cultivation of cotton and renders tobacco-growing a speculative business. Experimental cultivation was carried out at the Government Experiment Station, Zomba, and the growth was regarded as satisfactory. Other localities thought suitable for the cultivation of tea are Cholo, M'penda and parts of West Nyasa. In all these districts the rainfall is heavy, and their relatively high altitude should favour the production of tea of good quality.

CHILLIES AND CAPSICUMS.—The exports of these products were valued at £2,527, an increase of £541 as compared with 1909–10. The average price per cwt. was 45*s.* 0*d.* to 51*s.* 6*d.* in the case of chillies, and 35*s.* 0*d.* to 50*s.* 0*d.* for capsicums. There is an increasing tendency to cultivate capsicums in place of chillies, as the cost of harvesting the former is lower and it is an easy matter to dry them in tobacco flue-curing barns. Both crops are hardy in Nyasaland, and require very little care in cultivation; they flourish in almost any kind of soil, and grow specially well on rocky hillocks, which cannot be planted with cotton or tobacco.

SOY BEANS.—Experimental cultivation of the black and yellow-green varieties of soy bean was tried during the past season, and both proved successful. The yellow-green variety gave the better return, viz. 15 cwt. 38 lb. of seed per acre. It would probably not be a profitable crop for Europeans to grow for export, but it should prove of value as a native food crop on the Lower River, and for this purpose seed is to be distributed during the coming season; surplus seed might possibly be exported to Durban, where a soap factory has been established. Its chief value to the European planter would be as a green manure crop for exhausted tobacco soils.

VELVET BEAN (*Mucuna Lyonii*).—Experiments carried out at Zomba during the past season indicate that the velvet bean will probably prove the most suitable green manure crop for cultivation in Nyasaland. The plants are very robust, and require less weeding than the soy bean. They are not attacked by insects in the field nor by grain weevils, which do great damage to "kobwe" and other leguminous seeds. It is thought that the fertility of many discarded coffee gardens could be restored by growing the velvet bean in rotation with other crops, and it should prove of great value to tobacco planters, since the cost of transport of artificial manures prohibits their use.

COARSE FIBRES.—The area under Mauritius hemp in 1911 is 1,203 acres, as compared with 1,048 acres in 1910, and the estimated crop of this fibre is 89 tons.

Sisal hemp occupies 172 acres in 1911, as compared with 259 acres in 1910. A large number of Sisal hemp plants "poled" at Zomba during the year, and 150,000 bulbils were sold.

GENERAL NOTES.

Essential Oil of Myrica Gale, L.—Although oil distilled from leaves of *Myrica Gale*, L. (bog myrtle, sweet gale) was examined as long ago as 1837 by Rabenhorst, practically nothing has been done to determine its constituents until recently. Dr. S. S. Pickles, Senior Assistant in the Scientific and Technical Department of the Imperial Institute, has examined two small consignments of the plant collected in Argyllshire for Prof. W. R. Dunstan, and the results of this investigation have been communicated to the Chemical Society of London (*Trans. Chem. Soc.*, 1911, **99**. 1764). The first sample consisted of leaves and a rather large proportion of stems; the second consisted mainly of leaves, branches being present to a small extent only. The material was subjected to steam distillation, and yielded a pale-yellow oil with a characteristic pleasant odour recalling that of sage, but more camphoraceous. The oils obtained from the two samples differed somewhat in their physical and chemical characters, as will be seen from the following table:—

	Oil from leaves and stems.	Oil from leaves mainly.
Yield, *per cent.*	0·076	0·203
Special gravity at 15° C. . . .	0·915	0·912
Optical rotation in 100 mm. tube . .	−5° 17′	−11° 26′
Acid value	7·0	4·0
Ester value	24·7	19·2
Saponification value	31·7	23·2
Saponification value of acetylated oil .	—	56·4

The oil obtained mainly from the leaves was subjected to detailed examination. On cooling, or on the addition of alcohol, a solid material separated in colourless, shining leaflets. This proved to be a solid paraffin, melting at 63°–64° C., and having probably the composition $C_{29}H_{60}$. It was present in the oil to the extent of about 0·75 per cent. The oil also contained about 2·5 per cent. of free fatty acids, principally palmitic acid; cineol; esters of fatty acids; probably a mixture of high boiling alcohols; terpenes, including dipentene; and a sesquiterpene. The cineol and terpenes together constituted approximately 50 per cent. of the oil.

Trieste Origanum and White Thyme.—In 1907 the Imperial Institute received from Trieste a bale of origanum herb. This material was examined botanically at the Royal Gardens, Kew, and shown to consist of *Origanum Onites*, L., of which two forms appeared to be present. On distillation, 1 cwt. of the plant yielded 1 lb. 4 oz. of oil, having a golden-yellow colour, and the characteristic odour and sharp burning taste of origanum oil. The characters of the oil were as follows: Specific gravity at 15° C., 0·9483, optical rotation in 100 mm. tube − 1° 15′. The oil was soluble in 2·75 parts or more of 70 per cent. alcohol, and contained 68·0 per cent. (by volume) of phenols, consisting almost wholly of carvacrol. These characters are in fair agreement with those of the Trieste origanum oil of commerce. (Compare this Bulletin 1911, **9**, 308.)

Early in the present year consignments of plants labelled "origanum" and "white thyme" collected in Dalmatia were forwarded to the Imperial Institute by the Commercial Museum at Trieste. The new supply of origanum plant was also examined at the Royal Gardens, Kew, and identified as *Origanum hirtum*, Link. The white thyme plant on examination at Kew proved to be one of the many forms of *Satureia montana*, Linn., which is often difficult to distinguish from *S. cuneifolia*, Tenore.

Both plants have been examined chemically at the Imperial Institute by Dr. S. S. Pickles, and the results have been communicated to the Chemical Society of London (*Proc. Chem. Soc.*, 1911, **27**. 284, 285).

The origanum plant yielded 3·3 per cent. of pale-yellow oil, which possessed a pronounced odour of thymol and a burning taste. It was found to consist largely of thymol, carvacrol being absent, whereas oil obtained from a plant identified by Grisebach as *O. hirtum*, Link, and examined by Jahns (*Arch. der Pharm.*, 1879, **215**. 1) was found to consist mostly of carvacrol. The present sample of oil gave the following results: Specific gravity at 15° C., 0·9440; optical rotation in 100 mm. tube, + 0° 24′; the oil was soluble to a clear solution in 2·8 parts of 70 per cent. alcohol. The percentage of phenols present, estimated by absorption in dilute sodium hydroxide solution, was 64·4 by volume and 66–67 by weight. This oil appears to be quite similar to one examined recently by Schimmel & Co. (*Report, S. & Co.*, October 1911, p. 63), and stated to be derived from *O. hirtum a*

The coast-line of the Quilimane district measures about 400 kilometres, and the strip of low, flat land to a distance of 10 kilometres inland is considered to be more or less suitable for coconut cultivation, although the occurrence of frequent swamps detracts from its value for this purpose. Coconut palms have, however, been already planted intermittently from the mouth of the Zambesi to the Maballa River, a distance of about 150 kilometres.

Behind the coconut zone there is a wet zone with clay soil, which is frequently waterlogged and swampy, large areas being under water in the wet season. The swamp bottoms consist of rich argillaceous loam, which it is thought would make splendid sugar land if drained. The mean width of this zone is about 50 kilometres.

This wet zone is succeeded by a fringe of sandy country of varying width suitable for the cultivation of Sisal hemp. It is believed that Sisal will do better on this land than at the coast or further inland, and fibre of good length and quality is being already produced.

The rubber zone of Quilimane begins approximately at about 75 kilometres from the coast and extends inland for some 125 kilometres with a width of about 200 kilometres. This area has an undulating surface covered with forest, and is watered by innumerable streams. Manioc, pigeon peas, ground nuts, tobacco, sweet potatoes, yams, castor seed and sesamum seed are already grown by the natives Three plantations of Ceara rubber trees, containing, it is said, one million trees or more, have been established in different localities, but none of them has yet been worked. One of these estates was visited by Mr. Lyne, who places the number of trees at between 400,000 and 500,000; of these, 90,000 are between 3½ and 4 years old, and therefore ready for tapping. Preliminary tapping trials are said to have given very good yields of rubber, and Mr. Lyne states that the trees looked extremely healthy, and yielded latex freely on tapping. He is of opinion that the prospects of rubber cultivation in this portion of the Quilimane district are very promising.

The last zone consists of the highlands, where rubber will probably not succeed, owing to the elevation. In this area it is believed that maize, cotton, coffee, tobacco and other tropical and sub-tropical crops can be successfully raised. Ostrich and cattle farming may also be possible. The development of the highlands will, however, depend on the opening up of roads and the improvement of the means of transport.

It will be gathered from this account that Mr. Lyne has formed a very favourable opinion regarding the agricultural possibilities of the Quilimane district.

RECENT PROGRESS IN AGRICULTURE AND THE DEVELOPMENT OF NATURAL RESOURCES.

In this section of the Bulletin a summary is given of the contents of the more important papers and reports, published during the preceding quarter, in so far as these relate to tropical agriculture and the utilisation of the natural resources of the Colonies, India and the Tropics generally.

AGRICULTURE.

GENERAL.

Soils.—The influence of vegetation on the composition of drainage water from soil is discussed in the *Journ. Ind. Eng. Chem.* (1911, 3. 742). The experiments were made in tanks holding approximately 64 cubic feet of soil. These were filled with a clay loam of uniform composition, and in four of them maize was planted, in two oats, and three were left unplanted. As moisture, they received rain only. The flow of drainage-water was measured, and the summer and winter yields examined separately. The composition of these expressed in lb. per acre is given in the following table :—

Period.	Plant.	Total solids.	Nitrates. NO_3.	Calcium. Ca.	Potassium. K.
May 23 to Oct. 1, 1910.	None	405	48·3	66·3	1·4
	Maize	151	12·2	27·6	0·4
	Oats	175	18·4	31·8	0·4
Oct. 1, 1910, to May 1, 1911	None	2,179	481	340	9·6
	Maize	649	35	130	5·3
	Oats	728	37	141	9·2

The results indicate that for the conservation of plant food in soil it is advantageous to grow winter crops, since in winter the drainage water carried away from the unplanted soil three times as much total solids, twelve times as much nitrogen, and more than twice as much calcium as it did from the soils which were planted.

Farmers' Bull., No. 421, 1910, *U.S. Dept. Agric.*, discusses the various means that have been employed to prevent loss of soil from dry areas by wind storms. These may be classified as (1) increasing the cohesion of the soil, and (2) decreasing exposure to wind. The first may be accomplished by increasing the quantity of either water or humus in the soil, or modifying the texture. The second can be attained by providing a crop to cover the soil, or by supplying some form of windbreak. The practical application of these remedies is described in detail.

The adaptation of methods of dry farming to the needs of the Orange Free State and its probable advantages are discussed in *Bull. No.* 23, 1910, *Dept. Agric., Orange Free State.*

Mechanical and chemical analyses of a number of typical soils from German East Africa, East Africa Protectorate, and Nyasaland are given in *Berichte über Land und Forst in Deutsch. O. Africa* (1911, **3**. 248).

Manures.—A trial of used peat-moss litter as manure at the Royal Gardens, Kew (*Bull. Misc. Inf., Kew*, 1911, p. 349), showed that it had a deleterious action on plants, due to its acid character when fresh.

The *Journ. Board Agric., U.K.* (1911, **18**. 592), points out that siliceous limestones should not be employed as a source of manurial lime, since the lime obtained may "set" like cement when moistened by rain. A standard of 80 per cent. free lime in manurial lime is suggested.

The availability of nitrogen in various commercial manures is discussed in *Journ. Ind. Eng. Chem.* (1911, **3**. 584), the results of field trials being compared with those deduced from chemical analyses.

Artificial manures, such as calcium cyanamide (see this *Bulletin*, 1911, **9**. 44, 123) and calcium nitrate, are still attracting attention from agricultural investigators. The *Journ. Board Agric., U.K.* (1911, **18**. 328) records further results obtained by the use of the first-named manure with oats, which generally confirm those given already (this *Bulletin*, 1911, **9**. 126), and other experimental results of a similar character are recorded in *Journ. Soc. Chem. Ind.* (1911, **30**. 522). *De Indische Mercuur* (1911, **34**. 854) gives results of experiments on the moisture-absorbing properties of these manures alone and when mixed with other materials.

Farmyard manure.—The preservation of farmyard manure is dealt with in a leaflet issued recently by the Madras Agricultural Department. It is pointed out that many of the soils of Southern India are deficient in organic matter, and that in order to maintain fertility this must be augmented. Details are given illustrating the relative advantages of the "box," "pit" and "heap" systems for the storage of manure. In the first, the animals are put on a thick bed of litter which absorbs the urine, and the dung is trampled in until the whole is a compact mass. In the "pit" system the dung is removed daily and stored in a water-tight pit. The "heap" system consists in storing the manure in heaps in the open.

The following table illustrates the relative advantages of the three methods.

