ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

ADDITIONAL SERIES, II.

SELECTED PAPERS

FROM THE

KEW BULLETIN.

I.—VEGETABLE FIBRES.

[Reprint.]

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PREFACE.

THE volumes of the *Kew Bulletin* (1887–98) contain articles which more or less cover the whole field of commercial enterprise as applied to the Vegetable Kingdom.

These articles are necessarily printed in a disconnected form, in accordance with the principle laid down by the Government that information of public interest should be published as speedily as possible.

It will, therefore, be convenient to bring together occasionally the whole of the papers relating to one particular subject. The trouble of following these through a series of annual volumes would otherwise in great measure defeat the object in view.

The present volume, which may from time to time be followed by similar collections, deals with the subjects of Fibres. It is one which is of first-rate importance to manufacturers at home and also to our Planting Colonies.

In the pages of the *Bulletin*, as in other official publications emanating from Kew, it has not been customary, where all members of the staff in some degree co-operative, to assign the authorship of any particular piece of work to any individual person.

But in this particular line of inquiry it would be only just to state that the mass of useful and interesting information which is now presented to the public is in great measure due to the experience and research of the late Assistant Director, Mr. D. Morris, D.Sc., C.M.G.

I cannot but take this opportunity of expressing my gratitude to the numerous eminent commercial firms in this country who have always, in the most courteous manner assisted this establishment in its inquiries.

W. T. THISELTON-DYER,
Director.

Royal Gardens, Kew,
September 1898.

SELECTED PAPERS from the "KEW BULLETIN."

VEGETABLE FIBRES.

I.—BUAZÉ FIBRE.

(*Securidaca longipedunculata*, Fres.)

[K. B., 1889, pp. 222–225.]

Securidaca longipedunculata, Fres., is a much branched divaricate shrub, sometimes growing to a height of 8 to 10 feet, belonging to the natural order *Polygaleæ*, and distributed through Upper and Lower Guinea, Nile land, Mozambique district, &c. Two kinds of fibre appear to be furnished by the plant; one from the bark of the twigs is very strong and durable, and would seem to be the fibre from which the nets are made, known in Zambesiland as Buáze fibre; the other from the stem, cross sections of which show layers of fibrous bark between layers of wood.

Buazé fibre sems to have been first introduced to notice by Dr. Livingstone in 1857. In his *Missionary Travels and Researches in South Africa*, published in that year, he says (p. 645) that he submitted a small quantity of the fibre to Messrs. Pye Brothers, of London, who reported from 80, Lombard Street, under date 20th March 1857:—"The "Buazé evidently possesses a very strong and fine fibre, assimilating "to flax in its character, but we believe when treated in quantity by our "process it would show both a stronger and finer fibre than flax; but, "being unable to apply the rolling or pressing processes with efficiency "to so very small a quantity, the gums are not yet so perfectly extracted "as they would be, nor the fibre opened out to so fine a quality as it "would then exhibit."

The opinion obtained by Messrs. Pye Brothers from Messrs. Marshall, of Leeds, was as follows:—"The Buazé fibre appears to resemble flax, "and as prepared by you will be equal to flax worth 50*l*. or 60*l*. per "ton, but we could hardly speak positively to the value unless we had "one cwt. or two cwt. to try on our machinery. However, we think "the result is promising, and we hope further inquiry will be made as "to the probable supply of the material."

Dr. Livingstone adds that the plant is stated to grow in large quantities in the 'Maravi country, north of the Zambesi, but it is not cultivated, "and that the only known use it has been put to is in making threads "on which the natives string their beads. Elsewhere the split tendons "of animals are employed for this purpose. This seems to be of equal "strength, for a firm thread of it feels like catgut in the hand, and "would rather cut the fingers than break."

Dr. Livingstone's original fragmentary specimen of the Buazé plant, which consisting merely of foliage, was indeterminable at the time, exists in the Kew Herbarium. The botanical identification is due to Sir John

Kirk, G.C.M.G., K.C.B., late Political Agent at Zanzibar, who during his attachment to the Livingstone South African Expedition in 1859, and to the Zambesi Expedition in 1861, obtained an excellent series of specimens both in flower and fruit. The Buazé plant is well figured by Richard in his Tentamen Flora Abyssinicæ, t. 10, under the name of *Lophostylis angustifolia*, and by Klotzsch in Peters's Mozambique, t. 22, as *Lophostylis pallida*. Both names now give way to that at the head of this article.

Notwithstanding the comparatively favourable report on this fibre, received so far back as 1857, nothing has since been done to further its utilization in this country.

Note added 1894 :—In the article on Buazé fibre in the *Kew Bulletin*, 1889, pp. 222–225, there was given an account of a fibre used for making fish nets forwarded to Kew by the Foreign Office from Mafeking on Lake Ngami. This had been collected by Mr. James Nicolls. Further specimens, with fresh leaves of the plant yielding the fibre, showed that the Lake Ngami fibre was yielded by *Sansevieria sulcata*. (Art. XLI.)

II.—OKRO FIBRE.

(*Hibiscus esculentus*, L.)

[K. B., 1890, pp. 229–230.]

The plant variously known as okro, okra, gobbo, gombo, and quimbombo, is widely cultivated in the tropics for its horn-like pods, or seed vessels, which are used as a table vegetable. They are exceedingly mucilaginous, and are made into soups and sauces. The ripe seeds are sometimes parched and used as a substitute for coffee. The plant is an annual herb, with a stout hairy stem from 2 to 5 feet in height. The leaves are large, three- to five-lobed, coarsely toothed, with petioles about 6 inches in length, more or less bristly. The flowers are yellow, with a brown or crimson centre. The fruit is pyramidal-oblong, 6 to 10 inches long, and about $\frac{1}{2}$ to 1 inch in diameter, with five prominent ribs and smooth. The spherical seeds are grey or greenish, obovate, and covered with fine hairs.

The Okro (*Hibiscus esculentus*, L.), Abelmoschus esculentus, *W. & A.*, is probably a native of India, but it is now naturalised or cultivated in all tropical countries. Vilmorin distinguishes two varieties in cultivation : the long-fruited green okro and the round-fruited okro. In the latter the fruits are short and comparatively thick, being about 2 inches long and nearly 2 inches in diameter, and blunt at the ends rather than pointed. There is said to be a sub-variety of the long-fruited green okro with pendulous pods.

The okro has long been known in India and elsewhere to yield a long silky fibre, the breaking strain of which, according to Roxburgh, is 79 pounds dry, and 95 pounds wet. Specimens of Indian okro fibre in the Kew Museums resemble hemp in colour and texture. It is evidently well adapted for making ropes, twine, and sacking, while the residual portions could be utilised for paper-making.

Recently the preparation and use of okro fibre has been revived in both the Southern United States, where the plant is largely grown during the summer months, and also in Cuba. In the Report of Mr.

Consul Ramsden on the Trade, Commerce, and Agriculture of the Province of St. Iago de Cuba for the year 1889 [F. O. Annual Series, No. 779], the following information is furnished respecting the fibre of the okro plant, known in Cuba as the quimbombo :—

"The fruit of the quimbombo (*Hibiscus esculentus*) is well known in the English West Indies under the name of 'okra,' and is used as a vegetable, but although Richardo, in his 'Diccionario de Voces Cubanas,' mentions the plant as being 'applicable to rope making,' I am unaware that it has been used as a fibre, and, therefore, refer to it here. Last year Messrs. Bosch and Company, of this city, made an experiment with some, and sent 400 pounds of the dried fibre to London, where they say it was much liked, and found to be worth 40*l.* per ton. Three crops are obtained in the year, and its preparation by maceration gave very little trouble. The stem produces a fibre of fine quality, and about 4 feet in length, and apparently strong. Further trials will probably be made here. I send a sample of it with this report."

The sample of fibre above mentioned was forwarded to Kew by the Foreign Office, and is now in the Museum of Economic Botany.

With regard to the commercial value of this Cuban fibre, Messrs. Ide and Christie, of 72, Mark Lane, E.C., to whom it was referred, report as follows :—

"*Hibiscus esculentus.* The sample shows the fibre to be only moderately stronger than Jute, imperfectly cleaned, and very yellow in colour. We value it at 18*l.* to 20*l.* per ton to-day in London. It is possible that the colour could be greatly improved by more careful preparation, and that in that case its value might be increased by 4*l.* or 5*l.* per ton. We cannot imagine it possible that fibre of this type could have been found worth 40*l.* per ton last year in London as stated to the Consul and mentioned in his Report."

III.—KANAFF OR DECCAN HEMP.

(*Hibiscus cannabinus*, L.)

[K. B., 1891, pp. 204–206.]

Recently an announcement has been made of the discovery of a new textile plant on the shores of the Caspian. The plant known as Kanaff by the natives is said to yield a soft elastic and silky fibre, capable of being readily bleached or dyed in every shade of colour. From a report which appeared in a Tiflis journal, it is supposed that Kanaff fibre, from its abundance and consequent cheapness, and its extraordinary durability, will successfully compete with any other textile for sacking, ropes, and pack-thread. The fibre is said to have a greater resistance than hemp, and its specific gravity is less.

The chief source of information respecting the plant yielding this fibre is contained in an article entitled *Note sur le Sunn, le Yucca, et quelques autres plantes textiles*, by MM. Jules Grisard et Max. Vanden-Berghe, in the *Revue des Sciences Naturelles appliquées*, 1890, pp. 992–993. According to these authors, Kanaff or Kanap was at one time supposed to be *Apocynum sibiricum*. It is, however, now identified as *Hibiscus cannabinus*, L., a well-known fibre plant in India, also found in a cultivated state in Persia, and other places westward. In a note in

Boissier's *Flora Orientalis*, vol. i., p. 840, it is stated that *Hibiscus cannabinus*, L., is cultivated in the province of Ghilan in Persia, and that cords and ropes are prepared from its fibre. Specimens of Kanaff fibre have recently been received at Kew, but no authentic specimens of the plant producing it have so far been seen. There is every probability, however, that the plant is one of the many varities of *Hibiscus cannabinus*, and the utilisation of its fibre on the shores of the Caspian is a fact of some interest. The information so far furnished is as follows :—

"The French *Revue des Colonies* reports the discovery of a new textile on the shores of the Caspian. This plant, called Kanaff by the natives, grows in the summer, and attains a height of 10 feet, with a diameter varying from two to three centimetres. By careful cultivation and manipulation, M. O. Blakenbourg, a chemist and engineer, who has made a special study of Kanaff, has obtained an admirable textile matter; it is soft, elastic, and silky, gives a thread, which is very tough, and can be chemically bleached without losing its value. The stuffs manufactured out of Kanaff, and then bleached, can be successfully dyed in every shade of colour, and would compete with any of the furnishing materials now in use. But it is particularly for making sacks, tarpaulin, ropes, &c., that this new textile, from its cheapness and its extraordinary resisting power, might defy all competition. Its specific weight is much less, but its resistance much greater than those of hemp. Thus a cord of 8·25 mm. diameter, woven with the hand out of three threads of Kanaff, requires a weight of 180 kilogrammes to break it. A cord half an inch thick, manufactured at Moscow, did not break till the weight of 625 kilogrammes was reached. When it is considered that Russia annually consumes more than 150,000,000 of sacks, a third of which is imported, it may easily be seen that the appearance of this new textile on the Russian market is an event of no slight importance." (*Board of Trade Journal.*)

The following more recent information respecting Kanaff has been communicated to this establishment by the Foreign Office :—

(Copy.)

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, July 6, 1891.

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens, the accompanying despatch, reporting on the cultivation of cotton in the Caspian district, and transmitting some fibre of a newly discovered plant.

I am, &c.

The Assistant Director, Royal Gardens, Kew. (Signed) JAMES FERGUSSON.

(Extract.)

Mr. Vice-Consul MURRAY to FOREIGN OFFICE.

MY LORD, Batoum, June 24, 1891.

* * * * *

A newly discovered plant has been exciting great interest amongst Russian traders, as it is hoped that it will prove a strong rival to the Jute plant.

It is known as the Kanaff (Kanabe or Kanaspe), and is a textile plant found in large quantities on the Persian shores of the Caspian sea, all the production and sale being in the hands of Persians, who do not know what value to put on it, and therefore ask absurd prices, sometimes too high and sometimes too low.

The quality of the flax, it appears, is excellent, and it is only fair to suppose that this will develop into a large industry when the prices settle.

At the present time the price is about the same as that of Indian jute, which, when the high cost of local transport is added, practically puts it out of the market.

The present price is from $1\frac{1}{2}d.$ to $2d.$ per pound.

I have the honour to enclose a sample of the fibre of this plant.

I have, &c.

(Signed) ALEX. MURRAY,
Lieutenant and Acting Consul.

The Right Hon.
The Marquis of Salisbury, K.G.,
&c. &c. &c.

A full account of Deccan or Ambasi hemp obtained in India from *Hibiscus cannabinus* is given in the *Dictionary of the Economic Products of India*, vol. iv., pp. 231–236. The plant is a herbaceous shrub apparently wild in some parts east of the Northern Ghâts but largely cultivated for its fibre throughout India. The produce is chiefly used by the agricultural classes locally. Dr. Watt, C.I.E., states that the fibre is soft, white, and silky and eminently suitable for the coarser textile purposes to which jute is applied. Were a demand to be created for this fibre as distinct from that of Sunn-hemp or other fibres the cultivation of the plant might be indefinitely extended, and with profit to many needy cultivators who are unable to produce either jute or cotton. The leaves of *Hibiscus cannabinus* are used as a pot herb while the seeds are sometimes exported from India to England as an oil-seed.

IV.—COTTON IN WEST AFRICA.

[K. B., 1890, pp. 135–140.]

It is well known that Cotton is widely distributed in West Africa, but it receives little or no cultural attention, and the produce is chiefly used for making native cloths. The export of Cotton has only lately begun to receive attention. The samples of West African Cotton received in this country have, however, been favourably received, and it is evident that much could be done to extend the cultivation by judicious action on the part of the local authorities and by the introduction and distribution of seed of good and suitable varieties of the Cotton plant. If once the cultivation could be generally taken up by the native population, and especially in districts where the industry is more or less familiar to the people, there are good grounds for believing that West African Cotton would eventually become an important article of export. In the following correspondence attention is drawn to the subject of Cotton growing generally in West Africa; and an account is given of an attempt which has lately been made to introduce and cultivate experimentally the best forms of Egyptian Cotton. This

latter may or may not be suitable to the circumstances of West Africa. The value is, however, so high that it has been thought desirable to attempt its cultivation in West Africa, and the results of the experiment, as also indeed of the general effort made to introduce West African Cotton to commerce, will be watched with interest.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

[Extract.]

Royal Gardens, Kew,
22nd October 1889.

SIR,

* * * * * *

As regards a supply of seed of Egyptian Cotton for West Africa, as none is obtainable in this country at the present time, the best course would be to apply through the Foreign Office for the assistance of the Agent and Consul-General at Cairo in the matter. The cultivation of Egyptian Cotton in West Africa was suggested in the first instance in connection with Lagos, and I enclose a copy of the correspondence addressed to Kew by Mr. Alvan Millson, in which the advantages of cultivating Egyptian Cotton in West Africa are fully stated. In applying to the Foreign Office for a supply of Egyptian Cotton seed it would be well to ask for about 40 pounds by weight in order that some of the seed might be supplied to Lagos and to other Colonies disposed to try it.

* * * * * *

I am, &c.
(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.

Mr. ALVAN MILLSON to ROYAL GARDENS, KEW.

Hotel Windsor, Victoria Street,
Westminster, S.W.,
8th June 1889.

DEAR SIR,

I ENCLOSE a letter from a friend of mine who has made a special study of Egyptian Cotton in its application to ring and ordinary spinning.

From his remarks it would appear that the flood lands of the Niger basin and coast lagoons of West Africa offer suitable conditions for the extension of the supply of this valuable article of commerce, the scarcity and high price of which render its cultivation an exceedingly lucrative occupation.

Believe me, &c.
(Signed) ALVAN MILLSON.

D. Morris, Esq., M.A., F.L.S.

[Enclosure.]

Messrs. SAMUEL WHITLEY & CO. to Mr. ALVAN MILLSON.

Hansom Lane Cotton Mill, Halifax,
7th June 1889.

DEAR SIR,

WE venture to call your attention to the desirability of extending the growth of that class of Cotton now only produced in Egypt. This Cotton has many advantages in length, strength, and fineness of

fibre over that grown in America, and commands a much higher price; at present its production is limited to the Nile valley, where there is no room for extension to meet the increasing demand, and where the crop is at times almost ruined by a "low Nile," causing a large advance in price and its consequent derangement of trade.

The price obtained, which varies from 6*d.* to 10*d.* per pound for ordinary qualities, must give a large return to the planters, for Indian Cottons are grown, ginned, shipped, and sold for 3*d.* per pound.

The requirements of the crop appear to be, an alluvial soil; a regular supply of water to the roots and bright weather during ripening; careful picking to prevent the mixture of leaf with the fibre.

The writer has carefully noted the conditions in Egypt, and cannot see why this crop should not be extended to other parts of Africa.

We are, &c.

(Signed) S. WHITLEY & Co.

Mr. Alvan Millson.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, 1st November 1889.

WITH reference to your letter of the 22nd ultimo, I am directed by Lord Knutsford to acquaint you that the Foreign Office have been requested to instruct Her Majesty's Agent and Consul-General at Cairo to obtain 40 lbs. of Egyptian Cotton seed for transmission to the West African Colonies.

Lord Knutsford has desired that the seed should be forwarded to you, and he will be much obliged if you will undertake its apportionment among the various Colonies in such amounts as you may think most desirable.

I am further to request that you will state the exact amounts sent to each Colony, so that the total cost may be properly divided by the Crown Agents.

I am, &c.

(Signed) R. H. MEADE.

The Director, Royal Gardens, Kew.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, January 22, 1890.

WITH reference to your letter of 1st November on the subject of obtaining a supply of Egyptian Cotton seed for transmission to certain Colonies, I am desired by Mr. Thiselton-Dyer to inform you that he has recently received, at the request of Sir Evelyn Baring, a supply of Cotton seed from the British Commissioner of the Egyptian State Domains.

2. This seed has been divided into six lots, and apportioned as follows:—To Gambia and Lagos, one-fourth each; to Sierra Leone, Gold Coast, Windward Islands, and Leeward Islands, one-eighth each.

3. The small portion of seed selected for the West Indian Colonies is likely to prove of great service in such islands as Carriacou, Antigua, and the Virgin Islands.

4. It would be desirable to furnish the Governors of all the Colonies to which seed is sent with a copy of the correspondence enclosed in my letter of the 22nd October last, in order that they may have before

them the special importance attached to this Egyptian Cotton seed. The time for sowing the seed and the treatment of the crop, in the absence of instructions to the contrary, should follow those which obtain locally for ordinary Cotton.