	Weight of manure per pair of cattle per annum.	Nitrogen.	Potash.	Phosphoric acid.	Organic matter.
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Box . .	10,140	90·7	155·3	56·2	3,020
Pit . . .	9,830	55·5	70·0	46·2	1,765
Heap . .	6,070	60·0	59·8	44·5	2,168

Eng. Chem., 1911, **2**. 531). It is stated that Kaffir corn is superior to maize as a crop as regards resistance to drought, is less exhausting to the soil, and is a cheaper source of alcohol, its advantage in the last respect being as 23 : 27. The protein in Kaffir corn varies from 12·81 to 14·85 per cent., as against 8·35 to 13·88 in maize. The fat content of maize ranges from 3·95 to 6·02 per cent., and in Kaffir corn from 3·90 to 4·39. Kaffir corn fat melts at 44° C., and is better adapted for soap manufacture than maize fat, which melts at 19° C., and might well be mixed with edible fats, as it has a pleasant taste and odour.

Bull. No. 203, 1911, *Bur. Plant Ind., U. S. Dept. Agric.* deals with the improvement of the grain sorghums, and gives an account of their cultivation. Improvement in grain sorghums should be in the direction of (1) drought resistance; (2) earliness; to make the crops suitable for regions having a short growing season; (3) dwarf stature, which lowers the water requirements of the crop and permits heading by machinery; (4) better yielding varieties, by selection of well-shaped and well-filled heads; (5) freedom from suckers and branches; (6) erect heads. These properties can be developed by careful selection of seed for sowing.

Maize.—A new maize, to be known as "Mercer," has been produced in Natal by crossing eight-rowed "Hickory King" with twelve-rowed "North American Horsetooth." It yields a twelve-rowed ear of deep grain, which is stated to have all the advantages of "Hickory King" with increased yield (*Agric. Journ. Union South Africa*, 1911, **2**. 318).

The Report of the Chief Inspector of Grain, Union of South Africa 1910, gives the new regulations and standards for the grading of maize in South Africa, and also the terms of the agreement, under which the Government transports and sells maize and Kaffir corn for the farmer. The total exports of British South African maize for 1910 amounted to 356,305,905 lb., of which 99 per cent. was graded before export. The price realised on the London market for white maize averaged 24*s*. to 25*s*. per quarter of 480 lb.

According to the *Journ. d'Agric. Trop.* (1911, **11**. 143) Stewart's process for the extraction of sugar from maize is now being worked in Pennsylvania and Cuba, while a third factory is about to be established in Florida. In cultivating maize for this purpose, the unripe ears are detached from the stalks to induce a gradual accumulation of sugar in the stem. The following statements as to yields of economic products are made:—The stalks yield 88 per cent. of juice, containing 13 per cent. of sugar. From the residue a cellulose pulp is obtained, one ton of stalk yielding about 200 lb. of pulp. The maize stalk produced by this method of cultivation is stated to contain no silica, which renders its pulp of special value to paper-makers.

Rice.—Experiments in Hawaii (*Agric. Exper. Stat. Rept.*, 1910, p. 12) show that on some soils phosphatic and potash manures produce no beneficial effects. This also applies to nitrate of soda on all soils.

Sulphate of ammonia promotes growth and gives increased yields of rice, and therefore appears to be the form in which this cereal should be supplied with nitrogenous manure.

Dr. Fraser's views as to the causation of beri-beri (this *Bulletin*, 1910, **8**. 424) are supported by analyses of polished and unpolished rice made at the Indian Museum (*Ann. Rept. Ind. Mus., Indust. Sect.*, 1910–11, p. 11), which show that unpolished rice contains 0·47 per cent. phosphoric acid as against 0·27 per. cent. in polished rice.

Wheat.—*Bull. No.* 22, 1911, *Agric. Research Inst., Pusa* is a monograph on "The Milling and Baking Qualities of Indian Wheats," in which it is mentioned that strong, free-milling and high-yielding wheats have been produced at Pusa by modern breeding methods. Seed wheat of these new kinds is now ready for distribution. It is pointed out that cultivation, conservation of soil moisture, embanking and occasional green manuring have doubled the producing power of the soil at Pusa, and that such methods are applicable to wheat cultivation throughout the Indo-Gangetic plain.

Cocoa.—*Circular No.* 12, 1911, *Dept. Agric. Trinidad* contains notes on the cultivation of cocoa. Stress is laid on the importance of good tillage and proper drainage. Weeding, the various methods of manuring and pruning, are discussed. Diseases of the plant and remedial treatment are briefly referred to.

The world's production of cocoa in 1910 was 217,000 tons, an increase of 7·4 per cent. on 1909. Of this total San Thomé produced 16, Trinidad 12 and Ceylon 1·8 per cent. The British Empire produced one-fifth of the whole. It is estimated that the crop of 1911 will be 12 per cent. greater than that of 1910 (*Gordian*, 1911, **17**. 4635, 4677).

Tea.—A *Report on Tea Culture in Eastern Bengal and Assam* for 1910 shows the industry to be in a satisfactory condition, all the tea companies showing good profits for the year, but difficulty is still experienced in regard to the supply of labour. The area under tea at the end of 1910 was 442,582 acres: the crop amounted to 222,455,871 lb. of black and 1,380,327 lb. of green tea.

Fruits.—The *Rept. Hawaii Agric. Exper. Stat.*, 1910, contains information on the cultivation of avocado pear, mango, papaw and citrus fruits. A full account of experiments in propagation, insect and disease control and the study of varieties is given.

In the same *Report* soils for pineapple cultivation are discussed. There are roughly two classes of soil—manganiferous and non-manganiferous—in the pineapple districts on Oahu. The former are very extensive. The areas containing 4 per cent. of manganese or more are ill-suited to pineapple growth, but areas containing a lower percentage may by the application of suitable manures, such as ammonium sulphate, superphosphate or sulphate of potash, be rendered available. The physical properties, and consequently the drainage, of the manganiferous soils are superior to those of the non-manganiferous areas, so that if the toxic effects of manganese can be overcome, they will be better suited to pineapple cultivation.

Farmers' Bull. No. 440, 1911, *U.S. Dept. Agric.*, contains an account of the spraying of peaches for the control of brown rot, scab and curculio. The sensibility of peach-trees prevents the use of Bordeaux mixture or Paris green as spraying material, and the safest spray is a lime-sulphur wash, to which 2 lb. of arsenate of lead, suspended in water, is added, making the spray a combined fungicide and insecticide. It is applied to all parts of the tree with a power sprayer in the usual manner.

Bananas and plantains are affected by a bacterial disease (*Bacillus musæ*) which has been investigated recently in Trinidad (*A Bacterial Disease of Bananas and Plantains, Board Agric., Trinidad*, April 1911). The disease first appears in the lower leaves. The blades of these develop a yellowish tinge and then droop, the petioles break, and eventually the plant rots to the ground. A section of the stem showed that all the vessels were discoloured and filled with bacteria. This disease, which has so far only been noticed on the "moko" variety of plantain in Trinidad, has been controlled by purely sanitary measures, all diseased plants being dug up and destroyed, and all tools used in this work being sterilised by fire. As a preventive measure, suckers for planting should be carefully examined to see that they are free from disease.

Olives.—In Southern California and Arizona several ranches which depended entirely on irrigation were abandoned when the water supply broke down. Six years after, it was found that the olives still flourished, though the average annual rainfall was only $3\frac{1}{2}$ inches. The reasons for their survival are (1) the elaborate system of roots which, though shallow, spreads out, and so occupies the soil as to gather much moisture from a very slight rainfall. (2) The formation of low-spreading tops, which protect the trunk from the sun. (3) The structure of the leaf, which prevents excessive loss of water by transpiration. It is noteworthy that the varieties concerned above are those commonly grown under conditions of sufficient rainfall in France and Italy. Mention is also made of the successful dry land olive culture in northern Africa.

Trials are being made to determine whether dry land olive culture will prove profitable on a commercial scale (*Bull. No.* 192, 1911, *Bur. Plant. Ind. U.S. Dept. Agric.*).

Sugar.—A series of seven articles published in the *International Sugar Journal* (1910, **12**. 550, 608; 1911, **13**. 10, 66, 128, 180, 244) deals exhaustively with the cultivation of sugar beet, the methods followed in improving its quality as a source of sugar, the diseases which affect it

(*b*) varietal cultivation experiments on estates; (*c*) selection of canes at Hope for distribution to planters, and (*d*) distillery work. In an appendix the Director of Agriculture summarises the results obtained under all these heads since 1902. The manurial trials have shown that the application of lime is advantageous in many cane-soils in Jamaica, and that nitrogen and potash manures have generally proved effective in raising yields. Manuring is generally unremunerative in dry seasons. The varietal experiments have involved the critical study and observation of about 100 varieties of cane raised at Hope. Of these B 208 is recommended for general planting, B 147 as a drought resistant cane for deep, stiff soils, and D 625 as a valuable cane giving large yields in certain districts. In cane selection work at Hope only three varieties remain, as of the best class, of the original collection of 100. At present 140 new varieties are under trial, and of these four or five are regarded as promising. The value of this selection work is fully realised by planters, and a private syndicate has established a nursery at Cinnamon Hill.

The chief cause of the deterioration of stored sugar is attack by the "potato bacillus" with which sugar may be infected in the following ways: (1) the soil attached to the canes as they reach the factory introduces a large number of bacteria; (2) "low" sugars stored over long periods become infected from the air; (3) dirty water used in the centrifugal machines. The bacteria introduced in the first two ways may be destroyed by the subsequent processes involving heating, but only the use of clean water in the centrifugal machines can ensure freedom from infection by the third way. Dryness lessens the chances of infection on storage (*Int. Sugar Jour.*, 1911, **13**. 414).

FODDERS AND FEEDING-STUFFS.

Paspalum Grass.—In New South Wales *Paspalum dilatatum* has proved a useful fodder for milch-cows, and has also served to keep down weeds and scrub. It succeeds on newly cleared ground where such grasses as "timothy" and rye succumb under summer heat. On such ground broadcast sowing without previous ploughing gives a luxuriant crop in four months. A disadvantage of the grass is that it kills out lucerne. As a fodder it requires to be supplemented by leguminous products. In view of these facts Paspalum is best suited to new country in moist warm climates, and under conditions in which a large yield of cheap fodder is essential (*Dalgetty's Review*, 1911, **19**. No. 4, p. 162).

Rhodes Grass (*Chloris Gayana*).—An account of the growth of this grass under adverse conditions in Central Queensland is given in the *Queensland Agric. Journ.* (1911, **26**. 164). Here Paspalum succumbs in the hot dry summers. Rhodes grass germinates more quickly, and does not require so rich a soil as Paspalum. It grows quickly, is drought-resistant, is relished by stock, makes good chaff, especially when mixed with lucerne, and yields 5⅓ tons of hay per acre.

The comparative values of these two grasses are also discussed in *Agric. Gaz., New South Wales* (1911, **22**. 238). It is now regarded as established that Rhodes grass has a greater nutritive value than Paspalum grass, being richer in protein and poorer in crude fibre. It is more resistant to drought, and gives better yields of fodder.

Lucerne.—*Bull. No.* 6, 1911, *Agric. Series, Dept. Land Records and Agric., United Provinces, India*, deals with the cultivation of lucerne. Of the three varieties—Kandahar, Persian and Meerut—the last-named is best suited for the United Provinces. If properly managed it yields about eight crops, in all about thirty tons per acre of green fodder, per annum, during four or five years. Remedial measures for the "chenpa" blight, and notes on the feeding value of lucerne are also given.

Japanese Clover.—*Farmers' Bull. No.* 441, 1911, *U.S. Dept. Agric.*, states that Japanese clover (*Lespedeza striata*) is of value for grazing purposes, especially on poor or thin soils. On better soil it grows to a sufficient height to produce from 2 to 4 tons of hay per acre, but only gives one crop per season. It withstands drought well, and matures seed under severe grazing, hence it is unnecessary to re-sow it on pasture land. It is not so productive as alfalfa.

Bamboo Leaves.—*L'Agricoltura Coloniale* (1911, **5**. 22) states that fresh bamboo leaves chopped and mixed with oilcake form a satisfactory fodder where better materials are lacking.

Bambarra Ground Nut.—The *Queensland Agric. Journ.* (1911, **26**. 324) contains an article on this food-grain (*Voandzeia subterranea*, Thou.), which is variously known as African ground-bean, Madagasear pistachia nut, Bambarra earth-nut, ground-pea, underground bean, pistache malgache, etc.

It is generally stated to be similar to the common ground-nut or peanut, but this similarity begins and ends with the low growing habit, and the maturing of its seed in the soil.

The bean is fully described and the plant illustrated, and a brief account of the method of cultivation is given. Despite the fact that analysis shows that the bean in itself forms a well-balanced ration, it does not appear probable that it will become popular as a human food, except among natives, as it lacks flavour.

It is suggested that the bean might be of economic value in the tropical parts of Australia as food for stock, but in this respect it is inferior to the ground-nut.

A further account of *Voandzeia subterranea* is contained in *Der Tropenpflanzer* (1911, **15**. 413). The history and cultivation of the plant is given, and a full botanical description. The composition and digestibility of the nut as a food stuff is discussed in detail.

A New So-called "Ground-Nut."—Dr. Kersting has found in Togoland a plant which resembles the ground-nut and *Voandzeia subterranea* in so far that it ripens its seeds below ground (*Tropenpflanzer* 1911, **15**. 273). The native name is "Kandela" and the plant occurs in three forms yielding differently coloured seeds. It has been named *Kerstingiella geocarpa*. Chevalier found the same plant in Dahomey, and named it *Voandzeia Poissoni*. There it is called "Doi" by the natives, who distinguish between varieties yielding black, white and spotted seeds. The seeds are on an average 9 mm. long and 7 mm. broad, and are stated to be of pleasant flavour. Both in Togoland and Dahomey the plant has only been seen in cultivation.