5. The seed for Lagos was taken out by Sir Alfred Moloney on Saturday last. The remaining portion of the seed, contained in five small boxes addressed to the Governors of the Gold Coast, Sierra Leone, Gambia, Leeward and Windward Islands, will be forwarded to the Crown Agents for transmission to their destination with the least possible delay.

I am, &c.
(Signed) D. MORRIS.

This Egyptian Cotton seed consists of two varieties, A. "Ashmouni," B. "Bahmieh," a portion of each variety is included in the consignments mentioned above.

The Hon. R. H. Meade, C.B.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, March 19, 1890.

I AM directed by Lord Knutsford to transmit to you a copy of a Despatch from the Governor of Sierra Leone, forwarding a sample of Cotton collected at Mafweh, on the Bum River, and to state that his Lordship would be much obliged if you would be good enough to obtain the opinion of an expert as to its commercial value.

I am, &c.
(Signed) R. H. MEADE.

The Director,
Royal Gardens, Kew.

[Enclosure.]

Mr. ALLDRIDGE to the GOVERNOR of SIERRA LEONE.

SIR, Sulymah, February 6, 1890.

IN accordance to your Excellency's instructions to me of the 15th ultimo, No. 31, I have now the honour to forward to the Hon. the Colonial Secretary a sample bag of Cotton.

This particular sample was obtained at Mafweh by me.

I find that this class of Cotton is not the wild or bush Cotton, but that it is planted by the natives (usually between Cassada) for the manufacture of country cloths; it is not, however, cultivated as an article of trade in the raw state.

As I have already had the honour of informing your Excellency, the cultivation of this Cotton is so simple, the yield so prolific, and the growth of the crop so rapid, I am of opinion that when once it became an article of local marketable value, it would be cultivated to an important extent, and it should, I venture to think, soon become a great industry in this Colony, provided the price obtainable would be such as to induce the native community to take the matter up.

It would, no doubt, be an advantage if the Cotton could be purchased from the growers as it is picked from the shrub, without being ginned,

which, in the absence of special machinery, is a laborious operation, although it is not an insuperable difficulty.

I have, &c.
(Signed) T. J. ALLDRIDGE,
Travelling Commissioner.

His Excellency
Lieut.-Colonel Maltby.

ROYAL GARDENS, KEW, to the MANCHESTER CHAMBER OF COMMERCE.

SIR, Royal Gardens, Kew, March 21, 1890.

I AM desired by Mr. Thiselton-Dyer to inform you that he has received from the Secretary of State for the Colonies a specimen of Cotton collected at Mafweh on the Bum River, West Coast of Africa. This Cotton is grown by the natives for the manufacture of country cloths, and it appears not to come into commerce in the raw state.

2. It would be interesting to learn the value of this cotton, and with this view Mr. Thiselton-Dyer would be glad if you would be good enough to obtain the opinion of the members of your Chamber upon it. A sample of the Cotton is forwarded to your address to-day by parcel post.

3. At the same time I am desired to ask your opinion upon the advisability of endeavouring to introduce the cultivation of what is known as Egyptian Cotton into our Colonies in West Africa, and upon the special points in regard to this Cotton which render it specially sought for by certain buyers in the English market.

I have, &c.
(Signed) D. MORRIS.

The Secretary,
The Manchester Chamber of Commerce,
Manchester.

MANCHESTER CHAMBER OF COMMERCE to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester.
May 1, 1890.

SIR,

I THANK you for the letters of March 21st and April 24th, written by your direction, and for the sample of Cotton grown near the Bum River, West Africa, you were also good enough to forward to this Chamber. It was only yesterday that I was able to complete the information requisite to give a full answer to your inquiries.

This Cotton is of good quality, and is worth to-day about 6*d*. per pound in Liverpool. Already about 2,300 bales per annum are imported into that port, and, so acceptable is it to Lancashire spinners who have used it, that they would gladly welcome a very much larger supply than is now available. There is a good demand for it, and the only complaints respecting it, of which I can hear, are that the supply is scanty and intermittent, and that occasionally it is not so clean and free from impurity as it should be.

With regard to the question of endeavouring to introduce the cultivation of Egyptian Cotton into our Colonies in West Africa, I find that the prospect of doing so, with success, depends largely, if not mainly, upon the facilities which may be available for watering the plant. The successful cultivation of Cotton in Egypt appears to be due (apart from climatic considerations) chiefly to careful irrigation. The qualities which mainly give to Egpytian Cotton its high value as a raw material

for spinning are, the length, fineness, and strength of the staple. I need hardly say that English spinners would be greatly pleased to have another source of supply of Egyptian Cotton.

On behalf of the President of this Chamber I desire to thank you for the interest you have shown in this important question of Cotton supply, and to say that we shall be very pleased to hear from you as to the progress of the efforts which you are making for the extension of Cotton culture in West Africa.

I am, &c.
(Signed) ELIJAH HELM,
Secretary.

W. T. Thiselton-Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, 5 May 1890.

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 19th March, with a copy of a Despatch from the Governor of Sierra Leone on the subject of a sample of Cotton grown by natives at Mafweh, on the Bum River, West Coast of Africa.

2. The sample, as received, was forwarded to the Manchester Chamber of Commerce, and a copy of a report received from the secretary is enclosed for the information of the Secretary of State.

3. It appears that West African Cotton is received at Liverpool to the extent of 2,300 bales per annum. A much larger supply would be readily taken up, as this special kind is very acceptable to Lancashire spinners. These facts are of very encouraging character, and should be widely known in the Colonies concerned.

4. It will be within your recollection that the extension of Cotton-growing in West Africa has on several occasions been recommended by this establishment, and in my letter of the 22nd October last it was suggested also to try Egyptian Cotton, as likely to be successfully grown there. Seed of this Cotton obtained through the Foreign Office was distributed to the Gambia, Gold Coast, Sierra Leone, and Lagos, as mentioned in my letter of the 22nd January last.

I am, &c.
(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.

V.—COTTON IN WEST AFRICA—(continued).

[K. B., 1891, pp. 49-51.]

In the *Kew Bulletin* for June 1890 an account is given of the attempt which has been made to improve the produce of Cotton in West Africa by introducing the best forms of Egyptian Cotton. "This "cotton has many advantages in length, strength, and fineness of "fibre over that grown in America, and commands a much higher "price; at present its production is limited to the Nile valley, where "there is no room for extension to meet the increasing demand, and "where the crop is at times almost ruined by a low Nile."

The present correspondence relates to the experimental cultivation of Egyptian Cotton on the Gold Coast.

CURATOR, BOTANICAL STATION, ABURI, to ROYAL GARDENS, KEW.

[*Extract.*]

Botanical Station, Aburi,
Gold Coast, West Africa,
November 11, 1890.

SIR,

I AM directed by his Excellency to inform you that he is sending to Kew a sample of the Egyptian Cotton grown at Aburi. I beg to state that I planted an acre of this Cotton. It has grown remarkably well, and is yielding a good crop. I have already gathered a large quantity, and there is still a quantity not yet ready for gathering.

I am, &c.
(Signed) W. CROWTHER.

The Assistant Director,
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to GOVERNOR, GOLD COAST COLONY.

SIR, Royal Gardens, Kew, December 23, 1890.

I HAVE the honour to acknowledge the receipt of a sample of Egyptian Cotton which I learn from a letter from Mr. Crowther, Curator of the Botanical Station at Aburi, was grown by him there. This was no doubt raised from seed obtained by Kew early in the present year from the British Commissioner of the Egyptian State Domains.

2. This sample was submitted to the Manchester Chamber of Commerce, and I have now the pleasure of forwarding you a copy of their report.

3. I find that a sample of Cotton from Elmina was received at this establishment in 1882 from the Colonial Office. It was reported upon as having for its chief fault "the large proportion of short inferior "wool."

4. I trust that the station will possess in the new strain of Egyptian cotton a staple free from this defect, and will be able to promote its growth throughout the Colony.

I am, &c.
(Signed) W. T. THISELTON-DYER.

His Excellency,
Sir W. Brandford Griffith, K.C.M.G.,
Governor, &c., Gold Coast.

CHAMBER OF COMMERCE, MANCHESTER, to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester,
December 11, 1890.

DEAR SIR,

I THANK you for your letter of the 10th instant, and for the sample of Cotton named therein, which has come to hand. This will be submitted to the Board of Directors in accordance with your request, and I hope to forward a report upon them in the course of a few days.

Yours, &c.
(Signed) ELIJAH HELM,
Secretary.

CHAMBER OF COMMERCE, MANCHESTER, to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester,
December 20, 1890.

DEAR SIR,

I HAVE now the pleasure to report to you upon the sample of Egyptian Cotton grown at Aburi, on the Gold Coast, forwarded to me on the 10th instant.

This cotton is worth to-day about $5\frac{1}{2}d.$ per pound in Liverpool or Manchester, and at that price it would find a ready sale. The growth of it should be encouraged. Can you tell me whether or not the Gold Coast Egyptian Cotton represented by your sample is imported in the ginned or unginned state? I am informed by a gentleman who used to bring this description to England that he could not get it ginned in Africa, because the natives were either not sufficiently intelligent or too superstitious to use a ginning machine, although this is of the simplest description, resembling very closely an ordinary hay-cutter. It is to be feared that if this difficulty still exists it will constitute a formidable, if not an insurmountable, obstacle to the export of this Cotton from the Gold Coast.

Yours, &c.
(Signed) ELIJAH HELM,
Secretary.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street, December 16, 1890.

SIR,

I AM directed by Lord Knutsford to transmit to you some specimens of Egyptian Cotton, cleaned of seeds and uncleaned, grown on the Castle Farm, Christiansborg, Accra, which have been sent home by the Governor of the Gold Coast Colony. He states that the seed was planted at the end of June, and the Cotton picked between the 5th and 14th November.

Lord Knutsford would be much obliged if you could furnish him with a report on the commercial value of these specimens.

I am, &c.
(Signed) R. H. MEADE.

The Director,
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

Royal Gardens, Kew, February 9, 1891.

SIR,

I HAVE the honour to acknowledge the receipt of your letter of December 16, transmitting a report on a sample of Egyptian Cotton, grown on the Castle Farm, Christiansborg, Accra, and sent home by the Governor of the Gold Coast Colony.

2. In accordance with Lord Knutsford's wish the enclosed report upon the sample has been obtained from the Manchester Chamber of Commerce, which has very obligingly assisted this establishment on this and other occasions.

3. From the correspondence published in the *Kew Bulletin* for June 1890, you will observe that the production of this type of Cotton if successful in West Africa may be made the basis of a very profitable

industry. You will, therefore, no doubt also observe with satisfaction that the present sample is reported upon in very favourable terms. The estimated value is the highest which has been put upon any sample of cotton yet received from West Africa.

I am, &c.
(Signed) W. T. THISELTON-DYER.

The Hon. R. H. Meade, C.B.

CHAMBER OF COMMERCE, MANCHESTER, to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester,
February 4, 1891.

DEAR SIR,

I HAVE pleasure in reporting to you upon the sample of Egyptian Cotton, ginned and unginned, grown at Castle Farm, Christiansborg, Accra, forwarded by you on the 19th December. It has been submitted to the judgment of experts, members of this Chamber, and is described as good, clean, and very desirable cotton, worth to-day about $6\frac{3}{8}d.$ per pound in Liverpool. Can you inform me whether the sample was ginned in Africa or in this country?

Yours, &c.
(Signed) ELIJAH HELM,
Secretary.

VI.—GAMBIA PAGNS OR NATIVE CLOTHS.

[K. B., 1894, pp. 191–192.]

Next to the cultivation of the ground nut (*Arachis hypogæa*, L.), shipped to Europe for the manufacture of oil, the most important industry of the settlement of the Gambia on the West Coast of Africa is the cultivation and manufacture of cotton. From this cotton is made the native "pagns" or country cloths which are in great request in that part of the world. Sir Alfred Moloney (*Forestry of West Africa*, p. 142) states that in addition to supplying cloths for home consumption the "pagn" industry of the Gambia exported cloths of the value of 480*l.* in 1883 and of 2,742*l.* in 1884. "Pagns" are also made at Lagos, and some of them are exported even to Brazil for the use of the West African negroes who have emigrated to that country. The whole industry is a singularly interesting one. The cotton is gathered, ginned, and spun into thread by the native women entirely by hand. The loom for weaving the cloth is a very crude contrivance. "This "primitive hand-loom," says Sir Alfred Moloney, "in use amongst the "natives is what has come down through centuries to them from their "ancestors, and, it is needless to add, it is capable of improvement to "their advantage. It certainly deserves attention." Each frame weaves a strip of cotton only 6 inches broad. These strips are then sewn into long broad pieces to which the name of "pagn" is applied. The native "pagns" are regarded as extremely durable, and they are in greater request than any similar article of European manufacture. At the request of Kew, his Honour R. B. Llewelyn, C.M.G., Administrator of the Gambia, was good enough to forward, in January last, the

subjoined report on the native cotton industry, prepared by Mr. J. H. Ozanne, the Travelling Commissioner on the north bank of the River Gambia :—

Cultivation of Cotton. North Bank, Gambia.

Seed is planted as soon as the rains begin. It is planted in rows from 3 to 6 feet apart; the plants are from 2 to 5 feet from one another. Great care is taken in selecting the seed, as it is liable to be attacked by small worms. Corn is planted between the rows, which is reaped in August. By November the cotton plant is 3 feet high, and picking commences and continues until the end of April. There are two sorts of cotton grown in the district, one giving a perfectly white thread, the other a brownish colour like faded ink. The quality of both seems to be the same, but the white cotton yields more. The flower and leaf of both appear exactly the same. The cotton that is grown is not of the best, and would hardly stand the test required by an English cotton-spinner, but the plant has the advantage of being able to stand the dry weather, and the clothes made from this cotton are strong and durable. The cotton industry is almost as important as the ground nuts, and the people engaged in it work hard. In every town one comes across a row of cotton-spinners' sheds, each containing a machine. There are generally half-a-dozen of these at work in each town, and the creaking of the machine is heard from morning till night, sometimes even late at night. The cotton is picked by the women clear of seeds, and is beautifully white and clean. The women then take a bundle, mix a little lime or chalk and water on the fingers of the left hand through which the cotton passes, and spin the cotton out on to threads on a spindle which they work with the finger and thumb of the right hand. They do this very quickly, and it looks very easy, but it is not, for when I tried to do it, the threads broke. When they have spun a sufficient quantity of thread, the men choose a flat spot, and place forked sticks about 3 feet high, 40 feet apart, forming three sides of a square, each side being about 150 feet long; the threads are then run from one end to the other, and returned, until there are sufficient rows of thread to be woven into a strip of cotton 6 inches broad. These rolls of thread, 450 feet in length, are now handed over to the owner of the little machine, who so arranges them on two little frames, each about 6 inches wide, that every alternate thread is fastened to a wire of one or the other of the frames. These frames are then set in motion by the workman's foot, and either raise or lower every alternate thread at every stroke. The workman then tosses his shuttle of thread from one hand to the other between the rows of thread. By these means the cross threads are interwoven amongst the long ones, and to press them tightly together, a third little frame, with wires separating the long threads, is pressed against the cross threads. It is difficult to describe this native machine, which should be seen to be appreciated. These strips of cotton are then sewn into long broad pieces which are called "pagns."

J. H. Ozanne.

VII.—COTTON IN INDIA.

[K. B., 1894, pp. 318–321.]

EXTRACT from MEMORANDUM by Dr. GEORGE WATT, C.I.E.

Little more than a century ago it was felt in England that the time might arrive when India would have to be regarded, from political reasons, as the chief source of supply for cotton. A Polish botanist [Dr. Anthony Pantaleon Hove, employed as a collector for Kew in the last century], was sent out by the then British Government to study the indigenous cotton plants of India. His report, though not published until many years after his death, is full of interest. It shows that the crops grown in Western India a century ago were very different from those of the present day, and that the systems of cultivation pursued, even on the black soils of Guzerat, were in some important respects dissimilar from those now followed. During the first few decades of this century the Honourable the East India Company entertained the somewhat unfortunate opinion that the true way to enable India to participate in the greatly expanding British traffic in raw cotton would be to acclimatise the most highly prized forms of America. Large sums of money were accordingly spent in Bengal, Madras, and Bombay, that might (as we now learn) have been used to better advantage in an effort to improve and develop the indigenous crops. Year by year America steadily improved the quality and increased the length of her staple, and the demand for Indian cotton accordingly declined. Ultimately, however, India succeeded in producing New Orleans cotton at Dharwar—a staple of a far superior quality to the Indian. The high price paid for this, unfortunately induced adulteration instead of encouraging greater effort. In July 1863 a law had accordingly to be passed to repress the frauds perpetrated, but this, while being wholly ineffectual in its main object, very frequently punished the wrong persons, and accordingly did great harm to the industry. It was in consequence repealed, and the Indian cotton trade was thus left to take care of itself. The effort to participate in the British traffic had practically to be abandoned, and not because India had been proved incapable of producing a staple of the kind required. But this is not all. The reputation of India for its once famous indigenous cottons had at the same time been completely destroyed, and its American crop having fallen into disfavour, rapidly degenerated in quality, until at the present day it might almost be described as inferior to many of the indigenous cottons. Unskilled and impecunious cultivators were in India left to compete against the enlightened agriculture of America—unskilled because ignorant of the principles by which they might have developed the produce to meet the best market, instead of being content to allow it to drift into an inferior position. As matters stand, they may now be said to glory in that they are able to dispose of a worthless staple at remunerative rates.

That improvement towards a higher and better-paid standard is possible may be accepted as fully demonstrated by past experience and by the fact of superior races of cotton being found where attention is given to the crop, and still more so by the further fact that within the regions of superior production the cultivators are fully aware that degeneration occurs with neglect and with the prolonged continuance of cultivation of any particular form on the same soil. Selection of seed and the cultivation of specially selected plants for the production

of seed might easily improve the Indian crop of any district by 50 per cent.

For many years past the Indian cotton trade has been drifting into a restricted groove. Our produce goes to mills that do not wish for a superior or long staple, but only a pure one (that is, not a mixture of several lengths of staple), so that it may fairly be said many of our largest buyers discourage improvement. The dangers of a one-sided trade of this nature need scarcely be mentioned. India is thus destroyed as a possible country of supply for the English mills. The Indian mills are at the same time compelled to look to foreign countries for their present or future supplies of superior staples, and are thus more or less confined in their operations to one class of goods. It might almost be said that progression is deliberately stultified, the labours of centuries ruthlessly thrown away, and a large and important industry practically cornered or restricted in its possible development by interested parties, who advance the plausible axiom that demand is the controlling power of production. Hence improvement of the staple may be emphatically affirmed as the rational direction in which an extension of our production of cotton should be looked for, since the existing traffic is aimed at the destruction of all the good features of the indigenous fibre, if not of the morality of both grower and trader. It is essentially a retrograde traffic, as at present constituted, and one in which the aims and objects of most of those concerned are directed towards the attainment of a high yield of a worthless staple.