Miscellaneous.—The *Journ. Board Agric., U.K.* (1911, **18**. 97) gives descriptions and analyses of feeding-stuffs having molasses or sugar as a basis. It is concluded that treacle in moderate quantities is a good feeding-stuff, and particularly useful in feeding much straw or hay.

In *Annales des Falsifications* (1911, **4**. 30) it is stated that a flourishing trade exists on the Continent in the utilisation of waste rice, cotton meal, ground-nut bran, rice husks, cereal waste, inferior meals and linseed husks for the adulteration of linseed cake.

ESSENTIAL OILS.

General.—An account of the production of volatile oils and perfumery plants in the United States is given by F. Rabak in *Bull. No.* 195, 1911, *Bur. Plant Ind., U.S. Dept. Agric.* The volatile oil plants cultivated in the United States include peppermint, spearmint, wormwood (*Artemisia Absinthium*), tansy (*Tanacetum vulgare*), American wormseed (*Chenopodium ambrosioides*, Linn. var. *anthelminticum*), *Pinus palustris* and other pines producing turpentine oil.

There are also a number of wild aromatic plants from which oils are extracted, but which are not at present cultivated, including sassafras (*Sassafras officinalis*), wintergreen (*Gaultheria procumbens*), sweet birch (*Betula lenta*), Canadian fleabane (*Erigeron canadensis*), eucalyptus (*E. globulus*), wild bergamot (*Monarda fistulosa*), horse-mint (*Monarda punctata*) and American pennyroyal (*Hedeoma pulegioides*).

Suggestions are made with regard to aromatic plants considered capable of cultivation in the United States, and a chapter is devoted to the commercial aspect of the volatile oil industry.

Camphor.—The exports of camphor from Formosa during 1910 were 6,486,272 lb., valued at £404,112 (*Dip. and Cons. Reps*, 1911, *No.* 4769). It is stated that owing to the settlement of the interior of Formosa, large new tracts of camphor forests have been made available.

Citrus Oils.—Most of the citrus oils coming into the market from Italy and Sicily are produced by a hand-pressing process, and are considered to be of greater value than similar oils obtained by steam distillation. Owing to the high price of labour in certain countries, pressing by hand is impossible, and so far there has been little com-

detail. The flowers are produced when the trees are 18 months to 2 years old, and they succeed each other on the tree continuously. They should not be collected until about fifteen days after the opening of the bud, by which time they have become quite yellow and give off a strong perfume. The flowers are plucked in the early morning and distilled a short time after gathering. The distillation is carried out in the presence of water, and may be performed in a simple still. The operation should not be pushed too far, as if too high a yield is sought the value of the oil may be much decreased; the removal of 50 to 60 per cent. of the total perfume is said to give the best essential oil. The oil, which after distillation ought to be amber-coloured, should be filtered immediately and stored in opaque vessels in a place protected from heat, light and air.

In an article on Réunion ylang-ylang oil in the *Chemist and Druggist* (1911, **79**. 332) further particulars of this industry are given. The plants are grown from seed, usually in plantations with other plants, *e. g.* cassava, which provide shade while the trees are young. The trees will blossom for twenty years, but should be renewed after twelve to fifteen years, as the yield of flowers falls off. The yield of flowers varies with the age of the tree from 5 kilos per tree at four years to 10–15 kilos for trees ten years old, and the flowers yield from 1·5 to 2·5 per cent. of oil. Bénard (*Sols et exploitation rationnelle de l'Ylang-ylang*) gives the following constants for Réunion oil:—

Specific gravity at 15°C, 0·9714, optical rotation $-42°24'$, saponification value 148·4, saponification value after acetylation 189·8.

The annual production of ylang-ylang oil in Manila is 2,000 to 2,500 kilos, and in Réunion in 1908–9 was 1,391 kilos. It is also produced in smaller quantity at Nossi Bé and Mayotte in Madagascar.

The botanical origin of ylang-ylang oil is also discussed in the above article. Desruisseaux has recently advanced the opinion (*L'Ylang-ylang: culture, préparation, commerce;* Paris, 1911) that the true ylang-ylang plant (*Cananga odorata*, Hook.), is a native of China and spread thence to Burma and the Malay Archipelago, but that there is also another and almost indistinguishable plant which he calls *Uvaria Cananga*. This is probably identical with the *Canangium odoratum*, Baill., cultivated in Java. The latter is stated to yield cananga oil, whereas the former gives ylang-ylang oil. This theory is of interest in view of the fact that Dekker has been unable to obtain ylang-ylang oil from flowers of the cananga trees cultivated in Java (*De Indische Mercuur*, 1911, **34**. 551), and its validity is about to be tested by an interchange of seeds and cuttings between Manila, Réunion and Buitenzorg. Ylang-ylang has also been cultivated experimentally at Amani, German East Africa, and the flowers used for the preparation of oil on a small scale at the Biological-Agricultural Institute (*Der Pflanzer*, 1911, **7**. 543). The oils obtained were reported on by Messrs. Schimmel & Co. Only one could be regarded as saleable, and even that resembled cananga rather than ylang-ylang oil.

OILS AND OIL-SEEDS.

Coconut Palm.—In plantations in Central America salt has long been used as a preventive of "bud-rot" (*Journ. d'Agric. Trop.*, 1911, **11.** 159). The sheath of a maize cob is filled with salt and placed between the spathe and the trunk of the tree when the inflorescence first appears; the salt is gradually dissolved by rain and permeates the growing head of the palm. The value of this treatment does not appear to have been investigated.

A lecture by Bevan dealing with coconut cultivation in Ceylon (*Rept. Ceylon Agric. Soc.*, 1910–11) is of interest as describing modern practice in the culture of this important palm.

The preparation of sun-dried copra and its preservation from mould growths is discussed by de Jong (*Teysmannia*, 1911, **22.** 463). As a result of experiments, it is stated that sulphur dioxide has little or no preservative effect when applied to dried copra, and only temporarily prevents mouldiness in fresh copra if it is exposed to the air, though prevention is prolonged by storage in a closed room after treatment with sulphur dioxide.

Oil Palm.—The extraction of palm oil and kernels in West Africa by machinery is now being carried out in several localities in Togoland, Kamerun and Dahomey (*Verhand. Kolon. Techn. Komm. des Kolon. Wirtschaftl. Kommitees*, 1911, No. 1, p. 49). In most cases Haake machinery is being used, and as evidence of its superiority over other machinery it is stated that a French company is erecting a large plant of this type in Dahomey.

A concession has been granted recently by the Belgian Government to a British firm to engage in exploitation of palm oil, palm kernels and other oil-seeds in the Belgian Congo. The concession provides for the creation of a Belgian company with a capital of £1,000,000, and stipulates that mills capable of dealing with 6,000 tons of palm kernels per annum are to be erected within one year on each of the several areas of concession (*Dipl. and Cons. Rept. Ann. Series, No.* 4780, 1911, p. 11).

Olive Oil.—A method of decolorising olive oil is described in *Bull. de l'Office du Gouv. Général de l'Algérie* (1911, **7.** 167), involving agitation with an aqueous solution of tannin. From one to five parts by weight of tannin is required for one hundred parts of oil, according to the depth of colour. On standing, the aqueous solution of tannin settles to the bottom and the decolorised oil can then be run off.

The results of a number of technical trials, made in the south of France, on the expression of olive oil under different conditions are given in the same journal (1911, **7.** *Suppl. to No.* 12). From these it seems that ripe and well-crushed olives give the best yield in the first pressing, and that although prolonged pressing increases the yield, the quality of the oil may be lowered; the maximum yield of oil is obtained by the addition of hot water in the second pressing.

Shea Nuts.—In Northern Nigeria the shea butter tree flourishes over large areas of country from Zaria to the Benue River (*African Mail*, 1911, **4**. 453), but many trees are destroyed each year by bush fires. The opening up of the country by the Baro-Kano railway should cause a large increase in the output of shea nuts and butter; traders from Lagos are already settling along the line and buying in small quantities. A simple means of drying the nuts for export is desirable. The possibility of erecting oil mills and shipping the shea butter in casks is under consideration.

Soy Beans.—In "The soy bean in India" (*Agric. Ledger*, 1911, No. 3) Hooper deals with the occurrence, varieties, cultivation and importance of this crop in India. In Madras its cultivation is still in the experimental stage. In the United Provinces good yields were obtained on an experimental scale in 1885, and on distributing the acclimatised seed fairly good results were obtained in some cases; in others the crop failed altogether; the crop does not appear to have been popular with the native cultivators, and was consequently abandoned. Interest appears to have revived lately. In the Central Provinces the experiments carried out at Nagpur have not been promising. Trials have been made in Bombay for some years past in several localities with varying but generally poor results, although in one experiment a yield of 1,166 lb. of seed per acre was obtained.

In the Punjab an experimental plot gave a small yield in 1894; the crop does not appear to be adapted to the plains. Soy beans are grown in Burma in small quantities, being generally sown with other beans.

The different varieties grown in India are described and compared with those of Manchuria and Japan. Analyses of a number of samples of soy beans from different Indian localities show that they are as rich in oil as those derived from Manchuria.

Since 1909 experiments have been made in various parts of Victoria, and have in some cases given satisfactory results (*Journ. Dept. Agric., Victoria*, 1911, **9**. 627). No mention is made of the yields of beans obtained; the experiments in most cases appear to have been carried out from the point of view of the soy bean plant as a fodder and not as a source of oil-seed. In some cases the plots have yielded at the rate of ten to twelve tons of green fodder per acre. Further experiments are to be made, and plots of selected seed have been planted to furnish supplies of seed for the next season's planting, as it has been found that acclimatised seed gives more certain results than seed imported direct from Shanghai or elsewhere.

A few experiments with soy beans have been made in Queensland (*Queensland Agric. Journ.*, 1911, **27**. 25), but no very definite results have been obtained, and farmers are recommended to try the crop on a small scale to ascertain if the soil and climate of the different districts are suitable for its cultivation.

"Mafoureira" nuts (*Trichilia emetica*) are now being worked in the Marseilles oil mills, and the residual cake is being sold as a manure (*Les Matières Grasses*, 1911, **4**. 2466).

In a previous number of this *Bulletin* (1911, **9**. 63) it was mentioned that several poisoning cases had occurred in Germany through the consumption of margarine made with "Marotti" fat, and the suggestion was then referred to that this fat was probably derived from a species of *Hydnocarpus*, certain species of which are known to yield poisonous fats. This opinion has now been confirmed by an investigation made at the Hamburg Hygienic Institute, which has shown that the "Marotti" fat concerned is very similar to the fat yielded by *Hydnocarpus Wightiana* and *Hydnocarpus venenata* (*Zeitsch. Nähr- und Genussmittel*, 1911, **22**. 441). All three fats contain chaulmoogric and hydnocarpic acids, which are now shown to be physiologically active, causing nausea and vomiting and producing irritation of the mucous membrane of the stomach. It may be mentioned that "marotti" seeds and "marotti" fat appear to have been offered for sale in recent years in the United Kingdom, since during 1909 and 1910 inquiries were received at the Imperial Institute from commercial firms in this country as to the botanical origin of these materials, and it was possible to say then that they were probably derived from *Hydnocarpus* spp.

Several samples of "sardine" oil made at Cannanore and probably derived from *Clupea longiceps*, Cuvret Val., have been examined by Hooper (*Ann. Rep. Indian Museum, Indust. Sect.*, 1910–11, p. 6) in order to ascertain whether they were suitable for use in jute "batching" as a substitute for the whale oil or mineral oil commonly employed. Samples of the oil tested at jute mills proved quite satisfactory for the purpose; it is stated that an active demand should arise if it is found that the oils can be supplied to the jute mills at reasonable rates.

RUBBER.

Para Rubber (*Hevea brasiliensis*).—*The Report of the Director of Agriculture, Federated Malay States*, 1910, states that in 1910 48,813 acres of new land were planted with rubber, and the total area under this crop at the end of the year was 245,744 acres. The rubber output was 12,563,220 lb. against 6,083,493 lb. in 1909. The advisability of cultivating catch crops and cover crops with rubber, and various questions concerning the tapping and smoking of rubber are dealt with.

R. H. Lock records in *Circs. and Agric. Journ., Roy. Bot. Gard., Ceylon*, (1911, **5**. 231) the results of experiments carried out on old Hevea trees at Heneratgoda during a period of over three years. The effects of various conditions on the response to tapping, yield of rubber, percentage of rubber in latex, growth and renewal of bark, are considered. The tapping was done with the Bowman-Northway paring knife, followed by the sharp-pointed pricker. The area tapped at one time extended halfway round the trunk, and was occupied by three vertical wide V-shaped cuts one foot apart. Four areas were tapped in the following order: (1) on the west side at the base of the tree; (2) east side at the base; (3) west side above area No. 1; (4) east side above area No. 2. When area No. 4 was exhausted tapping was recommenced on the renewed bark of area No. 1.

The following conclusions are given as being applicable to old trees which have rested for a considerable period: (1) The yield per tapping increases with the interval between successive tappings up to an interval of four days, and remains high up to an interval of nine days. The increase, however, is not sufficiently great to make it desirable to tap less frequently than once a day where labour is available; (2) there is a slight but definite seasonal variation in yield which rises to a maximum about December, and falls to a minimum about May; (3) the percentage of rubber in the latex varies in the same way and to a somewhat more marked degree; (4) although climatic conditions exert some effect on yield, there is no close relation between rainfall and yield.

In the same *Journal* (1911, **5**. 301), M. K. Bamber and J. A. Holmes give the result of tapping experiments at Peradeniya during 1910–11, with Hevea trees four to five years old. Some of the trees were tapped on the full herring-bone system with the knife and pricker, others on the half spiral system, left to right half-way round the tree, and a third set was tapped on the spiral system right to left. In another set of experiments, incision methods of tapping were adopted in order to avoid removal of bark. It is stated that the chief drawback to this system is the large proportion of scrap formed, and the dark colour of the rubber. Accounts of other tapping experiments are also included, *e.g.* tapping on the half herring-bone system, quarter-section tapping, third-section tapping. In all cases the monthly yields are recorded. Analyses of soils from the Rubber Experimental Plots at Peradeniya are quoted.

In a subsequent circular of the same series (1911, **5**. 317) R. H. Lock and M. K. Bamber quote the results of tapping experiments on a tree raised from one of the seedlings sent out to Ceylon from Kew in 1876. The tree had a girth 8 feet 6 inches at 3 feet from the ground. Three wide V-cuts covering half the circumference of the trunk one above the other and a foot apart were made. When the bark on one-half of the tree was exhausted, the other side was treated similarly; the period required for the total removal of bark from the four areas formed was rather over two years. This necessitated 600 tappings, at an average interval of 1·3 days, $\frac{1}{15}$ of an inch of bark being removed at each operation. The Bowman-Northway knife and pricker were used. In 1909 the yield of dry rubber was 76 lb., and in 1910, 84 lb., or 4·15 oz. and 5·04 oz. per tapping respectively. The total yield for the 600 tappings was 162·5 litres of latex, giving $26\frac{1}{2}$ lb. scrap and $147\frac{1}{2}$ lb. biscuit rubber in a little more than 25 months, being an average of nearly 7 lb. per month. The average proportion of *dry* rubber in the latex was 41 per cent.

The cultivation of Hevea in the Belgian Congo is dealt with in *Dipl.*

and Cons. Rep., *No.* 4780 [Cd. 5465,/173], 1911, p. 8. *Le Caoutchouc et la Gutta-Percha* (1911, **8**. 5512) describes experiments on the cultivation of Hevea on the Ivory Coast. Particulars of the extent of Para rubber planting in French Cochin-China are given in *India-Rubber Journal* (1911, **42**. 308). Two publications dealing with the Hevea industry of Surinam have appeared recently, viz.: *Wild Heveas in Dutch Guyana*, by W. J. Gonggryp, and *Para Rubber Cultivation in Surinam*, by A. W. Drost.

Ceara Rubber (*Manihot* sp.).—The results of tapping experiments on *Manihot Glaziovii* at Boma, Lower Congo, are given in the *Bull. Agric. Congo Belge* (1911, **2**. 359). The first experiments were made during the dry season on 129 trees growing in deep, sandy soil. The tapping extended over a period of 29 days, and resulted in a yield of 58½ litres of latex, which gave 14·872 kilos (32¾ lb.) dry rubber. In the second experiment, made also in the dry season, 242 trees growing on a rough, clayey plateau were repeatedly tapped during a period of 10 days, and the yield amounted to 12·550 kilos (27½ lb.) dry rubber. In these experiments the latex was coagulated by means of formol (30 cc. per litre of latex), the rubber afterwards being immersed for 15 minutes in water at 80° C., then pressed and well washed with water. The product obtained was identical in appearance with plantation Para rubber, and was valued at 14·5 francs per kilo (5*s*. 3*d*. per lb.) with "fine hard Para" at 16 francs per kilo (5*s*. 9½*d*. per lb.).

Bitinga or Ecanda Rubber (*Raphionacme utilis*).—The tuberous roots of this plant were examined recently at the Imperial Institute (this *Bulletin*, 1908, **6**. 390) and shown to contain a small amount of rubber. According to *Dip. and Cons. Rep.*, *No.* 4772, *Ann. Ser.* [Cd. 5465/165], 1911, p. 4, cultivation experiments by Europeans with this plant in Bihé, Bailunda and Ganguellas, Angola, show that, though the plants grew well, the development of the tubers containing the rubber was too slow to give remunerative results.

Rubber Pests.—In *Circs. and Agric. Journ. Roy. Bot. Gard., Ceylon* (1911, **5**. 337) E. E. Green describes "The Rubber Slug" *Mariælla Dussumieri*, Grey, which has been known as a rubber pest since 1905, when it was observed attacking tapped rubber stems and imbibing the latex, causing an appreciable diminution in the yield of scrap rubber. Much more serious effects result from its habit of eating buds on young rubber stems. The habits of the slug are described, and remedial measures are suggested.

Coagulation of Rubber.—The coagulation of rubber latex by carbon dioxide gas is described in *Le Caoutchouc et la Gutta-Percha* (1911, **8**. 5496). The process consists in passing the gas through a heating chamber into the latex. Among the advantages claimed for this method of coagulation are that (1) the coagulation of the latex is instantaneous; (2) a high state of polymerisation of the rubber, as indicated by

and Egyptian kinds have not been overlooked. It has been demonstrated that there are 10,000–20,000 acres on the alluvial plains of Upper India under canal irrigation which are suited to Egyptian cotton, and that good American cotton can be grown in Sind. Under present conditions, however, the cultivation of short-stapled cotton is more profitable to the growers than that of long-stapled varieties. The former kinds find a ready market in Japan and Germany, give better yields than the exotic varieties, and have a shorter period of growth. Moreover, as there are no buyers of long-stapled cotton in India, the growers cannot obtain a fair price for Egyptian or American kinds, and it is therefore evident that progress in the production of such varieties cannot be made until proper agencies have been established to buy, gin, bale and export the crop. It is suggested that this could be best effected by the British Cotton Growing Association. The difficulties encountered in India in the disposal of long-stapled cotton have already been referred to in the article on "Long-stapled Cottons in Sind" (this *Bulletin*, 1911, **9**. 217). It is understood that the British Cotton Growing Association is taking action in the direction indicated above.

In *Bull. No.* 43, 1911, *Dept. Agric.*, *Bombay*, entitled "An Examination of the Seed Supply of the Broach District" by G. D. Mehta, it is stated that three-fifths of the cotton seed examined was diseased and had suffered from the attack of insects in spite of the fact that cotton is the most valuable crop of the district and that the growers are most anxious to obtain good seed. It is suggested that this difficulty could be surmounted if the cultivators of a village would co-operate and make arrangements with a ginning firm to treat their cotton separately. Each grower should pick the cotton from the best bolls on his farm and add it to that similarly collected by other growers of the village. The whole quantity would then be taken to Broach, ginned separately in a local factory, and the seed returned with an assurance that no other seed had been allowed to become mixed with it. The seed would be divided among the farmers according to their share of the seed-cotton, and this alone would be used for the next year's sowing.

An account of "Cambodia" cotton and the best methods of cultivating it has been given in the *Agric. Journ.*, *India* (1911, **6**. 160). This variety is a native of the Indo-Chinese Peninsula, and yields a superior white lint about 1·2 in. long. It has already proved very successful in several localities (see this *Bulletin*, 1911, **9**. 167, 168).

Ceylon.—The *Rep. Ceylon Agric. Soc.* 1910–11 states that the experimental cultivation of cotton is still being continued in the Island. In North Matale, cotton has been grown successfully as a catch crop among rubber trees. Arrangements have been made for cultivating the crop in the Northern and Eastern Provinces in plantations of 5–10 acres under the supervision of the Agricultural Instructors.

United States.—During the last seven years, experiments have been made in Arizona and south-eastern California on the acclimatisation and breeding of Egyptian cotton. Several distinct types have been derived from the original stock of seed imported from Egypt. In *Bull. No.* 200, 1911, *Bur. Plant Ind., U.S. Dept. Agric.*, an account is given by Thomas H. Kearney of the characteristics of the most promising of these types and of the methods adopted in the plant-breeding investigations. Two forms, the "Yuma" and "Somerton" varieties, are as distinct in the characters of the plants and fibre as some of the newer varieties which have originated from Mitafifi in Egypt. A third promising type is regarded as an improved acclimatised strain of Mitafifi rather than as a new variety. Samples of the fibre produced in 1909 were stated by commercial experts to be equal in all respects to imported Egyptian cotton of corresponding grades.

In *Bull. No.* 210, 1911, *Bur. Plant Ind., U.S. Dept. Agric.*, entitled "Hindi Cotton in Egypt," O. F. Cook gives an account of a visit to the cotton-growing districts of Egypt. The admixture of "Hindi" cotton with the crop is of serious importance to the Egyptian industry (compare this *Bulletin*, 1904, **2.** 238; 1911, **9.** 305), but it is claimed that the more intelligent farmers in the United States can secure a great advantage by the improved system of selection which has been developed in Arizona, and that by means of this system a much higher degree of uniformity is obtainable in Arizona than exists in most of the cotton fields of Egypt.

Hawaii.—Experiments on cotton cultivation were started in Hawaii in 1907. An account of recent work is given in the *Ann. Rep. Hawaii Agric. Expt. Station*, 1910. An area of 500 acres was planted in 1910 on commercial lines, and good results have been obtained with Sea Island, Egyptian and Caravonica varieties. In addition, experiments are being made with Chinese Upland, American Upland and a red-tinted Cuban cotton. It has been found that pure strains can be propagated by means of cuttings, and a number of plants thus produced were expected to come into bearing during the present year. Budding has also been tried on a large scale, and it has been found that propagation can be satisfactorily effected in this way. This method would of course have no value except in the case of cotton grown as a permanent crop. Manurial experiments have shown that the cotton crop could be largely increased by the application of fertilisers. The upland soils of the islands are lacking in available phosphates, owing to the insoluble nature of the soil phosphates, the phosphoric acid being largely combined with iron and aluminium as basic salts.

German East Africa.—A short account of the present position of cotton cultivation in German East Africa is given in *Koloniale Rundschau* (1911, p. 320). The rapid progress of the industry is illustrated by the exports, which amounted to 1,144,000 lb., of value £22,000 in 1909–10, as compared with 595,000 lb., of value £12,500 in 1908–9. Comparative experiments are being made at the Mpanganya Experiment Station in the Rufiji Valley in order to ascertain the variety best adapted to East African cultivation.

Silk.

Ceylon.—Accounts of efforts which have been made to develop a silk industry in Ceylon have been given in this *Bulletin* (1903, **1.** 204; 1909, **7.** 202). The *Rep. Ceylon Agric. Soc.* 1910–11 announces that the silk farm has been taken over by the Salvation Army. Both mulberry and eri silkworms are being reared, and a modern but simple reeling machine has been secured. An offer has been made by an English firm to purchase any quantity of eri cocoons at 1*s.* 6*d.* per lb.

Africa.—A well-illustrated article on African wild silks has recently appeared in the *Bull. Agric. du Congo Belge* (1911, **2.** 310). These products have already been described in this *Bulletin* (1907, **5.** 438; 1910, **8.** 150). It is stated that a company has been established on an international basis with the object of creating an industry in the silk, and has already commenced operations in Uganda and German East Africa. Another company is interesting itself in this question in the Belgian Congo.

Kapok and other Flosses.

German Colonies.—The cultivation of kapok and other flosses or silk-cottons is being extended. It is stated in the *Verhandlungen der Baumwollbau-Kommission des Kolonial-Wirtschaftlichen Komitees* (1911, No. 1, p. 47) that in German East Africa, 1,284 acres have been planted with 280,000 kapok trees, of which 100,000 are already in bearing. Planting is also being carried on in Northern Togoland. The floss of *Funtumia* sp. from German East Africa has been submitted to spinning trials and has proved suitable for the manufacturing processes. This fibre is also obtainable in Kamerun, where the tree is very common.

It is reported in *Der Tropenpflanzer* (1911, **15.** 272) that kapok trees occur in the whole of the Mangu-Jendi District of Togoland, and it is considered that, at the high prices now obtainable, an export trade would be profitable if transport was facilitated by the construction of a railway. Trees about 30 years old were found to yield on the average about 90 lb. of unginned kapok per tree, whilst six-year-old trees gave about 21 lb. per tree.

An account of an attempt to establish a kapok industry in New Guinea has been given in the *Verhandlungen des Vorstandes des Kolonial-Wirtschaftlichen Komitees* (1911, No. 1, p. 35). For several years in succession kapok trees were regularly planted and the crop was collected and exported. The product was of good quality and realised good prices, but the cultivation was found to be unprofitable, chiefly on account of the high cost of transport due to the bulky nature of the fibre. Other difficulties were also encountered. As the trees grow up,

1,173,586 acres, and the production of Manila hemp was 370,194,720 lb., whence the average yield per acre was 316 lb.