What is true of cotton is, however, equally applicable to sugar, wheat, wool—in fact, to almost all the articles of Indian trade. Little or no effort has been put forward towards developing, on scientific principles, the quality of the articles of Indian commerce. Past endeavours have for the most part been concerned with acclimatising the products of other countries, with the result, as already shown, that India has obtained many of her most widely grown crops from foreign sources.

The cottons of India may be referred approximately to two great sections, the early and the late crops. The former comes into market from October to March, the major portion from October to January. The latter does not commence to come into market much before February, and is, as a rule, over by April, though exceptional crops are not ripe before June. The early crops are represented by the "Bengals" (such as the cottons of the Punjab, the North-West Provinces, Oudh, and Bengal), the "Oomras" (the chief cottons of Khandesh, Berar, &c.), the "Hinganghats" (of the Central Provinces, &c.), and many of the Sind cottons. The late crops are represented by the "Dholeras" (important crops of Kathiawar, Kutch, and Guzerat), by the "Broach and Surats," by the "Coomptas" (indigenous cottons of Dharwar, Bijapur, Belgaum, &c.), and by the "Cocondas" and "Tinnevellys." This purposely leaves out of consideration the American cottons, such as "the saw-ghinned Dharwar," "Verawal," "Salems," and "Coimbatores," which are also, however, all late crops. While we have thus a comparatively easy classification according to season, this is at once revealed as more or less the expression of meteorological conditions, since within almost any of the regions of these crops widely different forms are separately classed in the trade under the names of the districts where produced. These when examined botanically are often found to be afforded by distinct races, varieties, or species. Nothing could convey an idea of the complexity of the Indian cotton traffic more forcibly than a tour through Guzerat during the months of January,

February, and March. At Surat and Broach (more especially in the latter district) a high cultivation on a rich black cotton soil is found to yield one of the finest of all Indian long-staple cottons. During the months mentioned, however, the soil is split into great blocks, the cracks penetrating to such a depth as to render perennial crops an impossibility. As the result, trees are very rare and hedges all but unknown. A few miles off, the lighter soils of large portions of Baroda are able to support perennial cottons, trees become frequent, and hedges universal. Here, then, are two cotton crops of the late series growing side by side, but which practically cannot be interchanged from district to district, and in which the systems of cultivation pursued and the quality of the staples afforded are as different as the two plants are from each other. They are botanically, agriculturally, and commercially different things, and have to be treated as such, whether the object desired be to extend the area of cultivation or improve the quality of the staple. A little to the north of Baroda (in Wadhwan and other districts) another change is met with, viz., the occurrence of close-podded forms of Dholera cotton. These are far more dissimilar from Surat, Broach, and certain Baroda cottons than are the Dholeras of the southern division of Kathiawar. Indeed one of the chief forms of Broach has undoubtedly been derived from Kathiawar, so that the trade distinction of "Dholeras" from "Broach and Surats" cannot be upheld botanically. What is more curious, the once famous Laberkhuva cotton of Mongrol was found on inquiry to be Broach cotton raised from seed imported fresh every fourth or fifth year. And these illustrations of Guzerat and Kathiawar cottons are more or less true of the whole of India. There are often very narrow limits indeed within which an extension of the area of cultivation can be carried without destroying completely all the special properties of the crop.

The total area in cultivation under cotton in British India in 1892–93 was nearly 9,000,000 acres. The largest areas were in Madras, Berar, Bombay, and the North-West Provinces. The highest export of cotton during the last five years took place in 1889–90, when cotton to the value of Rs. 187,000,000 was shipped from India. The export in 1892–93 was slightly less, being of the value of Rs. 127,000,000. Besides cotton, there was exported from India cotton seed in 1888–89 to the value of Rs. 301,577; in 1892–93 this had fallen to a value of Rs. 61,708.

VIII.—COTTON IN BRITISH CENTRAL AFRICA.

[K. B., 1896, pp. 118–119.]

Cotton has long been cultivated in Central Africa. On the Zambesi and elsewhere it is now semi-wild.

The following correspondence relates to a sample of the produce sent to Kew by Her Majesty's Commissioner in British Central Africa :—

HER MAJESTY'S COMMISSIONER AND CONSUL-GENERAL, BRITISH CENTRAL AFRICA, to ROYAL GARDENS, KEW.

Zomba, British Central Africa,
October 19, 1895.

DEAR THISELTON-DYER,

I SEND you by this post in a small canvas bag a specimen of the half-wild cotton of this country. It is cultivated by the natives in an

indifferent manner since some 15 years ago, when they ceased weaving any cloth from their own cotton, preferring to buy the European manufactured goods.

This cotton is sent to me by a planter in the vicinity who states that he believes it to be of very good quality. Could you have it reported on, and let me know whether it really is a cotton which would fetch a high price? Opinions are divided as to whether it is or it is not worth our while to cultivate cotton. It grows half wild about the country, but it is said that the transport to the coast, which would cost about an average of 6*l.* a ton, would leave little or no profit to the planter.

Believe me, &c.
(Signed) H. H. JOHNSTON,
Her Majesty's Commissioner and Consul-General.

SECRETARY, MANCHESTER CHAMBER OF COMMERCE, to ROYAL GARDENS, KEW.

Chamber of Commerce, Manchester,
January 9, 1896.

DEAR SIR,

I HAVE obtained an expert opinion upon the sample of Central African cotton referred to in your letter of the 6th instant, and have pleasure in reporting thereupon.

The fibre is of a woolly character, but it is clean and bright, though a good deal discoloured by what appear to be insect stains. The length of the staple is $1\frac{1}{8}$ inch to $1\frac{3}{16}$ inch, varying considerably in strength, but it is mostly very tender. It could probably be sold here at about $4\frac{1}{4}d.$ per lb. at the present time.

Faithfully yours,
(Signed) ELIJAH HELM,
Secretary.

John R. Jackson, Esq.,
Kew Museum, Kew.

IX.—CULTIVATION OF COTTON IN EGYPT.

(*Gossypium barbadense*, L.)

[K. B., 1897, pp. 102–104.]

Next to the United States and India, Egypt is one of the important cotton-producing countries of the world. The quantity of Egyptian cotton received into this country is about 2,000,000 cwts. annually. The quality is usually exceptionally good, and ranks next to the celebrated Sea-island cotton of America.

The following sketch of the history of cotton cultivation in Egypt lately appeared in *Journal of the Society of Arts* (December 25th, 1896, pp. 98, 99):

"Some interesting information is given in a recent issue of the *Bulletin du Ministère de l'Agriculture* respecting the different descriptions of cotton which have been successively cultivated in Egypt. The fibre cotton cultivated in the delta of the Nile was called *Jumel*,

after the name of the person who introduced its cultivation, in the reign of Mehemet Ali, in 1820. M. Jumel, who was a Frenchman, had remarked in the garden of one of his friends living near Cairo, certain cotton plants, of which the seeds had been imported from the Soudan. He succeeded in cultivating the plant from seeds which he obtained, and presented certain of them to Mehemet Ali, who, foreseeing the sources of wealth that the cotton might assure to the country, placed at the disposal of Jumel vast extents of territory, and gave him every facility in his enterprise. This cotton was also known by the name of *Mako*, after a Bey in whose gardens Jumel had originally found the first seeds. *Jumel*, or *Mako*, was for many years the only cotton cultivated, but for a time it was replaced by a new variety called *Ashmouni*. This *Ashmouni* degenerated after 20 years of cultivation, and was abandoned for *Mit Afifi*, which at the present time is most largely cultivated in Egypt. *Mit Afifi* is a very strong variety of cotton, easy to grow, and does not require any very excessive irrigation. The colour is slightly yellow and is much appreciated by spinners. Another kind of cotton called *Bahmieh** is grown to a limited extent, and this is a delicate variety requiring a stronger soil. It yields a whitish cotton, which is particularly used for certain articles of hosiery. It enjoys a great reputation in the United States, while France and Germany consume small quantities of it. The cultivation of the varieties called 'white cotton' has very considerably fallen off. Their total annual production hardly exceeds from 60,000 to 70,000 quintals. Many other varieties, such as *Zafiri*, *Abbassi*, &c., have been experimented with by many growers, but up to the present the results have not been sufficiently advanced to enable an accurate opinion to be formed as to their merits. Egyptian cotton, whatever its variety, preserves its essential qualities, which causes it to be much sought after by European and American manufacturers. As a matter of fact, no cotton, with the exception perhaps of Sea Island, the production of which is to some extent restricted, and the price too high to admit of its general and universal consumption, has the fineness, the strength, and brilliancy necessary for the manufacture under good conditions of a large number of special articles. Egyptian cottons are used in making threads of the numbers 60 to 150, while Indian cotton makes threads of numbers 5 to 18, and American cotton threads from 20 to 50. The qualities of Egyptian cotton are such that it finds a ready outlet on European markets, no matter what may be the production and prices of cotton of other origins."

The following further information respecting Egyptian cotton is taken from the *Journal of the Royal Agricultural Society*, vii. 627, and contains notes on the use of manures for increasing cotton crops in the Nile Valley:

"It is to the cotton crop of the Delta that Egypt owes its present financial prosperity. It covers between a third and a half of the area, the remainder being uncropped in the summer, but cropped with maize in flood-time. During the winter the country is an uninterrupted expanse of wheat, barley, and clover. The cotton is sown in March, and is on the ground till the end of October, receiving about 14 waterings, of which nine are given during the hot weather by lift with bullock-wheel or steam-pump. Its produce is at least eight times that

* An account of Bahmieh or Bamia Cotton is given in the Kew Report for 1877, pp. 26, 27.

of Indian cotton, giving an average of about 500 lb. of lint per acre. Clover or wheat follows.

"The clover is sown amongst the cotton plants before they are cut, and gives five cuttings between November and June, requiring eight waterings. Maize follows during the flood, and, after the maize, wheat. During the next flood maize is again sown, and is followed by clover, which, after two cuttings, is ploughed up to make way for cotton. Thus, in three years the cultivator gets a crop of cotton, two crops of maize, a crop of wheat, and seven cuttings of clover. In some places cotton is grown every other year, the intermediate crops being wheat, maize, and clover. On the large estate which formed the 'Domains' of Ismail Pasha, and is now managed by a board on behalf of his creditors, the maize cropping is generally omitted, and the land is given two fallows in flood-time in the course of three years. Maize is almost invariably manured. Cotton follows clover and is commonly unmanured. But the Domains administration has found that, by the use of manure, at least 200 lb. can be added to the produce per acre, and the practice of top-dressing is spreading. It may be safely concluded that two-thirds of the Delta—or one and three-quarters million acres—receive manure annually."

X.—EGYPTIAN COTTON IN SIERRA LEONE.

[K. B., 1897, pp. 304–305.]

[EXTRACT.]

Another promising economic plant in Sierra Leone is the native cotton, probably *Gossypium herbaceum*, L. In order to supplement this an effort was made some years ago to introduce the cultivation of the Egyptian cotton in the colony. The following letter affords particulars on these points:—

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

Royal Gardens, Kew,
21st January, 1893.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 2nd instant forwarding a copy of a despatch from the Governor of Sierra Leone regarding the experiments made in the colony to cultivate Egyptian cotton.

2. Mr. Thiselton-Dyer has noticed with regret that these experiments have not proved successful in Sierra Leone, and that the Governor does not consider that there would be any good in forwarding more seeds to the colony.

3. It will be within your recollection that in 1890, at the request of the Government of Sierra Leone, Kew undertook to obtain a commercial valuation and report on samples of native cotton collected in Mafweh on the Bum River; and in my letter of the 9th May 1890, a copy of a very favourable report furnished by the Manchester Chamber of Commerce was enclosed.

4. The Sierra Leone cotton was stated to be of good quality, and valued at sixpence per pound in Liverpool. There was said to be a good demand for it, and Lancashire buyers "would gladly welcome a "very much larger supply than is now available." A copy of the correspondence was afterwards published as a Government notice (No. 56, dated the 26th May 1890), in the local gazette, and the Governor, Sir James Hay, K.C.M.G., invited "the special attention of the public to "the importance of the subject."

5. It was evident that a very favourable opening existed in the Colony of Sierra Leone for extending a valuable industry. There are few West African products in the present day that offer a remunerative market. Hence this subject of cotton-growing was of peculiar importance.

6. It was thought desirable not only to encourage and extend the cultivation of the cotton already in the hands of the natives, but to introduce the more valuable Egyptian cotton, which is in great demand "for the "length, firmness, and strength of the staple."

7. If owing to local circumstances the cultivation of Egyptian cotton is not practicable in Sierra Leone, it may at least be possible to extend the growth and export of the ordinary cotton. If the colony could afford to support a small botanical station in the neighbourhood of Freetown, there is little doubt that many new industries could be started that are now believed impossible. The success attained at the two stations already established in West Africa at Lagos and Aburi, shows that they fulfil a most useful mission in regard to developing local industries.

I am, &c.

(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.
Colonial Office.

XI.—KAPOK.

(*Eriodendron anfractuosum*, DC.)

[K. B., 1896, pp. 204–207.]

Kapok is the Dutch name for the seed hairs of the white silk-cotton tree of the East Indies (*Eriodendron anfractuosum*). The kapok of Java is regarded as the best. It is, however, too short in the staple. too smooth, and too soft to be spun into yarn. Its chief use is for stuffing pillows, mattresses, and sofas, where its lightness, immunity from moth, softness, and elasticity, render it superior to all but the best qualities of feathers, wool, and hair.

Eriodendron anfractuosum is a lofty forest tree with a large straight trunk covered with prickles when young. The branches are horizontal and arranged in whorls. The rather large flowers are white, and are followed by a dry, green capsule, in shape like a short cucumber, filled with black seeds embedded in silky hairs. The seeds are sometimes eaten and yield a bland, fatty oil. The residual cake makes an excellent food for cattle. The tree occurs in the forest throughout the hotter parts of India and Ceylon and extends to Sumatra, Java, and the Philippine Islands. It is also distributed to South America, the West Indies and tropical Africa. The habit of the tree is a very striking

one. This is well shown in the representations of it in the North Gallery, Nos. 129, 176, and 632. It is majestic in size, and generally towers above all other trees in the dry forests where it flourishes. It sends out large buttress-like expansions from the base, while its branches afford a favourite resting place for numerous epiphytes. In fact the upper parts of an old silk-cotton tree form a very interesting garden. The branches and forks are thickly covered with a large tufted growth of several species of *Tillandsia*, numerous ferns, aroids, orchids, and the seedlings of *Ficus* and other trees whose seeds have been carried thither by birds. Next to the Cocoa-nut palm the silk-cotton tree affords one of the most characteristic features of tropical vegetation. It is regarded with superstition by the negroes both in Africa and the West Indies, and they can with difficulty be induced to cut it down or handle it.

In India the tree yields an almost opaque gum of a dark-red colour, which is said to be astringent, and to be employed medicinally in bowel complaints. The wood is soft and used in tanning leather. An inferior reddish fibre is sometimes prepared from the bark, which is used locally for making ropes and paper. It possesses, however, no commercial value; and the barking of the tree would not compensate for the injury done to it as a source of floss. The young roots are also used medicinally in Bombay. They are dried in the shade, powdered and mixed with the juice of the fresh bark and sugar.

In Java the growing silk-cotton trees are commonly used as telegraph posts as the branches grow so conveniently at right angles to the trunk that they do not interfere with the wires.

The kapok or floss from *Eriodendron anfractuosum* is, according to present demand, a fibre of considerable merit. The modern trade in it was created by the Dutch merchants, who drew their chief supply from Java. It is said that its elasticity and harshness prevent its becoming matted as in some other flosses. The extending use of kapok seems to point to it as a fibre likely to increase in demand year by year. It is important, as pointed out by Dr. Watt, to guard against an error "made by many writers of viewing kapok as a generic trade name for all the silk-cotton—including that of the *simal*—the floss of *Bombax malabaricum*. When the demand for kapok first started, Indian exporters placed in the market a quantity of very dirty *simal*, having a large percentage of dust as well as seed. This was at once condemned and fetched a price that would not cover the transport charges. India thus fell into an inferior position, which might have been avoided if carefully cleaned fibre had been sent to Europe."

In the *Annual Report* of the Director of the Botanical Department, Jamaica, for the year 1884, p. 48, the following particulars were given respecting kapok or silk cotton:—

"The silk-cotton tree is a very familar object in the Jamaica landscape, especially on the north side, where it attains an enormous size. The wood was formerly (and sometimes is now) utilised for the purpose of making canoes; but for all practical purposes the tree is accounted of little value in the West Indies.

"The chief supply of kapok for the Dutch market is obtained from the East Indies, and during the years 1877–82 the following quantities were imported, viz.: 1877, 14,093 bales; 1878, 10,519 bales; 1879, 12,050 bales; 1880, 6479 bales; 1881, 9991 bales, and 1882, 28,032 bales. The average price paid in English money was 7*d.* per lb. nearly.

"A great difficulty found in the importation of silk-cotton was due to its great bulk and the heavy cost of transport. The difficulty has now

been overcome by a silk-cotton press constructed by Stork and Co. at Henglo.

"It now only remains for some enterprising firm to initiate the collection of silk-cotton in Jamaica and ship it in well-packed bales for the European market. If each cotton tree yielded at the rate of about 100 lbs. weight of clean floss there might be exported from Jamaica every year about 3000 bales of silk-cotton of the value of 9000*l*."

In Ceylon, according to the *Tropical Agriculturist* (1884, p. 153), kapok was collected throughout the villages in the interior, principally in the Matura and Tangalla districts and in the Central Province. The season commences in May, and only one crop can be obtained in the year. The trees do not attain maturity until the fifth year. It is not uncommon to gather 1000 to 1500 pods from one tree. In preparing the article for export the chief difficulty was experienced in freeing it from the seeds. The improved Patent Saw Cotton Gin imported in 1884 was very satisfactory. The industry in Ceylon was started in consequence of letters written from the Melbourne Exhibition by the late Mr. A. M. Ferguson, C.M.G.