New Zealand Hemp.—A new variety of *Phormium tenax*, the New Zealand hemp plant, has been produced recently at the Ruakura Experiment Farm by hybridising the "Awanga" form, which is of prolific growth but yields a low percentage of coarse fibre, with the "Putaiore" kind, a medium-growing, disease-resistant form which yields a high percentage of fine fibre. It is stated in the *Journ. New Zealand Dept. Agric.* (1911, **3**. 60) that the hybrid is a quick-growing, disease-resistant plant, giving a high yield of fibre of medium quality.

Pine Fibre.—During the last few years a new textile industry has arisen in which pine fibre, in the form of paper made from wood-pulp, is employed. An article on the subject, by C. P. Hellberg, of Sweden, has appeared in the *Textile Institute Journal* (1911, **2**. 33). The paper is cut into strips, which are spun into yarn on a ring spindle. This paper yarn is said to be suitable for packing-twine and cords, whilst carpets made from it are already in great demand on the Continent. It can be combined with cotton for the manufacture of upholstery fabrics and workmen's aprons, and will doubtless compete with jute for the production of oil-cloth and sacking. The paper yarn is not damaged by water, either hot or cold.

Sisal Hemp.—A study of the composition of the leaf refuse obtained in the extraction of Sisal hemp has been made by V. Lommel (*Der Pflanzer*, 1911, **7**. 531), and it is shown that it is preferable to dry and burn the refuse and employ the ashes as a manure rather than to apply either the fresh or dried refuse directly to the soil. One hundred lb. of the dry refuse give about 13 lb. of ash, which contains about 80 per cent. of carbonate of lime, 11 per cent. of carbonate of potash and 4 per cent. of phosphate of lime.

Zapupe Fibre.—An interesting account of the cultivation of the Zapupe plant and the preparation and disposal of the fibre is given in *Der Tropenpflanzer* (1911, **15**. 235). It is estimated that in the canton of Tuxpan, Mexico, there are about two million plants under cultivation, so that, allowing 600 plants per acre, the area devoted to the crop would amount to about 3,400 acres.

MISCELLANEOUS PRODUCTS.

Cinchona.—The *Report of the Government Cinchona Plantations and Factory, Bengal*, 1910–11, states that the area under cinchona in the Munsong plantation increased during the year by 145·5 acres, 130 of which were planted with *C. Ledgeriana* and the rest with *C. officinalis*. The total number of plants on this plantation at the end of the year was 1,324,282, an increase of 60,618. Of the total, 1,202,707 were *C. Ledgeriana*, 25,490 *C. succirubra*, 93,985 *C. officinalis*, and 2,100 Hybrid

No. 2. On the Mungpoo plantation the total number of cinchona plants was 1,220,535, a decrease of 170,801: of this total, 892,945 were *C. Ledgeriana*, 159,232 Hybrid No. 1, 91,630 *C. succirubra* and the remainder Hybrid No. 2. The total number of cinchona plants on both plantations was 2,544,817, showing a decrease of 110,083 since the previous year. The total dry bark harvested from both plantations was 500,900 lb., an increase of 174,340 lb. The average yield of quinine sulphate from the bark was 3·28 per cent., as compared with 3·67 per cent. in the previous year. Of the bark worked in the factory, 371,448 lb. were Java-grown; and yielded 6 per cent. of quinine sulphate.

Herr Böhringer in *Der Tropenpflanzer* (1911, **15**. 496) draws attention to the over-production of cinchona in Java, and the low prices now ruling for bark. He considers that the area under cinchona should be reduced, and the land used for tea or rubber, preferably the former. These products would, he thinks, prove more profitable than cinchona, and the diminished production of the latter would raise the price.

Coca.—In the *Journ. d'Agric. Tropicale* (1911, **11**. 208) M. E. de Kruijff discusses the coca industry of Java. The amount of alkaloid in the Java leaves is given as 0·60 to 2·4 per cent. M. de Jong estimates the world's annual consumption of cocaine at about twelve tons (compare this *Bulletin*, 1910, **8**. 391). The exports of coca leaves from Java for January to November 1910 show an increase of about 7 per cent. over those for the same period of the previous year. The agricultural methods practised for coca in Java are described.

Catha edulis.—Attention is drawn to *Catha edulis* or "Kat" Tea in a note in *Der Tropenpflanzer* (1911, **15**. 510). The plant occurs wild in East Africa from Abyssinia to Natal, in districts along the Nile and in Arabia. It is extensively cultivated in Arabia, and forms a moderately important article of commerce there. It has a strong stimulating action, and is used in Arabia in much the same way as coca in Peru. Its active principle is an alkaloid about which little is known except that it is not identical with caffeine. Dr. Warburg considers it will become an important article of food in the future, and that it will enter into competition with tea and coffee. It has recently appeared on the London market, where it commanded a price of 1*s*. to 2*s*. per pound.

Hops.—The *Journ. South-Eastern Agric. Coll., Wye, No.* 19, 1910, contains an account of experimental work on the crossing of hops to produce varieties more resistant to disease and giving a larger yield of aromatic resins. Details of the varieties crossed, with the characteristics of the progeny, are given, with notes on the "soft resins" of the hop, and their estimation.

Industrial Alcohol.—In *Farmers' Bull. No.* 429, 1911, *U.S. Dept. Agric.* further information on the sources of alcohol is given (compare this *Bulletin*, 1907, **5**. 167), especially as regards working of factories. Experience has shown that small undertakings fail through high initial cost of plant and dear labour. To be successful the enterprise must be conducted on a large scale. Maize, potatoes or molasses are recommended as the most satisfactory raw materials.

Tobacco.—In the *Agric. Journ. Union of South Africa* (1911, **2**. 102) the Government Agriculturist for Cape Province gives a short account of the progress made in that Province in the cultivation of Virginian and Turkish tobaccos. It is estimated that the amount of Virginian tobacco produced under direct or indirect Government supervision was 5,000 lb. in 1909–10, and 6,693 lb. in 1910–11. A large part of this tobacco is sold at specially organised public sales, and the average prices realised at the last three sales were 7·95*d.* 8·62*d.* and 10·33*d.* per lb., showing a steady increase in the value of the tobacco produced.

The Turkish tobacco industry of Cape Province is even more important, the amounts produced in the last six years having been as follows: 1000, 3000, 13,000, 16,000, 40,464 and 67,173 lb. At the public sale in June 1907 the average price realised for Turkish tobacco was 1*s.* 6*d.*, in July 1908 1*s.* 11*d.*, in June 1909 2*s.* 0*d.*, in August 1910 2*s.* 2·85*d.* and in May 1911 2*s.* 5·24*d.* per lb. A small consignment of Turkish tobacco produced in Cape Province was sold recently in London in consultation with the Imperial Institute, and brought 1*s.* 6*d.* per lb. This tobacco was of very good quality and was favourably reported on by experts, so that there is very little doubt that when the production in Cape Province becomes greater than the local demand it will be possible to find a good market for the surplus in Europe.

An article in the same *Journal* (1911, **2**. 269) describes the cultivation, harvesting and preparation of "bright" tobaccos, with notes on the varieties suitable for cultivation for this purpose. The article is illustrated with diagrams showing the construction of flue-curing sheds.

The *Rept. Ceylon Agric. Soc.*, 1910–11, mentions that in 1910 an experimental cultivation of 25 acres of land with Sumatra and Java tobaccos was undertaken at Maha-iluppalama. The total yield is estimated at 20,000 lb., and a small advance shipment to Europe has been made. Samples of these tobaccos have been received at the Imperial Institute for report. A syndicate has been formed to plant Sumatra tobacco at Dumbara, Ceylon, under the supervision of an expert, who has had experience in tobacco cultivation in the Dutch East Indies.

The increasing use of tobacco for the manufacture of tobacco extract and nicotine, to be used as insecticides, has caused attention to be paid to the cultivation of tobacco for these special purposes. The *Journal of the Department of Agriculture and Technical Instruction, Ireland* (1911, **11**. 676), mentions that the Department carried out an experimental trial with *Nicotiana rustica* and "yellow Pryor" in season

reproduces well from seed as a rule, but cases of failure sometimes occur, and then, if clear cutting has been practised, deterioration of the soil follows and regeneration becomes difficult. If it were possible to rely on coppicing for regeneration, the working of forests of this species would be greatly simplified.

Forestry in Hawaii.—According to the *Rep. Board of Commissioners of Agric. and Forestry, Hawaii*, 1909–10, the work of afforestation carried on in the various islands of the Territory, and in Hawaii itself, is conducted with two principal objects in view: the creation of forest reserves, and the extension of forest areas on waste or barren land. The creation of forest reserves about the head-waters of streams, watersheds and catchment areas became necessary owing to the indiscriminate clearing of land for agriculture. For these reserves Hawaiian trees are chiefly employed; the principal species being Ohia Lehua (*Metrosideros polymorpha*), Koa (*Acacia Koa*), Mamane (*Sophora chrysophylla*) and Kukui (*Aleurites triloba*). The barren and waste areas are being planted for the most part with exotic species; amongst those employed for this purpose are *Eucalyptus robusta*, *E. globulus*, *E. citriodora* and other species of this genus, also two coniferous trees, *Cupressus macrocarpa* and *Cryptomeria japonica*. Government nurseries have been established for supplying trees to planters, and seedling trees are supplied gratis to those who plant on a small scale only, and can be procured at a trifling cost for planting on a larger scale.

Trees of Liberia.—The supplement to *L'Afrique Française* (1911, *No*. 8, p. 191) contains an account of the trees and shrubs comprising the forests of that region of French Guinea and the northern frontier of Liberia inhabited by the Tomas. The forests of Liberia contain a variety of trees of enormous size, related to the silk-cotton tree (*Bombax*) and the cashew-nut tree (N.O. Anacardiaceæ) which are exploited for timber. Among the smaller trees are *duro*, the fruit of which resembles grapes; *sounsoun*, with an edible fruit; and *mana*, which supplies good wood for house-building. Amongst the trees that attain very large dimensions are the common silk-cotton tree (*Bombax*); *kobi*, the fruit of which yields an oil used by the natives in making soap; *diala* or "Redwood" employed in "trials by ordeal"; *tali*, the bark of which contains a more or less virulent poison; *sô*, one of the best woods for building; *houro* and *sombala*, from the bark of which a khaki-coloured dye is obtained.

Shrubs belonging for the most part to the Acacia, Tamarind and Fig families are common. Kola (*Cola* spp.) is planted in the forests by the natives, particularly in the region between the N'Tofa and the river Saint Paul. The oil-palm is abundant; and there are numerous climbers that yield rubber; the most important is known by the native name *gbéi*. From the bark of another climber known as *gra*, an indigo-like dye is obtained. Bamboos are abundant in places, including one known as *bau*, the stem of which is semicircular in section. The natives utilise the stems for many purposes; they also prepare from the plant a drink known as *banghi*, and from the fibre they make twine and cord. Amongst introduced plants are coffee and Ceará rubber.

Babul Cultivation in Saline Soils.—The results of experiments on the growth of babul (*Acacia arabica*) in the saline soils of Lower Gódávari and Kistna are recorded in the *Annual Administration Rep. Forest Dept., Madras (Northern Circle)*, 1909–10. Although for the most part unsuccessful, the experiments were of value in that they indicated the cause of failure. In the Lower Gódávari area the surface water ran off the land very rapidly, and the seedlings perished before they had developed roots capable of reaching the subsoil water. In the Kistna area, situated on a slope, a similar result obtained on the higher ground, but in the lower part, and in hollows and depressions where water was retained for some time, babul seedlings established themselves and made satisfactory growth. It does not appear necessary for the subsoil water to be fresh, as some specimens were found to flourish with their roots in creeks of salt water.

An experiment is to be made with a view to establishing transplanted babul seedlings in the saline area. It is proposed to raise the seedling plants in a nursery on elevated beds, to induce them to form long roots. When transplanted to their permanent quarters it is expected that the long roots will enable the plants to utilise the subsoil water, and so become established before they suffer from drought. Should this prove successful, there are thousands of acres of bare saline soil which it is hoped can be re-clothed in this way. In view of the scarcity of fuel in the vicinity of this area, the success of these experiments is much to be desired.

Injurious Insects.—Insects, in their relation to the reduction of future supplies of timber and general principles of control, form the subject of *Circular No.* 129, 1911, *Bureau of Entomology, U.S. Dept. Agric.* It is estimated that for a ten-year period the amount of timber in the United States forests killed or reduced in value by insects represents a loss of $62,500,000 per annum.

Not only is timber killed as a result of insect attacks, but the standing or fallen dead trees serve as fuel for forest fires, and are a menace to the healthy timber. Fire-killed timber, too, serves as a host for one or more of the insects destructive to living timber, especially the bark-boring beetles. On the other hand, forest fires destroy a number of injurious insects, and it sometimes happens that complete fire control contributes to more extended depredations by insects on living timber, and increases rather than diminishes the need for insect control. Deterioration and decay of timbers are rendered more rapid than would otherwise be the case owing to the attacks of fungi that have been able to enter the inner tissues of trees, through injuries caused in the first place by insects.

In all efforts to control an outbreak, or prevent excessive loss, from forest insects, it has been found useless, as a rule, to attempt extermination of any given species; experience has shown that by weakening its forces by some 75 per cent. the pest does not continue an aggressive attack, but is kept in control by its natural enemies. The reduction necessary may often be brought about by adjusting or modifying details of forest management, to create conditions unfavourable for the pest, or favourable for its natural enemies. It is essential that the forester should possess an expert knowledge of the life-history and habits of the insects, and their natural enemies. The necessity for utilising insect-infested timber is also urged, as by this means it is possible to contribute to the reduction of insect pests, and to provide against serious injury to the future supply of timber.