Kapok had already attracted considerable attention in Australia. Messrs. Buchanan, of Melbourne, in their *Monthly Register* dated 21st June 1886, gave the following account of it :—"It is now 15 years since the first shipment of Java kapok came to this market . . . . but so firmly did it establish itself . . . . that when supplies were not regularly forthcoming a substitute was sought for. In proof of the lasting qualities of kapok, a non-commissioned officer engaged in the Mahratta war of 1843 has a pillow-case in constant use ever since which still retains its elasticity and fulness, and who assures us he has found nothing so cool or healthful to sleep on in warm climates. It is difficult to obtain reliable statistics concerning the trade . . . . We find it entered at the local Customs under all manner of names, such as 'vegetable fibre,' 'vegetable wool,' 'silk cotton,' 'tree cotton,' 'raw cotton,' and 'Simoul cotton.' There were imported into Melbourne during the year 1886 a total of 8845 bales of the value of 26,850*l*. A bale of Java kapok weighs about 80 lbs., a bale of Ceylon about 200 lbs., and a bale of India about 400 lbs."

Serious complaint is made in Australia and elsewhere of the quality of the kapok shipped from India. "Even at the low price of India "kapok it is found better to pay $8\frac{1}{2}d.$ and higher per lb. for Japan than "$3d.$ for Indian. The Indian is frequently received in such a filthy "condition as to be almost unsaleable." It is stated that hydraulic or steam-press packing of kapok tends to destroy that peculiar elasticity to which it owes its value, "for without its springy nature it is "unsuitable as a stuffing material." Moreover, by hard packing, when the seeds are left attached to the fibre, a dark-coloured oil is expressed which is suffused over the kapok, "hence a noticeable difference in colour between the Indian and the beautifully white Java products."

"At Java the trade has assumed a uniform practice. No unclean stuff is shipped, but the different grades of cleaning denote standards of quality; the first, 'extra cleaned,' being cleaned by machinery, and the first picking of the crop; the second, denoted as 'best cleaned picked,' being all hand-picked and free from seeds, except an odd one here and there; the third is simply designated 'cleaned.' It contains a few seeds, together with the 'slubs,' or little knotty, curly lumps, which are cast aside from the higher grades. The quality of any one class is found most uniform throughout the bales. Packing is all done in straw mats, and never tightly pressed; the first quality, 'extra

cleaned,' weighing about 65 lbs.; the second and third from 75 lbs. to 90 lbs. Bales over 90 lbs. to 95 lbs., on account of having to be dumped by machinery, destroying the elasticity of the fibre, are reckoned not to be worth within $\frac{1}{2}d.$ to $1d.$ per lb. in value of bales of lesser weight.

"In fact, it is a peculiar feature of the Java trade that weight of bales form an essential condition of price—the lighter the highest, and *vice versâ*."

The following paragraph appeared in the *British North Borneo Herald* for August 1, 1896 :—

"Kapok, the down which envelops the seeds of the silk-cotton tree, is, says the *Produce World*, receiving much attention. The cultivation of the trees is even said to be ousting coffee in the province of Burmah; they grow to a height of 80 feet to 100 feet, the wood is soft and worthless; the fibre, kapok, is extensively used for stuffing mattresses, pillows, cushions, seats of railway carriages, &c. The lack of proper machinery for cleaning the fibre stood in the way of its development, but that obstacle has been removed, and the stuff as it comes to market is in excellent condition for the purposes we have named."

Kapok has not been received in this country on a very large scale. It is not, however, quite unknown here. The following particulars have been received from a well-known firm in the City :—

Messrs. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
September 28, 1896.

SIR,

IN reply to your letter of the 24th instant, Kapok is coming here regularly to the extent of 100 bales a month from India and Ceylon. To-day's value is $2\frac{1}{2}d.$ to $4d.$ per lb. The trade is not large, but may grow.

Yours, &c.
(Signed) IDE AND CHRISTIE.

Dr. Morris, C.M.G.,
Assistant Director, Royal Gardens,
Kew.

XII.—FIBRE FROM LAGOS.

(*Honckenya ficifolia*, Willd.)

[K. B., 1889, pp. 15–16.]

Botanical specimens as well as a specimen of fibre were recently received at Kew through the Colonial Office from the Governor of Lagos. These specimens have proved interesting as bringing under notice, apparently for the first time, a valuable fibre plant on the West Coast of Africa. The plant has been determined as *Honckenya ficifolia*, Willd. (Clappertonia ficifolia, *Decaisne*), a member of the natural order *Tiliaceæ*. It is fully described in Oliver, *Flora of Tropical Africa*, Vol. i. p. 260. Below will be found the official correspondence bearing

on the subject, including a report of Messrs. Ide and Christie on the commercial value of the fibre :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street, 12th December 1888.

SIR,

I AM directed by the Secretary of State for the Colonies to transmit to you, for your observations, a despatch from the Governor of Lagos, enclosing a correspondence with Mr. Alvan Millson respecting a local fibre-yielding plant known as "Bolobolo" or "Agbonrin Ilassa."

I am, &c.
(Signed) ROBERT G. W. HERBERT.

The Director,
Royal Gardens, Kew.

[Enclosure.]

Government House, Lagos,
1st November 1888.

MY LORD,

I BEG to trouble your Lordship with a copy of the correspondence with reference to a local fibre-yielding plant known in the Popo vernacular as "Bolobolo" and in Yoruba as "Agbonrin Ilassa," which has been supplied by Mr. Millson, the Commissioner of the Western District.

Thecor respondence covers herbarium specimens and a sample of the fibre on which this Government would be obliged to be favoured with an expression of opinion by the Director of the Royal Gardens, Kew.

I have, &c.
(Signed) C. A. MOLONEY,
Governor.

The Right Hon. Lord Knutsford, G.C.M.G.,
&c, &c. &c.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
17th December 1888.

DEAR SIR,

WE have your favour of the 15th instant, with specimen of "Bolobolo" fibre from Lagos. We consider this a very valuable fibre of the jute class, but distinctly superior to the latter in many respects, and more particularly in strength. It is of good length and well cleaned. If this fibre is capable of being produced in large quantities there is a very wide field open to it commercially. Its market value would be regulated by that of jute, but in our opinion it would always command a higher price. At to-day's currencies it would sell at 16*l.* per ton in London. We do not think the minimum price would ever fall below 12*l.*, and if the jute market made a further advance, this "Bolobolo" fibre might realise 20*l.* If this fibre could be prepared of a whiter colour it would prove still more acceptable ; but even as it is, we should be very glad to see large quantities placed on this market, where they would sell readily.

We are, &c.
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.,
Royal Gardens, Kew.

XIII.—JUTE FROM THE GAMBIA.

(*Corchorus olitorious*, L.)

[K. B., 1898, pp. 38-40.]

[EXTRACT.]

Jute (*Corchorus olitorius*).—The seed of this plant was again sown and better results were gained than on the previous occasion. The ground was prepared and seed sown on the north side of the station, in a rather swampy situation. It was started this year two months earlier. The fibre produced was a very fair sample for a first trial. We shall be able to produce a much larger and finer crop next season. The plant to be successful here must be sown at the commencement of the rains, say the first week in July. It must have all the rain it can get while it is growing, and the seed must be sown thinly, or the plants will fail through not having sufficient room to grow.

The following notes were taken on the crop which produced the sample of fibre submitted to the Dundee Jute Growers' Association.

The area of the land sown was about a quarter of an acre. The seed was sown on June 13. Cutting the plants was begun on October 11. Retting the stems took twenty days. The number of plants cut from the area sown was 2800. These weighed when dried 22 lbs., and the amount of cleaned fibre obtained was 8 lbs.

The following report has been received from the Dundee Jute Growers' Association on a sample of jute grown and prepared at this station :—

DEAR SIR, Dundee, December 21, 1897.

I HAVE now to advise that the sample of jute from the Gambia Colony which was returned to you yesterday may be said to have been seen by the whole trade here, by whom it has been examined with much interest.

The sample does not have the high colour of the best jute from India, but it is similar in that respect to jute which is received in large quantity from that country.

The fibre is good, possessing strength and good spinning quality. It has been very well prepared, is free from "blacks" (small pieces of bark sometimes left adhering to the fibre from want of thoroughness in preparing) and it has a good glossy fibre. The sample may be classed as medium quality of jute and quite merchantable.

The root end has not been cut off, nor what is known as "crop" at the other end been removed, no doubt in order to show the full extent of the growth as far as possible. Jute of the quality of this sample when prepared for market should be free from root and crop. It will be seen that if so treated the sample would not yield more than two feet length of fibre.

Except for the short length, there is no fault to find with the sample in comparison with jute from India of the quality with which it would be classed.

It is understood that the short length of the sample is owing to late planting and an exceptionally dry season. Taking these circumstances into consideration, the sample gives great promise that jute-growing in the Gambia Colony will prove a practical success. It may be mentioned that the jute crop of this season now arriving from India is a

very large one, and that the prices are exceptionally low; but if with favourable conditions jute of the quality of the sample from Gambia can be produced, with length of fibre nearly equal to the Indian growth, there is a large future before it.

Taking one year with another, the values realised for the Indian crop have been sufficient to induce a constantly extending cultivation in that country.

You would receive along with the sample a small portion taken from a bale of Indian jute which has been sent to show the length of jute of this season's crop.

Apart from the fact that a better price per ton is realised for jute of a long growth, the bulk of produce from the land is materially affected thereby—a most important factor in the result to the producer.

It may be hoped that the trials now being made will prove that jute growing in Africa will fulfil all the conditions of commercial success.

Yours truly,
(Signed) GEO. C. KEILLER,
Secretary.

XIV.—SIBERIAN PERENNIAL FLAX.

(*Linum perenne*, L.)

[K. B., 1890, pp. 104–107.]

The common flax (*Linum usitatissimum*) indigenous in the South of Europe and in the East, has been in cultivation from the earliest times. It is now largely grown throughout the northern hemisphere, and extends to 54 degrees N. lat. It is one of the most useful members of the vegetable kingdom, and the tenacity and lustre of its cortical fibres places it at the head of textile plants. The testa of the seed (linseed) contains an abundant mucilage, and the embryo a fixed emollient oil which is very drying, and hence largely used by painters. What may possibly be regarded as a drawback to the ordinary flax is the fact that it is an annual, and requires to be raised from seed year by year. The discovery of a perennial flax possessing the properties of the ordinary flax would naturally excite keen interest amongst flax growers. The subject appears to have cropped up from time to time during the last 50 years, but the results so far attained do not hold out the hope of a perennial flax taking the place of the present annual species. There is, it is true, a *Linum perenne*, L., which is a native of the British Islands. It is also found in Middle and Southern Europe, in Western Asia, and in India. This plant has numerous wiry, slender stems about 1 to 2 feet high. The flowers are about 1 inch broad, bright blue. Many attempts have been made to utilise this plant for yielding fibre or oil, and attention has been drawn to the fact that in some parts of the world such as Siberia, flax has at one time been prepared from it. At the present time it is doubtful whether flax on a commercial scale is obtained from any other than the common flax, *Linum usitatissimum*.

The following correspondence will serve to show what is at present known respecting perennial flax, and it may lead to a further elucidation of the subject.

Royal Gardens, Kew, to Foreign Office.

Sir, Royal Gardens, Kew, 16 November 1889.

I have the honour to inform you that Mr. Thiselton-Dyer has received an inquiry in regard to Siberian flax, described as a perennial, much taller than the ordinary flax (which is an annual) and capable of yielding a succession of stalks from the same root for many years.

2. The only information on the subject so far attainable is given in the enclosed extract taken from Dr. Carpenter's "Vegetable Physiology" (London 1850) paragraph 517. It appears that the subject is more fully dealt with in a much older publication, but no copy of this exists at Kew.—"Vom perennirenden sibirischen Leine und dessen auch bey "uns mit Nutzen einzufuehrenden Baue handelt vorgaenzig, etc." D. Gottlieb Schrader, Halle, 1754.

3. If this perennial flax is still cultivated in Siberia and yields some of the flax exported from the Russian Empire, the fact would possess considerable interest to flax growers in the North of Ireland. At present the museums of the Royal Gardens possess no specimens of perennial Siberian flax, and beyond the meagre and somewhat obsolete information already cited, nothing is known of it in this country.

4. Mr. Thiselton-Dyer would therefore express the hope that the Secretary of State will approve of the kind offices of Her Majesty's Ambassador at St. Petersburg being invited to obtain particulars of the different kinds of flax cultivated in Siberia. If a perennial flax is known there answering to the description given by Dr. Carpenter, it would be desirable to obtain for the Kew Museums specimens of the stems in various stages of preparation, and of the flax yarn as usually exported. It would also be desirable to obtain two or three pounds of seed of this perennial flax, in order that it may be experimentally cultivated in this country; in this connexion any information as to its cultural treatment would be serviceable.

5. I am to add that any moderate expenses incurred in this service will be defrayed by this establishment in usual course.

I am, &c.

Sir Villiers Lister, K.C.M.G. (Signed) D. Morris.

[Enclosure.]

Extract from "Vegetable Physiology," by Dr. Carpenter (para. 517). London, 1850.

The only other species of this order, which is cultivated for the same purpose, is the Siberian perennial flax. This is a much taller plant, having coarser fibres; these are found to be very strong, but not so white or fine as those obtained from common flax. They serve very well, however, for the manufacture of coarse fabrics; and there is this advantage attending the cultivation of them,—that from the same root, a succession of stalks will be developed for many years; so that they require no further attention, than to be kept free from weeds.

Sir Robert B. D. Morier, G.C.B., G.C.M.G., &c., to the Marquis of Salisbury, K.G., &c.

My Lord, St. Petersburg, 20 March 1890.

In reply to your Lordship's Despatch, No. 83 of this series, and of the 21st November last, I have the honour to transmit to your Lordship herewith a copy of a letter, together with its enclosure, which I

have received from Mr. E. F. G. Law, giving the result of his inquiries respecting Siberian flax.

I have, &c.
(Signed) R. B. D. MORIER.

The Marquis of Salisbury, K.G.
&c. &c. &c.

[ENCLOSURE No. 1.]

Mr. E. F. G. LAW to Sir ROBERT B. D. MORIER, G.C.B., G.C.M.G., &c.

SIR, Constantinople, 1 March 1890.

IN accordance with your instructions I have made inquiries respecting the Siberian flax referred to in the Marquis of Salisbury's Despatch, No. 83, Commercial, of November 21, 1889.

This flax is at present quite unknown in the St. Petersburg market, in which it would be most likely to be found. A local English merchant has kindly undertaken to endeavour to procure samples for me, but these had not been received when I left St. Petersburg.

Meanwhile, through the kindness of the Vice-Director of the Department of Trade and Manufactures, I have received some information on the subject, emanating from the Director of the Technological Institute, and from Professor Batalin of the St. Petersburg University.

I append translations of the communications of these gentlemen.

I have, &c.
(Signed) E. F. G. LAW,
Commercial Attaché.

His Excellency
Sir Robert B. D. Morier, G.C.B., G.C.M.G.,
&c. &c. &c.

[ENCLOSURE No. 2.]

The Director of the Technological Institute writes :—

"Siberian flax (*Linum perenne*) is certainly different from the flax which is generally used in Europe. The difference is, that like perennial plants, it is cut and not pulled up by the roots, and therefore it is not annually sown like the ordinary blue-flowered flax (*Linum vulgare*) or the American flax with white flowers. The Siberian flax gives a short tow as the stems are short. The stems do not grow erect, but are bent, and even lie on the ground. The industrial use of this flax is unknown in Europe, where it has never been grown with the intention of using it. Whether it is used in Siberia or not I cannot say, but at a time when I interested myself in this subject I learnt that the Siberian flax was sold in St. Petersburg warehouses, and was distinguished by its proper name, and by its whiteness and softness, and by its freedom from 'Kostra' (Scutch ?), and it is more expensive. The traders collect it in the Governments of Viatka and Vologda, on the banks of the Kama."

Professor Batalin writes :—

Perennial flax (*Linum perenne*) is a quite distinct plant, distinguishable from ordinary flax by many peculiarities. One of the chief distinctions is the colour, and also the thickness of the stem. The seed is dark brown, almost black, and quite flat, so that it is quite useless for the extraction of oil. The pod has little of the soft part which is found in ordinary flax. Thirty or 40 years ago experiments were made in

Germany to grow perennial flax for the tow. In the works of Langethal and Metzger, the results of these experiments are thus spoken of :—"The plant grows more evenly and longer than ordinary flax ; " foul grasses easily overrun and even choke it, for which reason it is " necessary to cover the plants with manure in autumn. It does not, " under any circumstances, grow more than two years in the same " place, as in any case it gets overgrown by foul grasses. It is par- " ticularly sensitive to frost (*i.e.*, probably in winters without snow ?). " The tow was found to be coarser than that of ordinary flax, and " consequently it is very improbable that its cultivation will be " extended." In South Russia, if I am not mistaken, in the Government of Kieff, someone made the experiment of sowing Austrian perennial flax (*Linum austriacum*), which is very similar to the *Linum perenne*, but from this such coarse tow was obtained that its further cultivation was abandoned. Of this latter experiment an account was given in the "Zemledelcheskoy Gazette" (Agricultural Gazette) in the year 1870.

A little further information has been obtained respecting perennial flax in this country. In "Our Farm Crops" (Edinburgh, 1859), Professor Wilson states "Some experiments recently made with *Linum* " *perenne* tend to show that its perennial nature and its capability of " sustaining itself on soils of the poorest description entitle it to more " consideration than it has hitherto received at our hands. Its hardy " nature and its branching and vigorous habit of growing when a little " care and attention is bestowed upon it, would lead us to believe that on " the poor thin soil of chalk formations for instance it might be " cultivated with advantage, and would, probably, on such soils give a " far larger return than could be obtained from any of the plants we at " present cultivate. The branching habit of the plant would be favour- " able to the production of seed but unfavourable, it is true, to the " production of fibre."

The experiments mentioned by Professor Wilson in the above extract were undertaken by Professor Buckman and described by him in the *Agricultural Gazette*, 1860, p. 270. Professor Buckman called particular attention to the probability of *Linum perenne* yielding fibre which might be used for paper making. The results of his botanical experiments and conclusions were first communicated to the British Association for the Advancement of Science in 1857. In 1860 he states, " I have made a new plot of this plant from seed collected from the old " one, and the whole plant maintains its character, if anything in an " improved condition, so that we may at present be said to possess in it " a form of linseed which grows to as much as 30 inches in height, and " I should say capable of producing a far greater quantity from the " readiness in which its stems branch and this on very poor soil, not for " a single year but for years, as my plot sown in 1854 is still in good " growth, and yielded a good crop in 1859 (its fifth year), although " annually seeded for that time. However, as regards the fibre, I must " confess that I am still in want of conclusive evidence with respect to " its value and fitness for linen and paper making, but of this I can have " little doubt, as its family is a deservedly reputed one for these " purposes."

XV.—THE SPANISH BROOM AS A FIBRE PLANT.

(*Spartium junceum*, L.)

[K. B., 1892, pp. 53–58.]

The well-known Spanish Broom of gardens, *Spartium junceum*, L. (Genista juncea, *Lam.*), is a native of the south of Europe, and it is found wild in Spain, Portugal, the south of France, Italy, and Greece. It is a hardy shrub, 5 to 8 ft. in height, with upright round branches of a deep green colour. It has a few lance-shaped leaves, which soon fall off. The flowers are large but not numerous. They are disposed in terminal racemes, and are of a deep yellow colour and sweet scented. Loudon, *Arboretum et Fruticetum Britannicum* (ed. 1838), p. 576, gives a full account of this plant and its cultivation in this country. "In Britain," he says, "the plant is solely regarded as an ornamental "shrub, having the appearance of an evergreen from its smooth, dark "green shoots and fastigiate form, even in winter, when without leaves."

It is figured in the *Botanical Magazine*, pl. 85; and in Sibthorp's *Flora Græca*, pl. 671. As the generic name implies (*sparton*, cordage), the plant is known to yield a fibre. It has long been regarded as the material of cordage, nets, bags, and even of sails, which were in use by the Greeks, Romans, and Carthaginians. Owing to the more abundant and cheaper materials prepared from cotton and hemp, the use of the Spanish Broom as a fibre plant has in recent times become confined to remote parts of France and Italy, and even there the industry is gradually becoming extinct.

The plant thrives in the most sterile soils and in localities where few other kinds of vegetation are able to survive. It will grow equally well either in poor sandy soils or in those of a rocky and arid character. The young shoots are used as a winter fodder for sheep and goats. The flowers contain a large amount of honey and are attractive to bees. They also yield a dye. In France the plant is known as *Genêt d'Espagne*. An allied plant, the common English Broom, *Cytisus scoparius*, Link (Spartium scoparium, *L.*), known as *Genêt à balais* or *le grand Genêt*, is also occasionally used in France for fibre purposes, but its value in this respect is small compared with that of the Spanish Broom. In regard to the latter, Loudon discusses its economic uses as follows :—

"In Italy and the south of France a very good cloth is manufactured from the fibres of this plant, *Spartium junceum*. The shoots are cut over in the course of the month of August, and after having been made up into little bundles, are dried in the sun. These are afterwards beaten with a mallet, and then steeped in water for three or four hours; after this they are steeped in a ditch, among water and mud, for eight or nine days, and then taken out and washed, which operation has the effect of separating the parenchyma from the fibres. The bundles are then opened, and thinly spread out to dry, after which they are combed in the manner of flax; and the better part is laid aside for being spun, and woven into sheets, table linen, or shirts; the remaining part being used for sacking or for stuffing mattresses. In various parts of France, Italy, or Spain, where neither hemp nor flax is grown, owing to the poverty of the soil, *Spartium junceum* is found an excellent substitute. In Italy, about Monte Cassiano, advantage is taken of a hot spring, by alternately immersing the shoots in it, and drying them in the sun, instead of the more tedious process of immersing them in cold water; when thus treated the parenchyma is rendered fit for separation, and

the fibres for combing, in three or four days. The process is said by Rosier to be also performed with the *Cytisus scoparius*; though, according to Desfontaines, this is doubtful. In Languedoc sheep and goats are fed with the branches of *Spartium junceum* during winter, not because it is an excellent fodder, but because there is a general deficiency of forage at that season. Both in Spain and France, the shoots are used for forming baskets, and for tying up vines and other fruit trees. The bees are said to be very fond of the flowers, and the seeds are eaten with great avidity by poultry, partridges, &c. Medicinally, the flowers and leaves, in infusion, act as an emetic, or in a larger quantity, as an aperient."

In the *Paper Makers' Monthly Journal*, 1883, p. 414, it is stated that genista fibre "is stronger than hemp and has the advantage "that ropes made therefrom acquire greater strength when exposed to "moisture . . . Besides the fibre, the refuse or woody part can be "used for making cellulose that is adapted, owing to its strong texture, "for the manufacture of strong paper." An inventor in the United States (quoted above) recommends the following treatment for extracting genista fibre :—

"The plants are, preferably in small bunches, placed in a tank or vessel filled with water, which is raised to a boiling heat. To this water is added, either before or during the boiling, lye in proportion of about 30 to 60 pounds to 800 pounds of the plants. The lye may be added to the water as such, already prepared, or caustic alkaline earths, in combination with carbonates of alkalies, may be employed, which form the lye in the water containing the plants. Carbonate of lime and carbonate of soda, in proportion of about 30 to 40 pounds of lime and 8 to 12 pounds of soda for 800 pounds of plants, are preferably employed. In the lye the plants are boiled for about five or six hours, after which they are left to cool, and are then removed from the tank or boiler. The plants are then ready to undergo the same treatment as flax and hemp, viz., they may be steeped, dried, broken, and combed, to be subsequently employed for spinning, weaving, making cordage, yarn, and for other purposes to be used in place of hemp, flax, jute, or similar plants."

In a recent number of the *Revue des Sciences Naturelles Appliquées* (5 April 1891) a short notice appeared respecting the use of the fibre of Spanish Broom amongst the peasants in the neighbourhood of Lodève, and in the remote hamlets in the mountains of Languedoc. The following correspondence shows that the industry at the present day is greatly reduced in some places, whilst in others it has become quite extinct.

The efforts made by Kew to obtain specimens of articles made from the Spanish Broom for the Museums of Economic Botany are also detailed.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, 24 April 1891.

I AM desired by Mr. Thiselton-Dyer to enclose, for the information of the Secretary of State, an extract from the *Revue des Sciences Naturelles Appliquées*, April 1891, p. 555, on the subject of a fibre obtained from *Spartium* (Genista) *junceum*, L.

2. This fibre, although said to be used on the continent, is not so far represented in our collections in the Museums of Economic Botany at Kew. Mr. Thiselton-Dyer would therefore esteem it a favour, if the

assistance of Her Majesty's Ambassador at Paris is sought to obtain specimens of the fibre, and of articles made from it, for the use of this establishment.

3. I am to add that any reasonable expenses incurred in procuring the specimens will be defrayed by this establishment in usual course.

I am, &c.
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.,
Foreign Office, S.W.

The SECRETARY OF EMBASSY, PARIS, to FOREIGN OFFICE.

MY LORD, Paris, July 16th, 1891.

IN receipt of your Lordship's despatch, No. 81, of the 28th of April last, asking me to endeavour to procure for the Kew Gardens specimens of the fibre of the *Genista juncea*, and of articles manufactured from it, I addressed myself to the President of the Société d'Acclimatation to obtain the same. He answered me that he was sorry to say that the Society did not possess specimens of the fibre and products woven from it; but he had written to a correspondent to obtain them, and hoped shortly to be able to send them. This he has not yet done, although his letter was dated the 5th of May. . . . .

I have, &c.
(Signed) E. H. EGERTON,
for the Ambassador.

The Marquis of Salisbury, K.G.,
&c. &c. &c.

The SECRETARY OF EMBASSY, PARIS, to FOREIGN OFFICE.

MY LORD, Paris, August 8, 1891.

WITH reference to the Earl of Lytton's despatch, No. 295, of the 16th ultimo, and to your Lordship's, No. 81, of the 28th of April, transmitting the expression of the wish of the Director of the Royal Gardens at Kew to be furnished with products from the *Genista juncea*, I have the honour to enclose herewith copy of a letter from the "Muséum d'Histoire Naturelle," to Monsieur Tisserand, of the Ministry of Agriculture, to whom I had applied for information.

This letter says that the textile said to be derived from this "genista" is unknown in the competent departments, and that there has probably been a confusion on this subject in the publication of the Société d'Acclimatation. It might be well, the latter adds, to submit to experiment the rind of the *Genista juncea*, though this rind does not appear to possess the elements of strong or abundant textile fibre.

I have, &c.
(Signed) EDW. H. EGERTON.

The Marquis of Salisbury, K.G.,
&c. &c. &c.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, August 12, 1891.

I HAVE the honour to acknowledge the receipt of your letter of August 10, transmitting a despatch from Paris (herewith returned) relative to a fibre stated to be extracted in France from *Genista juncea*.

2. The matter is not perhaps of first rate importance. But it is the business of this establishment to study local industries based on the use of vegetable materials, as sooner or later they are sure to be the subject of public inquiry.

3. M. Cornu, in his letter, speaks of the information published by the Société Nationale d'Acclimatation de France as being an old affair (il y a déjà longtemps). But, as a matter of fact, it is contained in the number of the *Revue* for April of the present year.

4. The statements are extremely specific or I would not have ventured to trouble the Foreign Office in the matter. Thus it is stated :—" Dans " les villages pauvres du Bas-Languedoc, il est peu de maisons où l'on ne trouve du linge fabriqué en toile de Genêt." Again :—" Dans les " Cevennes, où le commerce de ce textile se trouve localisé, on " l'emploie également pour faire des cordes, &c."

5. M. Cornu suggests that there is a confusion with *Crotalaria*, the Sunn Hemp of India. This, if really the case, would be very curious.

6. Unless the information issued by the Société d'Acclimatation is purely imaginary, which, as it is a society of standing and repute, is improbable, there is a local industry in France of which nothing is authentically known. Perhaps Her Majesty's Consul at Marseilles could find out what the nature of it really is.

7. In any case I must beg to express my thanks for the trouble that has been taken in the matter.

I am, &c.
(Signed) W. T. THISELTON-DYER.

Sir T. Villiers Lister, K.C.M.G.,
Foreign Office, S.W.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, January 28, 1892.

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before the Director of the Royal Gardens, a despatch from Her Majesty's Minister in Paris sending specimens of fibres of the *Genista juncea* referred to in the letter from this office of July 17 last.

I am, &c.
(Signed) T. V. LISTER.

The Assistant Director,
Royal Gardens, Kew.

[Enclosure.]

The SECRETARY OF EMBASSY, PARIS, to FOREIGN OFFICE.

MY LORD, Paris, January 27, 1892.

WITH reference to your Lordship's despatch of this Series, Number 81, of the 28th of April, and to my despatch, Number 295, of the 16th of July last, I have the honour to transmit herewith specimens of the fibre of the *Genista juncea*, L., and of articles manufactured therefrom as requested by Mr. Thiselton-Dyer.

These specimens have just been forwarded to me by Monsieur Geoffroy St. Hilaire, President of the Société Nationale d'Acclimatation de France, who informs me that he has had some difficulty in obtaining the specimens, their place of manufacture being limited to a few remote villages in the Cevennes.

I have, &c.
(Signed) EDW. H. EGERTON.

The Marquis of Salisbury, K.G.,
&c. &c. &c.

HER MAJESTY'S CONSUL, MARSEILLES, to FOREIGN OFFICE.

MY LORD, Marseilles, January 27, 1892.

REFERRING to the Foreign Office despatch, No. 1, Commercial, of the 17th of last August, and its enclosures, which I return herewith, I have the honour to inform your Lordship that, through the kindness of M. Durand, Professor of the School of Agriculture at Montpellier, I have at length obtained and forwarded to the Foreign Office by the Peninsular and Oriental Company's steamer "Chusan" a parcel containing specimens of the *Genista juncea*, and of the articles made from it.

The plant, called locally *Gênet d'Espagne*, grows naturally in the country, and it is only utilised for textile purposes at Lodève in the department of the Hérault, where the stuff is only made to order, and the industry, such as it is, is dying out.

I have, &c.

(Signed) CHARLES G. G. PERCEVAL,
Consul.

The Most Hon.
The Marquis of Salisbury, K.G.,
&c. &c. &c.

The specimens mentioned in the above correspondence received at Kew afford ample material for arriving at a definite conclusion with regard to the origin and character of "Genista fibre." There is now in the Kew Museums a complete set, consisting of twigs, fibre in various stages of preparation, as well as yarns and coarse cloths. These were received from Mr. Consul Perceval. Besides, there is a sample of coarse sheeting received from M. Geoffroy St. Hilaire, through the British Embassy at Paris. These fully illustrate the fibre industry connected with *Spartium* (Genista) *junceum*. A summary of the information obtained by the *Société Nationale d'Acclimatation de France* whilst engaged in meeting the wishes of this establishment, at the request of Her Majesty's Ambassador at Paris, is given in the *Revue des Sciences Naturelles Appliquées*, February 1892, p. 128.

It is somewhat singular to observe that the first efforts of the Society to secure specimens met with entirely negative results. Their correspondent at Nîmes, supposed to be one of the localities where the industry was still carried on, reported that not only did a Genista fibre industry not exist in that district, but he had never heard of such an industry. The plant itself was plentiful enough, and was used for feeding sheep along with needles of *Pinus sylvestris*. The Society for a moment began to doubt, as shown in the correspondence, whether after all Genista fibre was not a myth. The first satisfactory intimation was received from Professor Durand, of the School of Agriculture at Montpellier. This gentleman was ultimately successful in obtaining the specimens received at Kew through the exertions of Mr. Consul Perceval. M. Vilbouchevitch has seen recently in the neighbourhood of Lodève very fine specimens of yarn, and cloth made from the fibre. Some of the latter had been in use for 15 years, and it was of fine texture and beautifully bleached. An application to the mayor of Lodève elicited the fact that the industry had existed in his neighbourhood, but at the present time it was almost extinct. He forwarded, however, to the Society, a series of specimens consisting of coarse cloth, mattress coverings, and sheeting; the specimens of the two latter were 80 years old. Of very recent manufacture he was able to send only some yarn.

It is evident that this interesting rural industry is fast dying out in France. It may be said to exist now only in very remote hamlets in the Cevennes. The inquiries made by Kew were therefore only just in time to secure the last specimens of cloth made in a laborious fashion before the days of rapid communication and the introduction of cheap cotton and other goods.

As an appendix to the article in the *Revue* above mentioned there is reprinted a memoir by M. Broussonet, entitled, "Observations sur la culture et les usages économiques du Genêt d'Espagne," published in 1785. This gives a very interesting account of the industry as it existed in France more than a hundred years ago. In those days, in certain country districts, no other linen material was used except that obtained from the *Genêt d'Espagne*. The soil was too poor to grow cotton, flax, or hemp, and each household made its own cloth as it was wanted. It was never for sale in any quantity. A further memoir is reprinted relating to the use of *Cytisus scoparius*, Link, as a fibre plant. This was known as *Genêt à balais or grand Genêt*. The latter memoir was written by M. Yvard in 1787.

XVI.—BARK CLOTH OF UGANDA.

[K. B., 1892, pp. 58–60.]

One of the most interesting of recent additions to the Museums of Economic Botany at Kew has recently been received from Sir John Kirk, G.C.M.G. It consists of a large sheet of bark cloth prepared by the natives of Uganda from the inner bark of a species of *Brachystegia*, a small genus of trees belonging to the *Cæsalpiniæ* sub-order of the natural order *Leguminosæ*. The specimen is abont 14 feet 6 inches long, 7 feet broad, and $\frac{1}{16}$ of an inch in thickness, and is of a reddish-brown colour, somewhat lighter on the under side, and is slightly crimped, probably the result of having been beaten out with grooved clubs.

The genus *Brachystegia* is confined to tropical Africa, and seems to be generally used by the natives as a source of bark cloth. Messrs. Speke and Grant in their expedition to the sources of the Nile, 1860–1863, made some interesting notes on the preparation and uses of cloth from this source, which it may be well to add. They say of *Brachystegia spiæformis*, Benth., that it is a light graceful tree of 20 to 40 feet high, common in rich forest, and is known in the Robeho mountains, Zanzibar, under the name of "M'chenga" or "M'nenga," the bark of which is made into kilts, cloth, band-boxes, huge grain stores, matches, roofing for camp huts, &c.; they also add that a blood-red juice exudes on cutting the bark. These same explorers collected slight herbarium material at Keegwah in lat. 5° 5′ S. of what is so far determined as *Brachystegia tamarindoides*, Welw., var.? Attached is the following note—"Native name 'Mecombo,' a first-class tree, as it has "so many uses. Tree 50 feet high, long naked trunk 9 feet in cir-"cumference. Foliage deep green. The wood is considered good "for building. Its bark after being boiled and prepared is made into "white sheets or cloths worn by the natives at 10° S. They also "make canoes, boxes, matches, and rope from it. Its honey is con-"sidered very superior in flavour and whiteness. First met with "30 miles from the sea; afterwards in the interior it was frequent.

" It is so plentiful at 6° S. lat. that our temporary huts were roofed " with its bark, and my plants were protected by planks of its bark, " which answered admirably, being light and stiff."

During Livingstone's Zambesi expedition in 1860 Sir John Kirk collected specimens of *Brachystegia appendiculata*, Benth., a tree of 20 to 40 feet high in the highlands of the Batoka country, where it is known under the name of "Motondo" (Setoka), the seeds being eaten by the natives; he also collected the same species near Muata Manja, 14° 19′ S. lat., and states that the fibrous bark is made into cloth by being beaten out. According to Dr. Mellor this tree is known as "Chenga" near Zomba. The herbarium contains a specimen of *Brachystegia longifolia*, Benth., collected by Mr. J. Buchanan in the Shiré highlands, and bears the following label—"Njombo. Bark cloth tree, wood very soft." Another herbarium specimen collected by Sir John Kirk near Kusuma, on the river Shire, is labelled *Brachystegia, sp. nov.*, and is described as being a good-sized tree with a fibrous bark which is used for cloth.

Since the above was written a report has been received through Sir John Kirk from Captain Lugard, the officer now commanding the Imperial British East Africa Company's troops in Uganda, in which the following reference is made to the bark cloth so extensively in use there, of which the specimen now in the Kew Museum is an example.

Captain Lugard says, " The fig class [*Ficus*] is largely represented in " Uganda where they are cultivated for the sake of their bark from which " the native cloth is made." Thus, although there can be no doubt that the bark cloth used in Nyassaland, and much of that used elsewhere, is derived from various species of *Brachystegia*, the subject requires further investigation, and it is most desirable that those in a position to investigate the question on the spot should send the leaf *at least* of the tree which they have seen used to yield the bark cloth, with specimens of the cloth itself.

The seeds of what has been determined as a species of *Brachystegia* from Mashonaland and Manica have recently been received at Kew from the Agricultural Department of Cape Colony.

SECRETARY FOR AGRICULTURE, CAPE TOWN, to ROYAL GARDENS, KEW.

SIR, Cape Town, January 15, 1892.

I BEG to send you herewith some seed of a tree which is found over a large tract of country in Mashonaland and Manica. The person who brought the seed from there calls the tree by the name of "Mahogany,' and describes it as a very beautiful one, and one of the most useful trees for South Africa, instancing the employment of the bark by the natives for making strong rope, bags (fit for grain), mats, beehives, &c. He states that the tree grows in every kind of soil and situation, in lowlands and on mountain tops.