"*Oak Pruner*" (*Elaphidion villosum*, Fab.).—The life history of this beetle is discussed in *Circular No.* 130 of the above Bureau. It occurs over the greater portion of the Eastern United States, with the possible exception of Georgia and one or two of the Gulf States. Deciduous trees, shrubs and woody climbers are attacked by the larvæ, but they are particularly partial to oak and hickory trees planted for shade. The eggs are deposited beneath the bark of a living branch, and on hatching out, the larvæ form cavities in the wood of the branch of such a size that the affected branches are easily broken by the wind. When present in large numbers considerable damage is caused by this pest. Its presence in such cases may be detected by the quantity of small branches beneath the trees. Most of the fallen branches contain larvæ within the cavities in the wood, and should be collected and burned.

Beech Coccus.—The relation between this pest and the beech tree forms the subject of a report by Messrs. Boodle and Dallimore in a recent issue of the *Kew Bulletin* (1911, *No.* 8, p. 332). The conclusion arrived at is that the coccus is not the primary cause of the death of trees on which it occurs. Parasitic fungi were present in all cases, the two commonest being *Nectria ditissima* Tul., and *Melogramma spiniferum* De Not., and these alone would have been sufficient to cause the death of the trees. Although the coccus may not itself do serious damage to beech, it may assist, if present in large numbers, in lowering the vitality of the trees and rendering them susceptible to fungoid attacks. In the case of old trees in parks, the destruction of the pest by spraying or washing the trunks with a paraffin emulsion or a caustic wash is recommended.

Blue Pine Bark-borer.—In *Bull. No.* 5, 1911, *Imper. Forest Dept., India,* Stebbing describes this insect and gives some account of its life-history and the damage done by it, and suggests preventive and remedial measures. Both in the larval and adult states this beetle (*Tomicus Ribbentropi*, Steb.) does serious injury to blue pine (*Pinus excelsa*) and

and allowed to complete the distillation as rapidly as possible, a temperature of 400° C. being reached. It is claimed that a maximum amount of distillate is obtained, with a minimum loss of alcohol and acetic acid (compare this *Bulletin* 1909, **7.** 73).

Wood and Fibre Boxes.—An inquiry into the box-making industry of the United States is summarised in *Circ. No.* 177, 1911, *Forest Service, U.S. Dept. Agric.* Owing to increasing competition, a dispute has arisen between manufacturers of the two forms of packing-case, the wooden box makers alleging that the use of fibre boxes (familiar in this country as "cartons" or straw-board boxes) is inimical to forest conservation, on the grounds that first-class wood-pulp is employed in their manufacture; while only low-grade lumber, unsaleable for other purposes, is used for making wooden boxes. It is claimed that the demand for the latter type of packing-case has diminished by 30-40 per cent. during recent years as a result of the increasing use of fibre boxes. Inquiry has shown this estimate to be much exaggerated, the actual state of affairs being that the wooden box is not quite holding its own in certain fields of competition. Moreover, the fibre employed for making the competing type of box is chiefly obtained from old paper, straw, and rope and bagging waste, only 16 per cent. of the material being wood-pulp. The pulp is of low grade mixed with a small proportion of good quality pulp, much of the latter being imported from Norway and Sweden.

Identification of "Powellised" Timber.—Difficulty has been experienced hitherto in distinguishing "powellised" and "un-powellised" woods which have been accidentally mixed, the difficulty being increased if the woods have been weathered. The Forest Chemist, India, has ascertained from the company using this process that a small quantity of arsenic enters into the composition of the solution (*Indian Forester*, 1911, **37.** 567), and has suggested a slight modification of Marsh's arsenic test as a means of identification. The presence of arsenic in timber does not necessarily indicate that the sample has been "powellised," since this substance may form a constituent of other preservative solutions.

Eucalyptus Timbers.—The results of mechanical tests of eucalyptus timber grown in California, together with some information in regard to its utilisation, are given in *Circular No.* 179, *Forest Service, U.S. Dept. Agric.* Of the introduced species of eucalyptus, the blue gum (*E. globulus*), red gum (*E. rostrata*), sugar gum (*E. corynocalyx*), gray gum (*E. teretiformis*) and manna gum (*E. viminalis*) are most commonly planted.

The known tendency of eucalyptus timber to warp, shrink and crack in drying is found to be much greater in Californian-grown trees less than thirty years of age than in the mature trees that are felled in Australia and Tasmania. The tests showed that, of the above-named species, the sugar gum possessed the greatest strength. The strength of sugar gum, blue gum and red gum timbers as grown in California compares favourably with that of white oak, pignut and shag-bark hickory, whilst the other species rank with what are considered the weaker varieties of hickory. Tests on blue gum showed an average shrinkage in volume of 21·8 per cent. when dried from a green to an oven-dry condition; eastern red oak is said to show an average shrinkage in volume of 18 per cent. under similar conditions. The best method of seasoning green-sawed timber is open-piling under cover, with uniform close-stacking, together with high-piling to prevent warping and twisting. When air seasoning alone is employed a three-year period of drying is considered necessary. So far, Californian-grown eucalyptus timber has not been utilised on an extensive scale, but it has been employed sufficiently to indicate that some species may in the future be used as substitutes for woods at present employed for cord-wood, piling, posts, poles, cross-ties, mine-timbers, paving blocks, insulator-pins, furniture, finish, veneers, cooperage, vehicle stock and tool handles.

Mahogany.—In *Der Tropenpflanzer* (1911, **15**. 479) Herr Paul Busch gives an interesting account of the red woods, which now come into commerce as "mahogany." He divides them according to their geographical origin into American, African and East Indian, and places in a fourth group various red woods which are not derived, like true mahoganies, from species belonging to the N.O. Meliaceæ. This last group includes a number of Australian eucalyptus timbers, such as the well-known "Jarrah."

Mangrove Timber as Firewood.—In the *Philippine Journal of Science* (1911, A, **6**. 1), A. J. Cox gives an account of the fuel value of timbers commonly used in the Philippines for firewood. The annual consumption of firewood is at least 200,000 cubic metres, and of this quantity the larger part is obtained from the mangrove swamps fringing the coasts and estuaries. The most important factors influencing the value of a wood for fuel are moisture content, percentage of ash, and specific gravity. These factors have been determined for a large number of local woods, with the result that the class for timbers of the highest fuel value is formed exclusively of Rhizophoraceæ, with a specific gravity of 0·90 or more, the timbers of *Bruguiera gymnorrhiza*, *Brugiera* sp., *Rhizophora mucronata*, *Ceriops tagal* and *C. roxburghiana* being specially mentioned. The next class is composed of *Sonneratia pagatpat*, *Bruguiera parviflora*, *Xylocarpus obovatus*, *Xylocarpus* sp., *Casuarina equisetifolia*, *Bauhinia malabarica* and *Vitex pubescens*, all with a specific gravity of 0·75 to 0·90. A third class, with specific gravities of 0·60 to 0·75, contains two mangrove plants (*Aegiceras corniculatum* and *A. majus*) and *Pithecolobium dulce* and *Psidium guajava*. Two remaining classes contain jointly but four species. In all cases the timber was deprived of the bark. A disadvantage of the use of mangrove timber as fuel in closed furnaces is the tendency to form a "clinker" as the result of the condensation of the abundant volatile constituents of the wood. The author gives a formula for the estimation of the calorific value of any timber when the moisture and ash contents are known, assuming that the heating value of the combustible matter of wood (*i. e.* wood less water and ash) is constant and equal to 4,418 calories.

Papuan Timbers.—According to the *Annual Report on the Territory of Papua* for 1910, the country is said to possess in *Afzelia bijuga*, A. Gray, an excellent hardwood that is durable and impervious to the attacks of white ants, and therefore valuable for use as sleepers and house-posts. The tree is found throughout the country, and is known to natives by the name of "Melila" and "Ulabo" or "Karahi." Several saw-mills have recently been erected in the Papuan forests, which contain both hard and soft woods, but up to the present little actual work has been accomplished. The undertakings will doubtless prove remunerative, and contracts for the supply of some millions of feet of log timber have already been arranged with importers in the United Kingdom.

A list of indigenous timbers, preliminarily identified by Dr. Foxworthy of Manila, is included in the report. Some forty-two species are enumerated, but only in a few instances has their full botanical identity been established.

Tanning Materials.

Divi-divi.—In *Der Pflanzer* (1911, **7**. 415) the Director of the Biological-Agricultural Station at Amani, German East Africa, mentions that divi-divi pods collected from trees fifteen years old, grown at Daressalem, have been examined recently in Germany. A sample of whole pods gave the following percentage results: moisture 7·0, matter soluble in water 53·2, of which 39·0 consisted of tannin and the residue of non-tannin matter. A ground sample was found to have the following percentage composition: moisture 9·0, matter soluble in water 74·7, of which 57·7 was tannin and the residue non-tannin matter.

Mangrove Bark.—In *Journ. d'Agric. Trop.* (1911, **11**. 257) M. E. Baillaud, who has already given some attention to the utilisation of mangrove bark in French West Africa (this *Bulletin*, 1905, **3**. 348), points out that owing to the increasing demand for this bark it would be worth the while of merchants in French tropical colonies to investigate the commercial values of any mangrove barks that may be available. It is well known that there are enormous areas of mangroves in West Africa, but unfortunately they yield bark which is much poorer in tannin than the mangrove bark obtainable in British and Portuguese

The heart-wood of *Acacia Suma*, also from Mikesse, contained 8·5 per cent. of moisture, 10·9 per cent. of tannin, and 5·1 per cent. of non-tannin matter, but gave a dark-coloured leather. It is suggested that this material might be employed for the preparation of cutch, like the heart-wood of *Acacia catechu*, from which Indian cutch is mainly derived.

ECONOMIC MINERALS.

Coal.—In an article on the coal resources of Canada (*Journ. Min. Soc., Nova Scotia*, 1911, **16**. 147) D. B. Dowling, of the Geological Survey of Canada, gives a brief account of the Canadian areas in which coal occurs, with details of the kind of coal and provisional estimates of the amount available. Many of the areas in the remote parts, especially in the north, await fuller investigation; and their extent is estimated from a general knowledge of the distribution of the coal-bearing formations. The following is a summary estimate of the area occupied by the coal formations in the different provinces, together with the kind and amount of coal available :—

Province.	Area.	Anthracite.	Bituminous coal.	Sub-bituminous coal and lignite.
	Square Miles.	*Million tons.*	*Million tons.*	*Million tons.*
Yukon	413	9	82	800
Mackenzie	400	—	—	1,000
British Columbia	1,351	61	39,674	490
Alberta	29,908	400	30,250	79,000
Saskatchewan	6,000	—	—	18,400
Manitoba	48	—	—	160
Ontario	10	—	—	25
New Brunswick	119	—	161	—
Nova Scotia	314	—	3,224	—
Total	38,563	470	73,391	99,875

In a paper on "Coal in the Namchik Valley, Upper Assam" (*Rec. Geol. Surv., India*, 1911, **41**. 214) E. H. Pascoe describes an important deposit of coal which was discovered during a visit to the Namchik river, a tributary on the left bank of the Dihing. The total thickness of coal measured was sixty feet, and with the exception of five or six feet it is of excellent quality. The coal occurs in five groups of seams within a thickness of about 360 feet of strata. The strata are of Tertiary age.

Diamonds.—J. C. Branner has given an account of the minerals associated with diamonds in Bahia, Brazil (*Amer. Journ. Sci.*, 1911, **31**. 480). He concludes that there is no evidence to show that the Brazilian diamonds are of eruptive origin, and that they were certainly not brought into their present position in the Lavras quartzites by eruptive action of any kind. He is strongly inclined to believe that the Bahia diamonds have, like the minerals with which they are associated, originated in the quartzite as a consequence of metamorphism.

Mercury Ore.—In his "Notes on the Cobalt Area" referred to on p. 428, W. G. Miller states that mercury has been discovered by the staff of the Nipissing mine. The mode of occurrence is not known; but the ordinary ore, as shipped, contains from four to five pounds per ton, and the material which resists crushing in the sampling work, frequently contains 20 lb. or even 40 lb. per ton. The process applied by the Nipissing Company at Cobalt is a combination of amalgamation and cyanide treatment, and is well suited to mercury-holding ore. The opinion is expressed that the mercury in the ore should at least serve to make up for any losses of mercury that may take place in amalgamation.

Petroleum and Bitumen.—In the *Journ. Min. Soc., Nova Scotia*, (1911, **16.** 129) Dr. R. W. Ells, of the Geological Survey of Canada, gives an account of the "Oil-fields and Bitumen of Trinidad and Barbados," summarising the information at present available as to the geological structure of the islands, and the state of development of the oil and bitumen deposits.

The northern portion of Trinidad is occupied by a range of hills rising to over 3,000 feet in height, and consisting of metamorphosed rocks which resemble in many respects the lower Cambrian rocks of Canada. To the south of this range of hills, and comprising the greater part of the island, the rocks consist chiefly of shales and sandstones of Tertiary age. These strata are thrown into a series of anticlines and synclines running in a general east-and-west direction across the southern part of the island. It is along the course of the anticlines that the oil, asphalt and natural gas occur. The pitch lake, which has an area of nearly 140 acres, is situated at the western end of one of these anticlines. In the eighteen years during which the mining of asphalt has been in active operation the level of the lake surface has been lowered about seven feet; and during this period about 1,500,000 tons of asphalt have been extracted.

A considerable amount of boring has been, and is being, done in search for oil, and preparations are being made to develop a number of the areas which are regarded as oil-bearing, and which occur along the lines of certain anticlines (compare this *Bulletin*, 1911, **9.** 316).

The geological formations of Barbados are somewhat different from those of Trinidad. Six-sevenths of the area of the island is occupied by coral limestone. The remaining seventh, chiefly in the north-eastern part of the island, is occupied by Tertiary sediments similiar to those of Trinidad. As in Trinidad, these Tertiary rocks contain petroleum and bitumen. As a rule, however, the rocks are more highly disturbed than those of Trinidad, the anticlines being sharper and in certain places overfolded. The bitumen ("manjak") of Barbados sells at a much higher price than that of Trinidad, the recent prices of the former ranging from \$80 to \$120 per ton, and those of the latter from \$20 to \$40 per ton.

The total output of oil from the wells in Barbados is stated to be 1,053,839 gallons.

Phosphates.—An interesting account of the phosphate fields of Florida is given in the *American Fertiliser* (1911, **35**. No. 1, p. 33). The occurrence, preparation, costs and composition of the various grades are discussed in full.

Silver-Nickel-Cobalt-Arsenic-Ores.—In "Notes on the Cobalt Area" (*Eng. and Min. Journ.*, Sept. 30, 1911, p. 645) W. G. Miller, Provincial Geologist of Ontario, discusses the nature and origin of the ores occurring at Cobalt, which is now the leading producer of silver, cobalt and arsenic, and is the third greatest producer of nickel. The ore-bodies are genetically connected with a huge sill of diabase, which has an average thickness of between 500 and 600 feet, and which is intrusive in the pre-Cambrian rocks of the Keewatin and Huronian Series. Ore to the value of \$60,000,000 has been produced at Cobalt, and of this 85 to 90 per cent. has come from the lower or foot wall of the diabase sill. A certain amount of ore has been obtained from veins in the sill itself, and one or two important veins have been worked in the upper or hanging wall. Calcite is the characteristic gangue mineral. Fluorite and barytes, which usually occur in such ores elsewhere, have not been found at Cobalt.

Sodalite.—The occurrence of this mineral at Dungannon, Ontario, is noted briefly by Messrs. F. D. Adams and A. E. Barlow in their "Geology of the Haliburton and Bancroft Areas" (*Memoir No.* 6, 1910, *Geol. Surv. Branch, Dept. of Mines, Canada*). The deposit is situated about five miles east of Bancroft, and occurs in a large body of nepheline syenite. An area of some 250 × 50 feet has been proved, and quarried sufficiently to indicate that there is a large workable deposit. Blocks weighing several tons are obtainable. It is stated that 130 tons were shipped to the United Kingdom in 1906, and that it is intended to work the deposit extensively as a decorative stone.

Tin Ore.—Further discoveries of the occurrence of cassiterite have been made in Rhodesia. In this *Bulletin* (1911, **9**. 317) reference was made to its discovery in the Enterprise district. Since then, according to the *Rhodesia Mining Review* (July 5 and August 16, 1911), it has been found in the Abercorn district and also near Ndanga, forty-two miles east of Victoria. In both cases the cassiterite occurs in pegmatite dykes, apparently associated with granite intrusions as in the Enterprise district.

In the *Canadian Min. Journ.* (Sept. 1, 1911, p. 549), R. W. Brock, Director of the Geological Survey, reports the discovery of cassiterite in a vein of greisen four feet wide, near Burnthill brook, South-west

to this important rubber-yielding tree, fills an important gap in rubber literature.

Dr. Christy is well qualified to write a treatise on *Funtumia elastica*, for in addition to having had a very considerable experience with Funtumia trees in Uganda he has travelled widely in West Africa for the purpose of specially studying the trees there and comparing them with those in the former country. Much of the information now published is the result of Dr. Christy's own experiments in East and West Africa, but all available records have been drawn upon and the results of trials by Government Departments and planters in Southern Nigeria, the Gold Coast and Kamerun are included.

The book deals in order with the botanical characters and anatomical structure of the tree; its distribution, and the conditions of climate and soil under which it occurs; the methods of cultivation and the rate of growth in plantations; its diseases and pests; the methods of tapping employed, and the yield of latex from forest and plantation trees; the characters of the latex and the methods employed for coagulating it; and the quality and value of the rubber.

There are many problems awaiting solution in connection with the methods of cultivating and tapping Funtumia trees and in preparing the rubber, and on all these points there is much useful and valuable information in the book. The author insists strongly, and quite rightly, that the Funtumia tree should not be cultivated and tapped by the methods employed in the case of Hevea, as its habit of growth and its behaviour on tapping differ entirely from those of Hevea. He attributes the poor results obtained in many cases with Funtumia trees to the use of wrong methods. In the earlier cultivation experiments Funtumia trees were planted at rather wide intervals, approximating to those used for Para, with the result that they branched low down and developed no tappable stem, but it has since been recognised everywhere that in order to produce suitable trees for tapping they must be planted very closely, say 6 feet by 6 feet. The plan recommended by Dr. Christy is to grow the trees closely in coppice formation in order to encourage the development of straight cylindrical stems, 15 to 20 feet high, and then to thin out the plantation during the third or fourth year so that the remaining trees may increase in girth. Trees treated in this way are said to be ready for tapping in their sixth year. Much slower growth is obtained if *Funtumia elastica* is planted under the shade of forest trees or in openings cut through the underwood, and in these circumstances the results are not likely to be satisfactory. Particulars of the rates of growth of Funtumia trees under varying conditions in Kamerun, Southern Nigeria and the Gold Coast are given in the book.

Similarly, Funtumia trees cannot be tapped by the methods adopted for Hevea. The latter tree, as is well known, can be repeatedly tapped for long periods, whereas Funtumia trees yield all their available latex at a single tapping, and can only be retapped two or three times a year.

Considerable discussion has taken place as to the method of tapping best suited for *Funtumia elastica*, and the principal systems which have been advocated are described in the volume. Dr. Christy strongly deprecates the excision of the bark in tapping Funtumia trees, and recommends a method of incision by means of a rowel pricker with a thin, sharp blade. Shallow grooves which do not reach the laticiferous tissue are cut in the bark by means of a special V-knife, and the latex is then liberated by means of the pricker. The tapping is done on the double half-spiral system (*i. e.*, a double herring-bone where the lateral cuts extend round half the stem) and the lateral incisions are made 8 inches apart. In retapping, fresh lateral incisions are made from 1½ to 2 inches above the old ones, and a new vertical channel is also cut at the side of the first. It is stated that the wounds heal in less than two years and that if the trees are tapped two or three times a year the renewed bark will be ready for retapping by the time the space between the first laterals has been used up. This method is said to give fair yields of latex regularly year by year with the least possible injury to the tree. Experiments over a long period will, however, be necessary before its effect on the trees can be definitely determined. It is stated that no injury is caused by the penetration of the wood by the pricker provided that the blades are thin, and that the burrs which frequently develop on Hevea stems as the result of the use of the pricker do not occur on Funtumia. Further observations on this point are, however, desirable, as there is no doubt that *Funtumia elastica* does sometimes develop excrescences of wood as the result of deep tapping, and it must be remembered that the full effects of the pricker method in the case of Hevea were not revealed until after two years.

The author further states (p. 147) that in making the lateral incisions "the free ends of the spirals may interlap with impunity; there can be no danger of ringing the bark with the pricker." This latter statement is perfectly true so far as one pair of spirals is concerned, since the rotary pricker makes only intermittent cuts in the bark, but when a number of such spiral incisions are made with the pricker at intervals of 8 inches up to a considerable height on the trunk it would seem that at one point or another the continuity of the whole of the bark tissue must be broken, with the possibility of injury to the tree.

A large number of tapping results from forest and plantation trees both by incision and excision methods are recorded in the book. It may be of interest to state that Dr. Christy estimates that Funtumia trees grown and tapped according to his system will yield 4 oz. of dry rubber in the sixth year, 5 oz. in the seventh, 9 oz. in the eighth, 12 oz. in the ninth, and 15 oz. in the tenth year.

A brief notice must suffice for the section of the book dealing with the important questions of the coagulation of the latex and the preparation of the rubber. The coagulation of the latex of *Funtumia elastica* presents a number of interesting features, the most important of which is that fresh latex is much more difficult to coagulate than latex which has been kept for several days. In consequence of this fact, processes which answer very well for old latex are frequently ineffective when applied to latex which has just been collected. Thus, for example, if Funtumia latex which has been kept for ten days be diluted with hot water it can be readily and completely coagulated by the addition of tannic acid or mercuric chloride, whereas if fresh latex be used only slow creaming takes place. If, however, a little acetic acid be added to the fresh latex diluted with hot water, the addition of tannic acid or mercuric chloride then produces immediate and complete coagulation, although the acetic acid has no coagulating action by itself. Again, if cold water be used instead of hot in these experiments only creaming of the latex takes place with both fresh and old latex. Funtumia latex is also peculiar in that it can be coagulated by adding formalin, which is frequently employed to retard the coagulation of other latices. Dr. Christy states that the addition of 15 c.c. of commercial formalin (40 per cent.) to one pint of normal, freshly-collected Funtumia latex induces complete coagulation in from fifteen to forty hours, depending on the dilution of the latex. This process is stated to give good results, as it is applicable to fresh latex, and furnishes rubber of excellent quality and light colour.

The rubber of *Funtumia elastica* is of very good quality if carefully prepared, and, as the author points out, consignments have recently been sold in London at prices equal or superior to that of fine hard Para.

Dr. Christy is a strong believer in the value of *Funtumia elastica* for purposes of general cultivation in Africa, and is inclined to question whether the Para tree (*Hevea brasiliensis*) will furnish such good results as the indigenous tree. The enumeration of the difficulties in the way of establishing plantations of Para trees in Africa as compared with Funtumia trees (pp. 96 and 97) is, however, rather overdone, and after reading the catalogue of possible misfortunes to the former tree it is a matter for astonishment that in spite of everything it has been possible to establish fairly extensive plantations of Para trees in a number of countries in Africa, and moreover to obtain from them very promising yields of rubber of excellent quality. Whether Funtumia or Hevea trees will prove to be most suitable for general cultivation in Africa has yet to be decided by careful experimental work, and the question of their relative advantages cannot be taken as settled by Dr. Christy's dogmatic assertion (p. 95) that "any one who will make a study of rubber cultivation in Africa as I have done will come to the conclusion, if unbiased, that the indigenous tree is the most suitable for general plantation purposes in Africa."

The book, which is furnished with numerous excellent illustrations, forms a very useful and valuable contribution to the literature dealing with *Funtumia elastica*, and it deserves to be carefully studied by all who are interested in the cultivation or tapping of this tree.

fungi, most of them only saprophytic, which have been recorded as occurring on the Para tree.

With reference to the general sanitation of rubber estates a number of important points are discussed, such as, the part which jungle stumps play, if left in the ground, as sources of root disease; the advantages of wide planting so as to admit light and air, and thus to reduce the humidity, all of which factors tend to diminish the danger of fungoid diseases; and the desirability, if intercrops or cover plants are to be grown, of choosing plants which are not liable to be attacked by the same diseases as Hevea. On this latter point Mr. Petch states that many of the diseases of cocoa are identical with those of Hevea, and that consequently cocoa is from the mycological point of view the worst possible intercrop to grow with Hevea. The importance of planting protective belts of trees, of some other species than Hevea, in order to separate the rubber areas into distinct blocks, is also referred to, but it is realised that this policy is a counsel of perfection which is very unlikely to receive general adoption.

No detailed account of the diseases described by Mr. Petch as known to attack Hevea can be attempted here—for this the book itself must be consulted—but one or two points of general interest may be noted. On the plantations in Ceylon and Malaya the leaf diseases which have appeared have been confined to seedlings in the nurseries, and even there have not caused much damage; no leaf disease has yet made its appearance on old trees. Three root diseases have been recorded up to the present, caused respectively by *Fomes semitostus, Hymenochæte noxia* and *Sphærostilbe repens.* The result of root disease is that the tree gradually dies back, owing to the inability of the roots to perform their proper functions, and very frequently the tree is finally blown over. In general, a root disease is much less serious than a leaf disease, as it is more localised and cannot spread so rapidly. The four stem diseases of Hevea which have been recorded are the so-called canker, caused by *Phytophthora Faberi;* "pink disease," caused by *Corticium salmonicolor;* "die-back," in which the most destructive agent is *Botryodiplodia theobromæ;* and a "black canker" caused by a species of *Fusicladium.* Detailed descriptions are given of the characters of all the fungi mentioned and of the appearance of the diseased portions of the plant, and in each case the method of treatment is clearly indicated.

Mr. Petch's book should prove to be one of the most valuable in the planter's library, since it deals in an excellent manner with a most important side of plantation work, which has not received adequate treatment in previous textbooks. The available information on the diseases of Hevea is now readily accessible in this volume, and it is to be hoped that its publication will increase the attention which is being devoted by planters to this important subject.