I append a Memorandum by Professor MacOwan, until lately Director of the Botanic Gardens here, and should be glad to learn from you, upon identification of the seed, its precise classification.

I have, &c.

The Director, (Signed) W. J. J. WARNEFORD,
Royal Gardens, Kew. For Secretary for Agriculture.

[Enclosure.]

Mr. MacOwan says :—"It is a pity that an English name has been manufactured for this Mashonaland tree. The native name would have some sense and value as part of the history of the species.

"The Transvaal Boers call *Afzelia cuanzensis*, Welw., by the name of 'Mahogoni boom' (boom is Dutch for tree). But it is utterly different from this, its seed being ovoid, black, and each seated in a cup-shaped scarlet arillus. These seeds are often brought down as curiosities.

"I should rather expect this seed to be some species of *Bauhinia*, if a guess must be made. The packet might be sent to Kew, and a few tried here and at Durban."

XVII.—KENDIR FIBRE.

(*Apocynum venetum*, Linn.)

[K. B., 1898, pp. 181–183.]

In November, 1896, a letter was received from the Foreign Office, forwarding a copy of a Report on the Nijni-Novgorod Exhibition of 1896, containing a reference to a fibre plant successfully used in the manufacture of Russian paper money. With the report a packet of the seed of the plant was received.

The following particulars were furnished (*Foreign Office Reports*, 1896, *Miscellaneous* Series, No. 409, pp. 16–17) :—

"Attention was especially drawn to a plant *Apocynum sibiricum*) which grows wild in the Semiraychinsky district, near the River Amu Daria, and the Ili. The local name is 'Kendir,' or 'Turka,' and it is much employed by the natives, who use the fibre for their ropes and fishing nets. Its chief properties seem to be the very great strength of the fibre, and the fact that it grows without irrigation. Specimens have been shown at various Russian Exhibitions, but the Government only took serious steps to procure any large quantities in 1894, and in the following year it was used successfully in the manufacture of Russian paper money.

"With the seed brought back in 1894, sowings were made in various parts of Russia, and these gave good results at Poltava, where the plants grew to a height of 4 feet in two years. In a wild state it reaches a height of 6 feet, growing best when on a hill-side near a river, sufficiently low to benefit by the spring floods. I enclose a small sample of seed, and some flax from the autumn crop ; that gathered in the spring is of a lighter shade."

The seed sown at Kew germinated this summer and yielded four plants. From these it was possible to identify the species as *Apocynum venetum*, L., of which A. sibiricum is a synonym. (See *Journal Linnean Society*, xxvi., p. 98.)

In the *Flora of British India*, iii., p. 657, *Apocynum venetum*, L., is described as an undershrub with slender cylindrical stems and branches. Leaves 2–3 inches long by $\frac{1}{2}$–$\frac{3}{4}$ inch broad, linear oblong or oblong lanceolate, entire or crenulate; nerves very slender; petiole very short. Flowers in small, erect, sub-corymbose cymes; bracts subulate, $\frac{1}{8}$ inch diameter, purplish, puberulous. Fruit consisting of two long, slender follicles. The plant is distributed from Southern

Europe to Asia Minor, through Siberia and Northern India to Mandshuria and Japan.

The following account, with a plate, is given by Dr. J. E. T. Aitchison, C.I.E., in the *Transactions of the Linnean Society*, 2nd Ser. Bot. iii., p. 87, t. 37, on the Botany of the Afghan Delimitation Commission of 1884–85 :—

Apocynum venetum, *Linn.* ; *Boiss. Fl. Or.* iv. p. 48 (plate xxxvii.).

Badghis : 115, March 5, 1885. Native names : Dumb-i-roba, Kundar, Dumb-i-gosalla. Common in beds of streams and in marshy localities at Gulran, at an altitude of 2,000 feet. Stems about 4 feet high, springing from a creeping rootstock, and terminating in a panicle of flowers. The annual stems remain attached to the rootstocks, but by the action of the wind they are soon reduced to their fibrous element, and this is found in bunches, having the appearance of artificial preparation. My attention was attracted to them by the seed-vessels still persistent on the battered branches. The fibre is a most excellent one, and the wonder is, as the plant seems to be common from Eastern Europe to China, that it has not heretofore been employed in manufactures. The bark of the creeping rootstocks is employed in tanning the leather skins used as water bottles.

Roots of this plant were sent to Saharumpore, whence we received flowering specimens for the Herbarium at Kew.

A more detailed account of the plant had previously been received from Dr. Aitchison.

Dr. J. E. T. Aitchison to Royal Gardens, Kew.

Dear Sir Joseph Hooker, Gulran, 8th March, 1883.

Since I wrote last to you only a couple of days ago, I have come across a find—an Asclepiad, a fibre plant that grows in marshy land, amongst loam with sweet water, about 5 feet high, annual shoots from a woody rootstock, and great creeping thick roots.

I first of all noticed the shrub-like plant in good seed, and the seed flying about out of a pair of very long pods that belong to the Apocynaceæ, the seeds with silky plumes. On examining the stems, bundles of several years' collected together, the bases were covered with a mass of what looked like tow (naturally exfoliated from the standing stems by rubbing against each other during a wind), very silky, and a good fibre. This natural tow, with the fruits and seeds, I have sent you by sample post. The natives of the surrounding parts, especially the Turcomans, say that ordinary twine and rope is made from the fibre, but that a tribe of Turkomans, called Kayák, east of Bokhara, who live at a place called Kallá, manufactured cloth from this fibre. The natives here call that cloth Katán. The plant is called Dũmb-e-robá (tail of fox), or Dúmb-e-Gósallá (tail of calf), this name, no doubt, due to the fluffy seed.

The bark of the rootstock is employed for tanning, or rather preparing, skins to hold water, and it is known as "Gao-gosh" (cow's ear). These skins become red in preparation and waterproof.

A Russian traveller, Prejevalsky, mentions a cloth being made at Lobnor, in his travels, from an Asclepiad.

As I think it is likely to turn out a good thing, I have sent to Saharunpore a large number of the roots, which were just showing eyes like potatos, and hope they may succeed. I have no doubt, if you have Prejevalsky's species, that you will be able to recognize my plant

from the fruit. This is nearly 5 inches long, and not thicker than ¼ inch. With the seeds, you will be able to raise some plants. The roots during winter are covered with water, and in summer I should say are almost dry. It is in immense quantities in this vicinity, only in marshy ground. The natives call the cloth Katán, but this is the Persian name for linen and hemp fabrics indiscriminately. We would require to get the true Turki name.

Forsyth, in his Yarkand report, mentions a cloth called "Luf." I feel sure this is the same. Native information said it was produced from a plant that had a fruit like the Liquorice.

The annual shoots, growing in March and coming to perfection during the summer, would lead one to suppose it might do well in India. The fibre I have sent you is merely what I collected on the stalks, but, of course, if collected at the proper season, it would be of much better quality—as it is, it is very good.

I am, &c.

(Signed) J. E. T. AITCHISON.

XVIII.—STREBLUS PAPER.

(*Streblus asper*, Lour.)

[K. B., 1888, pp. 81–84.]

The preparation of paper and even cloth from the bark of the Paper Mulberry (*Broussonetia papyrifera*) is a circumstance which is well known. Various specimens, illustrating the uses of the bark of this plant, exist in the Museums of Economic Botany at Kew from China, Japan, and the Pacific Islands. It appears that in Siam paper very similar in character to that prepared from *Broussonetia*, is obtained from *Streblus asper*, Lour. This latter is a tree widely distributed throughout India, Ceylon, and tropical Asia, where it is known under a variety of native names. It does not appear, however, that it is used for paper making to any appreciable extent in any country except Siam.

The following correspondence, which has taken place between this establishment and the Foreign Office, contains practically all the available information on the subject :—

"Kew, 25th April 1887.

"I HAVE the honour to inform you that I observe in the Paper "Makers' Monthly Journal an account, based on information acquired "by the late Sir Richard Schomburgk, of the manufacture of paper in "Siam from the bark of *Streblus asper* (otherwise *Trophis aspera*), "a tree locally known as Ton-Khoi.

"It is stated that legal documents and Government correspondence "are written on paper made from this material. Black paper, written "upon with talc, is also stated to be used for rough drafts.

"The tree is a common one in the East generally, and it therefore "seems worth while to obtain some information about its use in the "manufacture of paper. The Museum of the Royal Gardens possesses "no specimens illustrative either of the raw material or of the product "derived from it.

"I venture, therefore, to express the hope that the Secretary of "State will approve of the kind offices of the Minister Resident at

"Bangkok being invited to assist this establishment in procuring "specimens (1) of the raw material in its several stages; (2) of any "characteristic implements employed in in the manufacture; (3) of "finished samples of the paper.

"It would also be desirable that the collection, if made, should be "accompanied by a dried specimen of the foliage, and, if possible, "flowers of the tree, in order to make the identification perfectly "secure. Any moderate expense incurred will be defrayed by this "establishment in usual course.

"W. T. THISELTON-DYER."

"Foreign Office, 10th December 1887.

"WITH reference to your letter of the 26th instant, I am directed by "the Marquis of Salisbury to transmit to you a despatch from Her "Majesty's Chargé d'Affaires at Bangkok, forwarding a report of the "manufacture and uses of Ton Khoi paper.

"P. W. CURRIE."

"Bangkok, 28th October 1887.

"IN obedience to instructions contained in your Lordship's "despatch, No. 21, of 29th April 1887, I have now the honour to "enclose a report, prepared by Mr. Beckett, Student Interpreter of "this Legation, with regard to the manufacture of paper from the bark "of the tree called 'Ton Khoi.'

"Under my direction Mr. Beckett has made several visits to a "village where the paper is manufactured, and has procured as many "as possible of the specimens required by the authorities at Kew "Gardens.

"These specimens have been placed in two cases addressed to "Kew.

"E. C. GOULD."

"TON KHOI," ITS MANUFACTURE AND USES.

Mr. French, in his commercial report for the year 1885, in describing the process of the manufacture of native paper, writes as follows :—

"Native paper is manufactured out of the bark of a tree called "'Ton Khoi.' The process of manufacture is simple. The smaller "branches of the trees are cut, and steeped in water for two or three days. "The bark is then stripped off, and brought in bundles and sold to "persons who make the paper. The bunches of bark are put in water "for two or three days by the paper maker, and, having been cleansed "from dirt, are taken out and steamed over a slow fire for two days, a "little clean stone lime being sprinkled through the bark. It is then "steeped in water in earthen jars, and more lime is added. After a "few days it is taken out of the jars, and, having been well washed to "free it from the lime, it is beaten with a wooden mallet [for about "two hours] until it becomes a mass of soft pulp. A frame of netting "about six and a half feet long, and of width varying from eighteen "to five inches, is set afloat in water, and the pulp, having first been "again mixed up in water, is skilfully poured out on to the frame so "as to be equally distributed over it. The frame is then lifted out of "the water, and a small wooden roller is run over the surface of the "pulp. By this process the water is squeezed out and the pulp pressed

"together. The frame with the pulp on it is then set to dry in the "sun. In the course of some ten hours it is quite dry, and the sheet "of paper can then be lifted off the frame. It now only remains to "smooth the surface. This is done by applying a thin paste of rice "flour to the surface, and then rubbing it down with a smooth stone.

"A black paper, which is written on with a slate pencil, is made by "colouring the surface with a mixture of charcoal."

The process of the manufacture having been thus described, some additional facts regarding the tree itself, and the various uses of the paper may prove of interest.

The place at which most of the native paper industry is carried on lies on the left bank of the River Mënam, between six and seven miles from Bangkok, consisting of a cluster of attap houses built on piles over the river and a creek which runs through their midst.

The average height of the "Ton Khoi" is about 30 feet. The branches grow in an irregular and straggling manner. The leaves are dark green in colour, oval in shape, and acuminated, with a serrated edge. The petiole of the leaf is very short, the venation is reticular, and there is but a single midrib.

The fruit, which is ripe during March and April, is small and dry, and is not put to any use by the natives of Siam.

The bark, in addition to being employed in the manufacture of paper, is used by native doctors for medicinal purposes. It is boiled with a large portion of salt, and, when reduced to a pulpy state, it is supposed to allay pain, especially in the teeth, when applied internally to the affected part.

The native name for the frame of netting into which the pulp is poured is "Phaneng," the price of which is one tical (2*s*.). The price of a sheet of the paper, as it is taken off a frame, $6'\ 1\frac{1}{4}'' + 1'\ 11''$, is one fuang, equivalent to 3*d*. English money.

A paper of a thinner texture is also manufactured, the fineness of the texture depending on the greater or lesser admixture of water with the pulp of the "Ton Khoi" bark when placed in the frame of netting. This thin paper is now falling into disuse, and is gradually being relegated to remote districts of Siam, and to use by the poorer classes.

The black paper mentioned in Mr. French's Report, and of which also specimens and samples are enclosed, is made of the outer and darker peelings of the bark, whilst the white is produced from the interior lining. The paper made of the outer peelings, after undergoing the same process as the white, is smeared with a liquid mixture obtained by boiling the charcoal of the tree or shrub called "Ton Sanoh" with a certain quantity of rice. When folded in the shape of books of the better quality, the paper is usually covered with a double coating of this mixture.

The "Ton Sanoh" above mentioned is a shrub growing to the height of some 8 or 10 feet, and is of a pithy nature.

The method of writing on white paper is either by the use of a European pen and ink, or, better, by means of a native pen formed of a small piece of split bamboo, hollowed along the centre, and tapering to a point. This latter is used with Chinese ink (the same as Indian ink), which is sold in sticks at prices varying from $1\frac{1}{2}d$. to 6*d*. a stick. To write permanent characters on the black paper requires a no mean degree of skill and practice. The pen used is the same as the one used for writing on white paper, the liquid employed being a mixture of lime either with the sap of the "ton makhuit" (a species of gum) or with a kind of chalk called by the natives "horadan." After the

writing has been impressed on the paper, the whole is smeared with a coating of varnish obtained from the "ton jang," in order to fix the characters and prevent erasures.

The black books are extensively used in the native law courts for the taking of evidence, &c. The evidence is written down by means of a chalk or steatite pencil, and is capable of easy erasure should any emendations be required. It is then read over to the witness or other person, as the case may be, and bound round with string, a seal of mud being affixed on the centre, in order to prevent the opening of the document until it is required at the trial. The witness then makes a mark in the mud seal with his nail, or, according to a more recent custom, is given a small wooden seal, with which he stamps the mud, and which he carefully preserves for the day of trial.

A scale of prices of the various kinds of paper sold is subjoined, the numbers corresponding with the numbers docketed on the samples forwarded, viz. :—

						s.	*d.*
Book	No.	I. (white),	equal to	5	phanengs*	=1	3
,,	,,	II.	,,	4	,,	=0	9
,,	,,	I. (black)	,,	5	,,	=2	0
,,	,,	II.	,,	2	,,	=0	4½
,,	,,	III.(unfinished),	,,	4	,,	=0	9
,,	,,	IV. (inferior quality)				=0	2

Samples of the bark in its different stages of manufacture are also forwarded, numbered and marked according to the successive stages through which it passes before its appearance in paper form ; also specimens of the leaf, and of such other objects that bear upon or illustrate the manufacture of native paper as I have been able to procure.

W. R. D. BECKETT.

The specimens illustrating the industry which have been deposited in the Kew Museums are as follows :—

Section of trunk of tree ; a frame of netting ; native books, white and black ; samples of material in various stages of preparation ; hammer for beating bark ; a mixing pot, with pigments and pens for writing.

SIR, Kew, 30th December, 1887.

I HAVE the honour to acknowledge the receipt of your letter of December 10th, transmitting a despatch in original (herewith returned) from Her Majesty's *Chargé d'Affaires* at Bangkok, forwarding a report on the manufacture and the uses of paper from *Streblus asper*.

The cases of specimens have been duly received. The collection is extremely interesting and instructive, and the objects transmitted are a very desirable accession to the museum of this establishment, where this curious industry has hitherto been wholly unrepresented.

I venture to express a hope that the Secretary of State will be pleased to convey to Mr. Gould an intimation of his satisfaction at the courteous and very intelligent manner in which Mr. Gould has assisted this establishment.

It is proposed to publish the report in an early number of the *Kew Bulletin*.

Sir Philip W. Currie, G.C.B. W. T. THISELTON-DYER.

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* Or sheets.

XIX.—CANADA NETTLE FIBRE.

(*Laportea canadensis*, Gaudich.)

[K. B., 1897, p. 430.]

A nettle-looking plant was received last year from the *Jardin d'Acclimatation* at Paris, under the name of *Bœhmeria candicans*. It was said to afford fibre superior in quality to China-grass (*Bœhmeria nivea*), or rhea or ramie (*B. tenacissima*), and its cultivation has been recommended in Southern France, Algiers, Egypt, &c. Fortunately, the plant on arrival at Kew was in excellent condition and in flower. Upon examination it was found to be not a species of *Bœhmeria*, but a well-known new-world species, *Laportea canadensis*, extending from Canada to Florida and Mexico, and westward to the Rocky Mountains. The fibre yielded by this plant was at one time largely used; latterly it has been almost entirely forgotten. In Hooker's *Flora Boreali-americana*, Vol. II. (1840), p. 142, it is stated, "the fibre of the stem "is copious and strong, and Mr. Whitlaw endeavoured to recommend "it to this country as an article of commerce." Later, in 1865, the Abbé Provancher refers to it in his *Flore Canadienne*, p. 516, under the name of *Ortie du Canada*, or Canada Nettle, and adds:—"Sa "culture a été tentée en Europe pour sa fibre, mais ses avantages réels "sont encore doutés."

It is well known that many members of the nettle order are capable of yielding fibre. Even the common English stinging nettle (*Urtica dioica*) is a very ancient fibre plant, its inner bark affording a tough fibre suitable for many purposes, and used for cordage and coarse cloth. A lace parasol cover partly made from this fibre is in Museum I., Case 102. A series of yarns prepared from the same plant, and variously coloured, were brought to Kew by Mr. B. Gray, of Glenanne, Ireland.

In the *Descriptive Catalogue of Useful Fibre Plants of the World*, by Mr. C. Richards Dodge, recently issued by the United States Department of Agriculture, the following note (p. 213) appears respecting *Laportea canadensis*:—"The fibre of this species, before "the introduction of cotton, had an application more extensive than at "present in Europe, where, particularly in Germany and in more "northern countries, they manufactured the cloth called *ortica* (German, "*nesseltuch*), or nettle cloth."

It may, therefore, be safely assumed that the Canada nettle possesses no special merit as a fibre plant compared with China-grass or ramie. Further, as it possesses stinging hairs, it is difficult to handle.

XX.—URERA FIBRE.

(*Urera tenax*, N. E. Br.)

[K. B., 1888, pp. 84–85.]

The fibres exhibited in the Natal Court at the late Colonial and Indian Exhibition attracted a good deal of attention. Unfortunately the labels had become misplaced in transit, and consequently the collection did not offer such facilities as could be desired for detailed investigation. It is now clearly established, however, that a fibre marked

"*Hibiscus*," which attracted chief attention, was really what is known in Natal as Native hemp, possibly a local form of *Cannabis sativa*. In the Official Reports, p. 378, it is stated by Mr. C. F. Cross, "that the "yarn prepared from this fibre was of a greyish colour, bleaching easily "under the ordinary treatment to a full white. It was remarkably "soft to the touch, more nearly resembling an Angola yarn than flax "or cotton. This fibre has been submitted to flax spinners of expe- "rience, and from inspection, together with the results of laboratory "investigation, they have formed a high estimate of its value."

Mr. J. Medley Wood, A.L.S., the indefatigable Curator of the Botanic Gardens at Durban, to whose zeal and co-operation we are indebted for the elucidation of many problems connected with the flora of Natal, mentions that his native hemp grows vigorously to a height of six feet or more, and that it lends itself readily to the exigencies of culture.

The next most interesting fibre exhibited in the Natal Court appears to have been forwarded by Mr. J. Kirkham, of Umzinto. It was stated by Mr. Wood to belong to the natural order *Urticaceæ*, but he had at that time been unable to obtain either fruit or flowers, and it was unrepresented in the herbarium at Durban.

Of the nettle family in Natal he states :—

"There are several indigenous species, some of which attain a "height of over 20 feet, with a pithy semi-herbaceous stem eight "inches in diameter. Others are more or less dwarfish, being but half "an inch thick and four to five feet high. The barks of all are highly "prized by the natives on account of the strong cord or thread they "make, in their own rude manner, from the fibre contained therein. It "is known to them by the name "*imbogo sempi*."

In a letter dated 23rd August 1887, Mr. Wood writes :—

"By this post I send flowers of my No. 3,837, which appears to be a "*Urera*. It is a shrub about 8 to 10 feet high or more, and is, I "think, the plant producing the fibre which was said to be the second "best fibre shown at the late Colonial and Indian Exhibition.

"The plant is not uncommon in the midland districts, but this is "the first time that I have seen the flowers.

"It will be important I think, to ascertain whether its fibre is "really of value ; it grows readily from cuttings, and could be grown "in quantity if found to be payable."

Again on the 23rd November :—

"I have collected a quantity of seed for distribution, also staminal "flowers, of my No. 3,837, *Urera sp.*, but I am afraid that they are "scarcely recognisable. A specimen of bark shall be sent by next "week's post. I should like to have sent a larger quantity, but the "messenger I sent said that the trees had been stripped by the natives, "who use the bark for making their sleeping mats. I am having the "plant propagated here, in case it may be in demand."

On investigation at Kew, the plant sent by Mr. Wood proved to be a new species, which has been described and figured in the *Icones Plantarum* as *Urera tenax*, N. E. Br.

The bark, as sent here, appears to resemble in many respects that of uncleaned Ramie or Rhea (*Boehmeria nivea*). The fibre is, however, more brittle and not so lustrous as the best specimens of China grass. Unfortunately the sample hitherto received does not admit of this new fibre being treated in an exhaustive manner. It is quite possible that

an indigenous plant of this character may be better suited to the circumstances of Natal than the China Grass. On receipt of a larger sample, it will then be possible to investigate its merits in an exhaustive manner.

XXI.—RAMIE.

(*Boehmeria nivea*, Hk. & Arn.)

[K. B., 1888, pp. 145–149.]

The plant known under the several names of China Grass, Ramie, or Rhea, belongs to the natural order, *Urticaceæ*, and hence it is not a grass at all, but a species of nettle, somewhat resembling, in appearance and habit of growth, the common nettle of Europe.

The China Grass plant, first known and long cultivated by the Chinese under the name of Tchou Ma, is the *Boehmeria nivea* of botanists. The specific name, nivea, was given to it on account of the white appearance on the under-side of the leaves. A plant called in Assam, Rheea, and in the Malay Islands, Ramie, was believed by Roxburgh to be distinct from the Tchou Ma of the Chinese, and it was named by this botanist *Boehmeria* (*Urtica*) *tenacissima*. In this plant there is an absence of the white felted appearance on the under-side of the leaves, so characteristic of the China Grass plant, but in all other respects the two plants are identical in their botanical characters.

For purposes of classification, the Tchou Ma, or China Grass plant, *Boehmeria nivea*, may be accepted as the typical species, and the Rhea or Ramie, retained as a geographical variety of it, under the name of *Boehmeria nivea* var. *tenacissima*. This latter is sometimes known as the Green-leaved China Grass, a name which may be conveniently retained for it.

The fibre yielded by these plants has been long recognised as pre-eminent amongst vegetable fibres for strength, fineness, and lustre. Hence numerous attempts have been made to cultivate them, and to prepare the fibre in large quantities for commercial purposes. The plants are exceedingly easy of cultivation, and thrive in all soils, but preference should be given to those of a light loamy character. It is essential that the climate be moist and stimulating, in order to produce abundant and frequent crops of stems. The plants may be raised from seed, but the more ready method is by root or stem cuttings. The roots being perennial, the stools become stronger and more vigorous every year, and from these fresh sets are easily obtained for extending the cultivation.

Numerous attempts have been made during the last 10 years to extract the valuable fibre which exists in this plant. The experimental processes hitherto employed may be briefly classed as either mechanical or chemical. In the first, it has been sought to extract the fibre from the green stems by means of rapidly revolving beaters attached to a drum driven by steam power. In some cases, water is used to wash the fibre while under the beaters. The chief difficulty experienced in this method is the small quantity of fibre cleaned per day. This has enhanced the cost to such an extent as to render the process practically

unremunerative. In the chemical processes, the Ramie stems are treated green or dry. The object sought is to treat the stems either under great pressure with steam or with chemicals, so as to dissolve the gum in which the individual fibres are immersed. After being thus treated, the fibres are easily detached from the stems by hand or by machinery, and are sent to market in the form of ribbons. The question of cost is here also very important, and it is felt, under present circumstances, that China Grass can only be satisfactorily grown and prepared where there is an abundance of cheap labour.

It is a fact universally known, that the fibre of the China Grass is one of the finest and strongest known. If a process could be devised that would extract and clean the fibre at a cheap rate, the results would prove of the greatest possible interest to all our tropical colonies. The China Grass plant can be grown as easily as the sugar cane, but in spite of many years of continuous effort, the problem how to prepare the fibre on a large scale, and place it in the market at remunerative rates, is apparently still unsolved.

We gather from the numerous applications made to Kew for information, that interest is still maintained in the utilisation of China Grass or Ramie, and under these circumstances it is felt to be desirable to place on record the latest facts that have been gleaned respecting the present position of the industry.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, April 16, 1888.

I AM desired by Mr. Thiselton-Dyer to inform you that considerable interest is being taken in British Colonies in the culture of the Ramie plant, known as Rhea and China Grass (*Bœhmeria nivea*).

2. Hitherto the industry has not assumed large proportions anywhere, owing to the want of a thoroughly suitable machine to prepare the fibre.

3. In the Foreign Office Report, for the year 1887, on the agriculture of the Barcelona district [No. 275, Annual Series, 1888], Mr. Consul Wooldridge states, that in the province of Cataluña, "Machines are "already in use, capable of decorticating the [Ramie] fibre on a "profitable scale."

4. Mr. Thiselton-Dyer is of opinion that it is very desirable to obtain from Mr. Wooldridge the names of the makers of the machines which appear to have successfully solved the problem of decorticating Ramie stems. Any particulars he could add as regards the cost of the machines, the power necessary to drive them, and the out-turn of clean fibre per day, would prove of the greatest possible interest to planters in our tropical Colonies.

I have &c.

Sir T. Villiers Lister, K.C.M.G. (Signed) D. MORRIS.

Mr. CONSUL WOOLDRIDGE to the MARQUIS OF SALISBURY.

MY LORD MARQUIS, Barcelona, April 25, 1888.

I HAVE the honour to acknowledge the receipt of Sir James Fergusson's despatch, of the 19th instant, on the subject of the machines used in Cataluña for decorticating the stalks of the Ramie plant; and I am directed to report to your Lordship the names of the makers of the machines, and to give any further particulars which might prove of interest to planters in British tropical colonies.

Although the Ramie plant has been cultivated for many years in the north of Cataluña, it is only within the last two years that, through the invention of a decorticating machine by Monsieur Favier, member of the "Société La Ramie Française," it has been brought before the public. M. Favier has a factory, called the "Fabrica Favier," at Torroella de Montgri, in Gerona, in the vicinity of the Ramie plantations, where his decorticating machines are at work.

These machines are used to decorticate the stalks in a dry state, after having been cut and exposed to the powerful rays of the sun for 48 hours, as experiments and practice show that the operation on the green Ramie is impracticable.

It appears that M. Favier has been the first to solve the problem of decorticating Ramie with success; and, according to Professor Obiols, his machine leaves nothing to be desired; and of this invention the "Centralblatt," of Berlin, in its number of January 23, 1883, says:—
"Although the use of the Ramie, as a textile plant, dates from time "immemorial, the separation of the fibre from the stalk has been found "hitherto so surrounded with difficulties that no hope existed of any "considerable extension in its use; however, since M. Favier has dis-"covered a machine for the purpose of separating the fibre, a real "revolution has been produced in the industrial world, and the "cultivation of the Ramie plant has taken extraordinary proportions."

Another decorticating machine, similar to the Favier one, has, however, been invented by a Monsieur Billion, of Marseilles, who obtained a patent for it in Spain, but, being considered by M. Favier as a piracy, the latter prosecuted M. Billion, who eventually came out triumphant; and, although this machine has not been used in Spain, some persons consider it to be superior to the Favier one.

Full descriptions are given of these machines in Professor Obiol's pamphlet (in Spanish), and can be purchased for a few pesetas.

The Billion machine can produce 300 kilogrammes of fibre a day, showing an advantage over the Favier one.

The Favier machine is not for sale to the public, the inventor preferring to establish factories near the plantations and purchasing the produce from the agriculturists, and decorticate and manufacture threads, &c., himself, as the "Société La Ramie Française" is doing at Torroella. Neither, I believe, is the Billion machine to be acquired for money.

There is another machine, known as the "Agramadera (flax-dresser) Kaulek," invented by M. Kaulek, of Paris. Its size is a cubic metre, and it requires half a horse-power to put it in motion, and can be worked by the arm, by a windmill, or by steam. It is portable, weighs 350 kilos., and its price is 2,000 fr. (80*l.*). It has been known to produce 175 kilos of commercial Ramie, in ribbons, in 10 hours.

Another machine has been invented in Barcelona by Don Demetrio Prieto for extracting fibre from textile plants, and many of his machines are in use with success, in Mexico. The inventor is about to introduce certain modifications in this machine, in order to adapt it to the decortication of the Ramie plant. (*See* Art. LV. later.)

The personnel required to work the Favier machine, and the cost per diem (in Cataluña), are as follows:—

	Pesetas	c.
Two men to separate the extremities of the stalks -	0	75
One man to introduce the stalks - - - -	1	50
One man to receive the fibre - - - - -	1	50
One man to supply the stalks to the introducer -	0	75
	5	25

or about 4*s.* per day for each machine ; and for, say, a 1,000 kilos. of dry stalks the proportional out-turn would be as follows :—

50 kilos of extremities, or 5 per cent. of the whole weight.
190 kilos. of fibre, or 20 per cent. of the whole weight.
570 kilos. of wood.
100 kilos. of pellicles, and
90 kilos. of loss.

Yet the wood, extremities, and pellicles may all be utilized.

Taking the working of 20 of Favier's machines, which would require about 10 horse-power of steam, the expenses and profits result as follows :—

Cost of installation, 120,000 pesetas, or francs, each machine costing 6,000 fr., with the necessary capital of 60,000 fr.

Actual cost of stalks of Ramie (in Spain), 100 pesetas per 1,000 kilos ; each machine decorticates 216 kilos. per day.

Expenses.

	Pesetas	c.
4,320 kilos. of stalks - - - -	432	00
Labour - - - - - -	108	00
Incidental expenses - - - -	122	00
Total - - -	662	00

Products.

5 per cent. of extremities - - -	10	80
20 per cent. of decorticated stalks, or 864 kilos of fibre - - - - -	864	00
57 per cent. of wood - - - -	61	50
10 per cent. of pellicles - - - -	17	20
9 per cent. of loss.		
Total - - -	953	50
Total products - - - - -	953	50
Total expenses - - - - -	662	00
Clear profit - per day	291	50

or 117,150 pesetas per annum of 300 days of labour, which represent approximately 48 per cent. of the capital.

The Favier machine has the advantage of extracting the fibre and making the threads clear of gum, for in the raw Ramie which comes from China and India there is so much gum that it is most difficult to cleanse. These machines, as I said before, are not yet within the reach of agriculturists, that of M. Favier being used by the inventor, and that of M. Billion having ceased to work in Spain.

I have, &c.
(Signed) FRANK WOOLDRIDGE.

XXII.—RAMIE—(*continued*).

[K. B., 1888, pp. 273–280.]

The subject of the utilisation of the Ramie plant (*Boehmeria nivea*, Hk. & Arn.) is one which has been closely followed at Kew for many

years. The importance of the subject in India and the Colonies has led to considerable correspondence being addressed to this establishment. Specimens of Ramie stems, grown at Kew, have been supplied, as far as practicable, for experimental purposes in this country, and the *Bulletin* for June 1888 (pp. 145–149) gave a summary of information on the subject.

Recently the French Government undertook a series of trials of methods for preparing Ramie fibre, and on behalf of the India Office, Mr. D. Morris, F.L.S., the Assistant Director, was appointed to attend these trials and prepare a report of the results. This report, with the permission of the India Office, is reproduced below :—

Kew, October 24, 1888.

In the French *Journal Officiel* of the 13th of April last there appeared a ministerial order approv ng an International Competition of Methods (mechanical and chemical) for preparing the fibre of the Ramie plant. The order was based on the fact that considerable interest was taken in the cultivation of the Ramie plant in Algeria and French Colonies generally, and that it was a matter of national importance to solve the problem of preparing Ramie fibre so as to bring it within the reach of commercial enterprise.

The competition was, in the first instance, fixed for the 15th August, but it was afterwards postponed to the 25th September on account of the unfavourable season which had been experienced for the growth of the Ramie plant intended to be used in the trials.

Importance of the Ramie Question.

It is well known that the production of the fibre of Ramie in commercial quantities, and in an economical and remunerative manner, has constituted one of the most important industrial problems of the present day. It has been keenly followed in nearly every part of the world ; but the chief efforts hitherto made have been confined to India, to the West Indian Colonies, to the United States, and more recently to France and her Colonies.

The Government of India, nearly 20 years ago, was led to offer a reward of 5,000*l*. for the best method for preparing Ramie fibre and presenting it in a suitable condition for textile purposes. It was led to this step by the conviction that the only obstacle to the development in India of an extensive trade in Ramie fibre was the want of suitable means for decorticating the plant. This was the third time that Ramie had become the subject of official action. The first effort for utilising this plant was in 1803, when Dr. Roxburgh started the question ; the second was in 1840, when attention was directed to it by Colonel Jenkins. The offer of 5,000*l*. in 1869 induced many competitors to enter their names, but it was found that no machine fully fulfilled the conditions laid down by the Government, and therefore the full prize was not awarded. Other unsuccessful attempts were subsequently made, and eventually the offer of 5,000*l*. was withdrawn.

Since that time many thousands of pounds have been spent upon the Ramie plant, and the aid has been invoked of both mechanical and chemical science to solve the problem connected with decorticating the fibre. Many processes have been brought forward from time to time, and it was claimed for each of them that they had fully realised the hopes of their inventors. But promising as some of these processes were, they do not appear to have been introduced into regular use, and only one or two have at all come into prominence.

Naturally the earlier attempts to prepare Ramie fibre had followed the methods already in use in preparing flax, hemp and jute ; but it was soon evident that as regards Ramie these methods were useless. The fact that the fibre of the Ramie plant is embedded in a gummy substance offered the greatest obstacle to the production of clean and bright threads suitable for the spinner.

Arrangements for the Paris Trials, 1888.

The *Concours International de la Ramie*, recently held at Paris, took place in one of the annexes of the proposed exhibition of 1889 on the Quai d'Orsay (Place de l'Alma). It was attended by representatives from all parts of the world.

It was evident that the proceedings were watched with considerable interest by inventors, no less than by persons directly interested in the cultivation of the Ramie plant. Very complete arrangements had been made beforehand by the French Ministry of Agriculture. Steam power was provided and a large supply of green stems (of the white-leaved *Boehmeria nivea*) had been grown in the neighbourhood of Paris ready for the trials. Dried stems had been obtained from Algiers, while to test the chemical processes, a quantity of Ramie ribbons were available ready to be converted into filasse.

The commission of jurors included M. Tisserand, Councillor of State and Director of Agriculture, a number of prominent engineers, chemists, and botanists (including the Professeur de Culture of the Jardin des Plantes), and the Director of Agriculture in Algiers. They were evidently men who were acquainted with the economical problems connected with the cultivation and utilisation of the Ramie plant, and the trials were conducted in a systematic and exhaustive manner.

List of Prizes Offered.

Prizes had been offered by the French Government in the following five categories :—(*a.*) For a machine to decorticate Ramie in a green state, driven by steam power, 1st prize, 1,000 fr., 2nd prize, 700 fr. ; (*b.*) For a machine to decorticate Ramie in a dry state, driven by steam power, 1st prize, 1,000 fr., 2nd prize, 700 fr. ; (*c.*) For a machine of a light and portable character driven by horse power, and suitable for use in the Colonies, 1st prize, 700 fr., 2nd prize, 500 fr. ; (*d.*) For a hand-power machine of a light and portable character, suitable for use in the Colonies, 1st prize, 500 fr., 2nd prize, 300 fr. ; (*e.*) For the best, and most economical process (chemical or otherwise) to convert the Ramie ribbons into commercial filasse suitable for the use of textile manufacturers, 1st prize, 1,000 fr., 2nd prize, 700 fr.

The entries previously made at the Ministry of Agriculture included 19 machines and 10 (chemical) processes. On the morning of the trials, only four machines and one chemical process were, however, submitted to the jurors.