THE RUBBER PLANTER'S NOTEBOOK: A Handy Book of Reference on Para Rubber Planting, specially designed for use in the Field.

Compiled from the most reliable and modern sources by Frank Braham, F.R.G.S. Pp. viii. + 108, illustrated with diagrams and photographs. (London: Crosby, Lockwood & Son, 1911.)

The object of the author in compiling this small volume is to supply the "ordinary man" and the "thousands of untrained assistants" on rubber plantations with a summary of information regarding the methods employed in cultivating the Para tree and in preparing its rubber. It is obvious that it is impossible to deal adequately with these subjects in a book of about 100 pages, and of a size suitable for the pocket; and it may be doubted whether the information supplied, although on the whole accurate so far as it goes, is sufficiently detailed to be of practical value in the field. The book can only be regarded as an introduction to the larger works on the subject, but as it furnishes a short summary of the work of rubber plantations it may be useful to persons possessing no knowledge of rubber planting. A short bibliography of rubber literature is given, together with notes on tropical hygiene.

It is stated on p. 3 that Para rubber seeds "contain kernels of rich oil," but what is intended is, no doubt, that the kernels are rich in oil.

DRY-FARMING. A SYSTEM OF AGRICULTURE FOR COUNTRIES UNDER A LOW RAINFALL. By John A. Widtsoe, A.M., Ph.D. Pp. xxii + 445. (New York: The Macmillan Company, 1911.)

This book has been published at a very opportune moment, since the subject it treats of is now receiving attention in many parts of the world, and delegates from various countries are being sent to attend the congresses on dry-farming which were inaugurated in 1907 at Denver, Colorado, and have been continued in various towns of the Western States. The methods of the art have long been employed more or less perfectly, but it is only comparatively recently that they have been critically discussed as a special branch of agricultural practice.

A general outline of the subject was given in this *Bulletin* (1911, **9.** 149), so it need not be repeated here. The author considers that dry-farming is applicable in places receiving an annual rainfall of 20 inches or less, but that even where the rainfall is 25 or 30 inches, various causes may make it desirable, such as torrential rains, high winds, low humidity, or the way the rainfall is distributed in the course of the year. These and other factors have to be considered as well as the total fall per annum. He states that if the annual fall is above 15 inches there need be no crop failures if the soil is suitable and the methods are correctly employed; and that even with only 10 to 15 inches the failures need be very few, if proper precautions are taken. Of course, circumstances such as the excess of soluble matter in the so-called "alkali lands" prevent success, and the possibility of obtaining a sufficient amount of water for the requirements of the homestead and the live stock has to be taken into account.

The subject is treated of in a very systematic and thorough manner, and there are over one hundred illustrations elucidating the text, among which those of the agricultural implements are especially valuable.

THE SOYA BEAN OF MANCHURIA. By Norman Shaw. A report issued by the Chinese Imperial Maritime Customs. Special Series, No. 31. Pp. 32. (London: P. S. King & Son, 1911.)

This pamphlet gives a concise but fairly complete account of the soy bean and the soy bean industry in Manchuria. Much information has been published in recent years about the cultivation, composition and uses of soy bean, and the author has collated these scattered data and added to them from his own knowledge of the Manchurian industry.

The first part of the report gives an interesting account of the cultivation of the bean in Manchuria, where it has been known for centuries, though it first found its way to the United Kingdom only towards the close of the eighteenth century, and has only become a commercial article in Europe in the last three years. The many factors concerned in the cultivation of the plant are discussed, particulars are given of Manchurian soils, and the different varieties of soy bean are described. The native method of preparing the beans for food, and of expressing oil from them are also dealt with.

The development of the export trade in soy beans from Manchuria is sketched, with particulars of prices and cost of transport. Statistics of production, etc., are also quoted.

The report contains several illustrations and maps.

THE BLEACHING, DYEING AND FINISHING OF FLAX, HEMP AND JUTE YARNS AND FABRICS. By H. R. Carter. Pp. xii + 164. (London: John Bale, Sons & Danielsson, Ltd., 1911.)

This book, which forms an addition to the series of technical handbooks on textile subjects to which references have already been made in this *Bulletin* (1910, **8**. 98, 330, 441), consists, like its predecessors, of a collection of papers which have appeared from time to time in the *Flax, Hemp aud Jute Trades Journal.* As very little has been published previously in the United Kingdom on the subjects dealt with, the work should be of considerable service.

FORESTRY FOR WOODMEN. By C. O. Hanson. Pp. 222. (Oxford: The Clarendon Press, 1911.)

A number of standard books are now available for English students of forestry, but most of them are expensive and beyond the means of the working forester and woodman. It was with a view to supplying a cheap book on scientific forestry for the use of foresters that this volume was prepared. It is based on Schlich's *Manual of Forestry*, and other important books bearing on special branches of the subject have also been consulted by the author. With the exception of the first two chapters, which describe the life history of a tree and tree growth in

but frequently an alternative spelling is given in brackets. The 1911 census figures are quoted when available. Great facilities now exist for reaching India from all parts of the world and for travelling throughout the peninsula; and the country presents a wonderful field for the enjoyment of travel and sport as well as for the study of architectural monuments, interesting races of people, and numerous native industries and handicrafts. This handbook forms a concise encyclopædia of all these subjects, and should prove of great assistance to visitors to India.

The numerous maps and plans, together with the full index and directory, further add to the value of the handbook as a work of reference.

NEWFOUNDLAND IN 1911. By P. T. McGrath. Pp. 271. (London: Whitehead, Morris & Co., Ltd., 1911.)

This book, which contains a foreword by Sir Edward Morris, the Prime Minister of Newfoundland, should do much to dispel the misconception which undoubtedly exists in the minds of many people in this country with regard to the oldest colony of the Empire. In spite of recent developments, Newfoundland is still commonly regarded as a land of fog and ice, with natural resources limited to the world-famous cod fishery. The author has no difficulty in showing such ideas to be erroneous. Newfoundland, which lies between the latitudes of Paris and Edinburgh, enjoys a salubrious and comparatively mild climate, the thermometer rarely falling below 0° F., while fogs are practically confined to the eastern coastal districts, and even there are less frequent than is generally supposed. The fisheries still form the staple industry of the country, contributing about 80 per cent. of the exports, but much potential wealth lies in the extensive forests and mineral deposits of the interior, the development of which is, in both cases, only now being seriously undertaken.

The book under notice is well arranged and clearly written. A general account of the Colony and its resources is given, forming a key to the subsequent chapters which deal in detail with the questions raised. The author points out that the modern development of Newfoundland is of quite recent origin, dating no further back than the conclusion of the contract with the Reid Company in 1898. Previous to that date enterprise in the Colony had been chiefly confined to the fisheries, with the result that the coastal districts alone were developed, while the interior remained comparatively unknown. The Reid Company has, among other enterprises, reorganised and extended the railway and telegraph systems, and equipped a fleet of modern steamers engaged in a regular coastal trade. Two other factors have contributed largely to the Colony's awakening. The first is the development of the iron ore deposits at Belle Island by two companies, the annual output being a million tons of ore, mined by up-to-date methods and appliances. The second is the recent establishment of the wood-pulp and paper-making industries of the Anglo-Newfoundland Development Company and Messrs. Albert Reed and Co. The importance of these undertakings to the Colony may be gauged from the fact that Newfoundland possesses the second largest pulp mills in the world. The mills are established at Grand Falls, in the midst of extensive forests of spruce and fir, with abundant water available for both power and transport purposes. The forests have been surveyed to be cut once in thirty years, this period being calculated to provide for complete natural regeneration, to which the climatic conditions are remarkably favourable.

A good account of the agricultural prospects of the country is given. While the professional farming population is still small, it is pointed out that practically every fisherman cultivates a small area during the "off-season." Potatoes, cabbages, roots, hay and oats form the principal crops, and it is estimated that the fertile farm-lands, notably those of the western districts, could support a population several times greater than that of the whole island at the present day. The author, however, expresses the opinion that the best agricultural policy lies in the encouragement of the resident population to engage more extensively in the cultivation of the soil, rather than inducing the immigration of people who would not find in Newfoundland the attractions offered by Western Canada and the United States. The book is well illustrated, and contains useful appendixes containing statistical, legal and shipping information. It is unfortunate that neither a map nor an index is provided, both features being very desirable in a volume of this character.

NEW ZEALAND. By the Hon. Sir Robert Stout, K.C.M.G., LL.D., and J. Logan Stout, LL.B. Pp. 185. (Cambridge: at the University Press, 1911.)

This work is one of a series of small volumes, entitled "The Cambridge Manuals of Science and Literature." The volume under notice deals for the most part with the social evolution of New Zealand. After a short introductory chapter on the geography, climate, products and people of the Dominion, a very clear and succinct account is given of its early history, commencing with the discovery of the North and South Islands by Tasman in 1642 and concluding with the settlement of the disputes with the Maoris in 1870, from which date the history of the country becomes a record of its industrial and political progress. The latter subjects are fully dealt with in a chapter on the forms of government, the judiciary and education facilities; and one which includes an epitome of the legislation dealing with social conditions, labour and land. An interesting chapter is that dealing with the origin, characteristics and customs of the Maoris. The book is illustrated with a number of reproductions of photographs and possesses a fairly complete index.

DER NEGER IN DEN VEREINIGTEN STAATEN VON NORDAMERIKA. By Moritz Schanz. Pp. 133. (Essen: G. D. Baedeker, 1911.)

This work gives an interesting account of the negroes of the United

States, including historical and statistical records and information with regard to their religions, societies and organisations, education, penal code, the callings in which they engage, and their social and political positions.

With the exception of the Japanese, there is no people which has made such rapid intellectual and material progress as the North American negroes, and yet, in spite of this, the future prospects of the race appear far from bright on account of its inferior status in the political and social life of the country.

BRITISH AND FOREIGN BUILDING STONES: A DESCRIPTIVE CATALOGUE OF THE SPECIMENS IN THE SEDGWICK MUSEUM, CAMBRIDGE. By John Watson. Pp. viii × 483. (Cambridge: at the University Press, 1911.)

The building stones described in this catalogue have been gathered together by the exertions of the author, who has devoted several years to the work. The collection is a valuable contribution to economic geology, though naturally at present somewhat unequal and incomplete, but these are faults that can be remedied if it receives in the future contributions from other workers as zealous and painstaking as Mr. Watson.

The introduction is excellent. It approaches the subject from the point of view of the instructed and intelligent architect who has a competent knowledge of the principles of geology. It may be doubtful, however, whether the decay of masonry with a southern aspect is wholly due, as the author believes, to the sun: it is more probable that the prevailing strong rain-bearing winds from the south-west must bear the main share of the blame. The general survey of the building stones from different localites is also full of interesting matter.

The least satisfactory portion of the book is the catalogue itself. The leading title of each rock conveys little information. The heading "English Granite," for instance, is repeated twenty-two and "Scotch Granite" twenty-one times. It would have been more helpful to have prefixed the word England or Scotland to the whole, and named the individual rocks after the localities where they were found, such as "Penryn Granite," "Shap Granite," "Aberdeen Granite." The method adopted has not even the advantage of satisfying technical requirements. No engineer would employ such an indefinite expression as "Scotch Granite" especially if the term "granite" is used, as it is unfortunately here, to include a number of other rocks such as diorite, kentallenite and gabbro. Why, too, should a rhyolite tuff from Turkey be described as a "Turkish lava," a tuff from China as "Chinese green stone" or "white" or "red stone" according to the colour, when one from Siam is termed a "Siam tuff"?

The items in the catalogue are, no doubt, copies of the labels, but even in labels the title that catches the eye should convey as much correct information as is practicable.

issued, and have proved of great value for administrative purposes. The survey has, however, now been reorganised under Major Guggisberg, and the whole country, the area of which amounts to 77,000 square miles, is to be surveyed.

The horizontal framework in the mangrove and forest region near the coast is constructed by means of theodolite traverses checked by closing and by observed latitudes and telegraph-longitudes, while in the inland, more open, country, major and minor triangulation is employed. The Lagos sheet, in the preparation of which much of the work of the previous survey was utilised, is already in the publishers' hands.

In the present volume the author has provided a complete vade-mecum for his staff to guide them in the execution of the tasks allotted to them. Details of equipment, organisation and procedure are carefully noted, and all ranks receive most excellent advice. The author has not hesitated to gather his materials from all available sources, and has at the same time utilised his own experience in the Gold Coast. The methods employed are clearly explained and well illustrated by maps and diagrams, and, although primarily intended for use in tropical Africa, the book can be recommended to every one who proposes to carry out survey work in uncivilised regions, especially those which are thickly covered with forests.

In a work so full of detail as this, there will naturally be some points in which it is open to criticism. The author very properly warns the surveyor against using general names of physical features as place names, but he himself employs the word "Enugu," which, though applied to a particular town, means simply a *hill*, as the name for one of the sheets, and this is not the only case where the sheet names are open to criticism. In the excellent guide to the pronunciation, p. 56, Awwah is presumably a misprint for Awwaw, and, though the statement that "y" "is never used as a terminal" is of course quite correct, it does not go far enough. It would be better to say that it is never used as a vowel.

A concluding word of commendation is due to the excellent tables in the appendix.

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Botanical names and Titles of Books reviewed are printed in italics.