The de Landtsheer Machine.

Taking the machines in the order in which they stood, the first was that invented by de Landtsheer, of Paris (Décortiqueuse de Ramie Systême de Landtsheer). The cost was stated to be 40*l.* This was driven by steam power, and required two men to attend to it. It had a horizontal feed plate, and consisted of a series of rollers and crushers, which received eight or ten stems at a time from the hands of the operator, and passed them on to be beaten by a pair of rapidly revolving

drums very similar in character to those found in the Death machine. In the de Landtsheer machine, however, there is a reverse action attached of an effective character. When about five-sevenths of the lengths of the stems had been cleaned, they are quickly returned by means of the reverse action to the hands of the operator, who then presented the uncleaned ends to the machine and completed the operation. The fibre in this case was only moderately well cleaned; there was considerable waste, and the actual amount of rather bruised ribbons was as follows: from dry stems, 5 kilos. per hour, and from green stems, 18 kilos. per hour. As the latter were weighed before they were dried, the calculations for dry ribbons would be about 6 kilos. If we take the result at $5\frac{1}{2}$ kilos. per hour of dry ribbons, the de Landtsheer machine would produce only 55 kilos. per day of 10 hours, equal to about 124 pounds avoirdupois. The commercial value of these ribbons at 7*l.* per ton would be 7*s.* 6*d.*

The inventor claimed for the de Landtsheer machine that it could produce 3 cwt. of dry ribbons per day. The small out-turn at the trial was attributed by him to the poor character of the stems supplied. There was some cause for complaint on this head, but in any case it was difficult to believe that this machine could produce, as worked at Paris, ribbons in commercial quality at a remunerative cost.

The Barbier Machine.

The second machine, known as Barbier's (Décortiqueuse Armand pour la Ramie et toutes les plantes textiles: Constructeur Paul Barbier, Paris), was very similar in construction to the de Landtsheer machine already described. The cost was the same, viz., 40*l.* It was also fitted with a reverse action. The feed-plate was horizontal, and the operator handled about 8 to 10 stems at a time. The fibre was somewhat severely bruised in cleaning. In the first trial with dry stems it produced 3·6 kilos. per hour of ribbons. With green stems it produced only 7·5 kilos. in 47 minutes. There was a large amount of waste, and owing to the fibre being pushed backwards and forwards between the revolving beaters, the ends were often badly tangled.

It was claimed by the inventor that this machine could treat 2,500 kilos. of green stems per day of 10 hours, yielding 125 kilos. (presumably of dry) ribbons worth 50 francs per 100 kilos.

A machine illustrative of the Systême Lassalle (constructed by H. Chasles, Paris) was on the ground, but it was unable to compete in the trials. For the purpose of this report it may be passed without further notice.

Machine of American Fibre Company.

The next machine was exhibited by the American Fibre Company, of No. 18, Broadway, New York, under the charge of Mr. Noble. This was on an entirely different plan from any of the fibre machines hitherto in use, and deserves a few words of description. The machine was about 4 ft. 6 in. long, and supported on standards about 5 ft. high. Above the machine was a wooden structure designed to receive the movable frames in which the stems were placed. The feeding was vertical from a frame containing about 30 stems placed above two wooden rollers working horizontally through the whole length of the machine. By means of a movable bottom in the feeding frame, the stems were dropped base-end downwards between the rollers, which slightly crushed them. While firmly held in the machine the stems

were pressed against a horizontally moving knife, which split them along their whole length. After this they were bent in such a manner that the woody portions were fractured and separated from the fibrous cuticle. The latter was ultimately delivered in two ribbons, one on each side of the machine. In this instance, all that was attempted was to separate the fibrous bark from the stems, and deliver the former in broad ribbons, almost intact. No attempt was made to remove the corky epidermis or separate in any way the constituent fibres. This machine was worked by steam power, and required three men to attend to it. The cost was not given. It was tried on green stems only, and produced at the first trial 7 kilos. of wet ribbons in 18 minutes. At the second trial it produced 12·8 kilos. of wet ribbons in 38 minutes. These results would be equivalent to 21 kilos. of wet ribbons per hour (or allowing one-third of the weight for dry ribbons) equal to about 15 pounds avoirdupois of dry ribbons per hour. It must, however, be borne in mind that the ribbons produced by this machine were simply the crude fibrous bark without any cleaning. The actual value of these ribbons would be very small; but if the machine had been capable of turning out half a ton, or even a quarter of a ton of such ribbons in a day, it would have possessed some value. The machine, as shown at Paris, it is needless to remark, was practically useless for commercial purposes.

The Royer Chemical Process.

The only chemical process for converting Ramie ribbons into filasse (or the beautifully white silky threads which Ramie is capable of yielding) for textile purposes was shown by M. Royer. This was described by the inventor as "Dégommage de la Ramie Brute: "Système E. Royer, Paris. Le traitement industriel complet de la "Ramie Brute par ce Système constitue une dépense de 10 à 12 fr. "par 100 kilos. de matière brute." The details of the process were not made known. The ribbons were laid horizontally in small portable wooden crates, and submitted to the action of certain chemicals in successive baths. Afterwards they were placed in an iron cylinder or closely fitting steam chest, and thoroughly exposed to the solvent power of steam at high pressure. The filasse produced was beautifully white in some cases, but in others it was mixed with portions of bark and discoloured. The system appeared to be laborious and costly. The jury was unable to arrive at a satisfactory conclusion as regards the merits of the process during the session of the trials between the 25th and the 30th September, but the general opinion of those present was not favourable to the process.

The actual trials commenced on the 26th September and closed on the 30th. The first day was devoted to trials with dry Ramie stems, the second to green Ramie stems, while the third was chiefly devoted to the chemical process for converting ribbons into fibre. On the fourth day the jury carefully examined the construction of the machines, tested by a dynamometer the powers necessary to drive each one, and in some instances retried the machines in order to correct or confirm the results already obtained.

Awards of the Jury.

As regards the awards of the jury, in a letter received from the Foreign Office, dated the 12th instant, enclosing a despatch from the English Embassy at Paris, it is stated that "since the International

"competition for machinery for, and methods of, decorticating Rhea "was held, the question of distributing prizes was duly taken into "consideration. But, according to the information conveyed to the "Embassy by the French Ministry of Agriculture, none of the "advertised prizes were given, the jury having only made the follow-"ing awards:—600 francs to M. de Landtsheer, 2, Place des "Batignolles, Paris; 400 francs each to the Compagnie Américaine "des fibres, 18, Broadway, New York, and to M. Armand, whose "machine was exhibited by M. Barbier, 46, Boulevard Richard Lenoir, "Paris.

"No report on the subject of the competition will be published in the "*Bulletin de l'Agriculture* before the issue of the November number "of that periodical."

These are, briefly stated, the results of the Paris trials on Ramie. That the results are unsatisfactory, and disappointing, and fall far short of the estimates of the inventors, there can be no doubt. It is probable that a fresh series of trials will be inaugurated next year in connexion with the Paris Exhibition of 1889; and if the value of the prizes is increased there will doubtless appear a larger and better representation of machines and processes.

The Favier System.

It will be noticed that there was no trial this year of the Favier system, which is in operation in Spain, and described in the *Kew Bulletin* for June 1888, pp. 145–149. Nor was there a trial of the Death machine (constructed by Death and Ellwood, of Leicester), which has been in use, experimentally, in many parts of the world. The Favier process is being worked privately, and is therefore not available to the public. The fibre hitherto produced has been exclusively used in France; but the quantity so far available has not been sufficient to base an opinion as to the permanency of the enterprise. M. Favier, who has long taken a deep interest in the Ramie fibre, was a member of the jury at the Paris trials, and the articles which he has contributed on the subject to the *Journal de l'Industrie Progressive* of October 7 *et seq.*, may be looked upon as embodying the views of one of the best informed of French experts on the present position of the Ramie question.

The Treatment of Dry as against Green Ramie Stems.

Amongst the French there is attached an importance beyond their value to machines for cleaning Ramie in the dry state. This has arisen partly, no doubt, from the fact that the Favier system, the only one which hitherto has obtained a measure of success, requires the stems to be dried before they are treated. An idea was also prevalent in France that in some parts of the country it might be possible for the farmers to grow one or two crops of Ramie, and cut and harvest the stems in summer and work them off at their leisure during the winter. If a machine were devised to treat Ramie successfully, it is improbable that France could compete with tropical and sub-tropical countries, where three or four crops of stems could be reaped in the year. This conclusion is now being gradually adopted in France, and the future exploitation of Ramie is treated as a question which more nearly concerns Algiers and the French tropical Colonies.

As regards India and our own Colonies, it is essential that Ramie machines should work upon the green stems, and not upon the dry. In

the rainy season, when the air is impregnated with moisture, to dry Ramie stems in the open air after cutting would be an impossibility. To attempt to dry by artificial means the enormous quantity of stems yielded even by a few acres would entail so much labour in handling, and so much expense for buildings and fuel, that it would be altogether a hopeless task.

The per-centage of crude fibre yielded by Ramie stems is estimated at about 10 per cent. If the stems must be first dried before they are treated, it would be necessary to handle, to cart in and cart out again from drying sheds, 100 tons of stems for every 10 tons of fibre produced. It might be suggested that harvesting the stems should take place in the dry season, when the conditions would be most favourable to drying them in the open air. This, unfortunately, would not be practicable. The stems grow best during the rainy season, and when once ripe they must be cut at once. Besides, it is evident that the sooner one crop is removed the better will be the prospects of the next. During the dry season the stems grow very slowly, and it has been noticed that such stems have short internodes, are very woody, and offer relatively greater resistance during the process of decortication.

Other Processes and Machines.

Of processes and machines not already mentioned, it is desirable to refer to one or two for the information of persons who may not otherwise become aware of them. In June of last year Mr. C. Maries, of Durbhungah, Bengal, forwarded a series of specimens of Ramie fibre in different states of preparation to Kew, and asked for an opinion upon them. It appeared that he had invented a machine, worked by two men in the field, capable of operating upon two or three hundred stems per hour. This machine simply separated the fibrous bark from the wood. The bark was then operated upon by other processes, and eventually it was deprived of gum and mucilage and worked into a tolerably fair fibre suitable for manipulation by textile manufacturers. This fibre was reported by Messrs. Ide and Christie to be "long, fairly cleaned Ramie "fibre, worth about 28*l.* per ton." The particulars of Mr. Maries's methods have not been made public; but we understand that a well-known firm of merchants in Calcutta has acquired the patent connected with them, and the system is now in course of being practically tested on a large scale.

In the columns of the *Times* there recently appeared an account of a machine invented by Mr. John Orr Wallace, and placed on view at the Irish Exhibition. This was termed a "patent scutching machine "for cleaning ramie, flax, hemp, &c." The apparatus is about 6 feet high by 4 feet wide, and 5 feet long. It consists of an upper feed table 36 inches wide, on which the stems are fed to three pairs of fluted rollers which deliver the stems downwards between five pairs of pinning tools, alternating with six pairs of guide rollers. The pinning tools somewhat resemble hand-hackles, and may be popularly described as very coarse wire brushes. They are attached to two vertical frames, to which a horizontal to-and-fro motion is imparted, and the pins interlace as the two sides approach. The fibrous material is drawn downwards by rollers which have an intermittent motion, and at each momentary pause, the pricking pins enter the material and are rapidly withdrawn from it. By degrees this curtain is delivered on to a sloping receiving table at the bottom of the machine, over which table the woody substance has previously passed to a receiver in a crushed and semi-pulverised condition, and perfectly free from fibre. This

machine, it may be mentioned, was not constructed for the special treatment of Ramie. In spite of this, however, it has cleaned Ramie in a fairly satisfactory manner, and the inventor claims that, with a few necessary alterations in detail, he will be able to treat the stems either green or dry, and produce clean fibre at the rate of 1 cwt. per hour. The machine can be driven by a two-horse power engine, and it requires two persons to feed and tend it.

Small quantities of Ramie stems grown at Kew have been successfully passed through the machine. It is proposed by the inventor, when he has completed the alterations, to submit this machine to a public test similar to that adopted at the Paris trials. For this purpose he states that a large supply of Ramie stems will be obtained from France.

There are some special advantages connected with this machine which deserve to be mentioned. In the first place the feed table is so large that at least 40 stems can be fed to the rollers at once. When the stems have been fully grasped by the rollers, the operator need not retain his hold upon them any longer. They pass on uninterruptedly through the machine, and they can be followed immediately by a fresh lot without the return action, which is an essential part of the treatment by the Death and the de Landtsheer machines. There is here a considerable saving in time, and there is also a complete absence of the rough usage to which the fibre is subjected in nearly all the purely mechanical processes which have hitherto come under my notice.

Personally, I am unable to express an opinion upon the Wallace machine. To say that it is more promising than any machine exhibited at the Paris trials is merely to affirm that it is not altogether a failure. When the machine is fairly tested on its merits, and it is worked continuously on large quantities of Ramie stems, the results will speak for themselves. Until this is done it is obviously undesirable to do more than draw attention to a machine which possesses considerable merit and which, with further improvements, may be rendered of service in the production of marketable fibre.

General Conclusions.

An eminent firm of brokers recently informed me: "There is no "doubt that Ramie is exciting great interest in many parts of the world, "and many people are experimenting with various processes for "extracting the fibre cheaply and quickly. We cannot say that any "results submitted to us up to the present time are quite satisfactory. "The fibre is either imperfectly freed from gummy matter, or the "process breaks down in the matter of cost or owing to the local conditions under which it must be carried on. We consider that no "system of preparation which cannot produce the clean, unbleached "fibre under 30*l.* per ton is likely to succeed in establishing this "article firmly in the estimation of English textile manufacturers."

This opinion expresses very briefly and clearly the conclusion at which I have arrived in connexion with the preparation of Ramie fibre. It is quite possible that some machine or process will eventually solve the problem, but at present the exploitation of Ramie, in spite of years of labour and the expenditure of large sums of money upon it, cannot be said to have yet emerged from the experimental stage.

D. Morris.

XXIII.—RAMIE—(continued).

(*Boehmeria nivea*, Hk. & Arn.)

[K. B., 1888, pp. 297–298.]

The difficulties attending the development of the Ramie industry appear to be not confined alone to preparing the fibre as detailed in the preceding pages. It is also found that those who have in a measure been successful in preparing the fibre in commercial quantities are disappointed with the reception this fibre has received at the hands of spinners and manufacturers. In a word, it is found that Ramie fibre when produced is practically unsaleable in the London market at the present time. A correspondent interested in Ramie estates wrote to Kew a short time ago:—

"We have spent much capital on Ramie, but as yet cannot see our "way to commercial success. We have produced excellent filasse, but "the cost has been far too great, and the chief difficulty seems to rest "not in the production of filasse, many systems [if the question of cost "is set aside] have accomplished this, but in the spinning of the filasse "into yarn. No British manufacturing firm appears willing to take up "this business except on terms that would practically give them the "monopoly; they also require a guaranteed minimum of raw material "which we cannot give."

In a subsequent letter the same correspondent states :—

"I am beginning to think that the only way to succeed with Ramie "is to follow M. Favier's system described in the *Kew Bulletin*, p. 148, "namely, to grow and treat it for a special purpose, and carry it right "on to manufacture. Then it will pay right well. At present the "filasse that would suit one manufacturer would be useless to nine "others, who would want it prepared differently."

Another correspondent, in a letter dated the 14th November, from a different point of view, appears to confirm the experience detailed above :—

"In the *Kew Bulletin* for June last there is an article upon Ramie "or Rhea fibre. Have you had any applications from, or can you put "me in communication with, any manufacturers who may be disposed "to take up this fibre as a speciality? I am interested in a works and "process for the preparation of Ramie filasse in the form similar to the "enclosed sample. With our present appliances we could undertake to "deliver it at from ten to twenty cwts. weekly. So far we have not "been able to find any manufacturers here so inclined, and the prepared "material has been sent abroad. If you can render me any assistance "it will be esteemed a favour."

Since the receipt of these letters Kew has been favoured by Messrs. Ide and Christie, the well-known firm of fibre brokers in the City, with a copy of their monthly circular dated the 15th November. In this circular, under the head of China Grass and Ramie, it is stated :—

"On the 31st ulto. a large parcel consisting of about 130 tons "ribbons and 20 tons Ramie or Rhea in various stages of preparation, "were put up for public sale, practically without reserve, and after "being widely announced. The prices realised, viz., 8*l*. to 9*l*. per ton "for the ribbons, and 20*l*. to 25*l*. for the filasse, were most disappointing, "and testified to the languid interest which this material possesses for

" the manufacturers of Europe. Considering the attention with which " planters in various parts of the world regard this material, and the " numberless processes and machines which inventors have set forth " for its manipulation, the result of this sale must be viewed as dis- " tinctly discouraging. It would almost appear as if no true demand " exists for this interesting fibre, and that, in the present attitude of " the manufacturing interest, the application of skill either to cultiva- " tion of the plant or extraction of the 'filasse,' is premature and " misplaced."

In order to understand the present condition of the Ramie industry it would be useful to adopt some kind of classification of the details connected with it. In the first place we have the mere business of cultivating the Ramie plant, and of producing stems with the fibre in the best possible condition. This is purely the work of the planter. Secondly, we have the process or processes necessary to separate the fibre from the stem in the form of ribbons and filasse. It is necessary for many reasons that this should be done either by the planter on the spot, or by a central factory close at hand. Thirdly, we have the purely technical and manufacturing process in which Ramie filasse is taken up by the spinners and utilized in the same manner as cotton, flax, and silk are utilized for the purpose of being made into fabrics.

For our present purpose we may take it for granted that the cultivation of the Ramie plant presents no insuperable difficulty. Also that if a suitable selection of soil is made, and the locality possesses the necessary climatic conditions as regards heat and moisture, there is no reason to doubt that Ramie could be grown to greater or less extent in most of our tropical possessions. As regards the second stage—in which is involved the decortication of the Ramie stems—the difficulty, as shown above, is by no means completely solved.

On this really hangs the whole problem. The third stage is disappointing and unsatisfactory, because the second stage is still uncertain; and being thus uncertain the fibre is necessarily produced in small and irregular quantities, and only comes into the market by fits and starts. It would appear that Ramie fibre differs so essentially from cotton and flax that it can only be manipulated and worked into fabrics by means of machinery specially constructed to deal with it. Owing to the comparatively limited supply of Ramie fibre hitherto in the market, no large firms of manufacturers have thought it worth while to alter the present or put up new machinery to work up Ramie fibre. If appliances, or processes for decorticating Ramie in the colonies were already devised, and the fibre came into the market regularly, and in large quantities—say hundreds of tons at a time—there is no doubt manufacturers would be fully prepared to deal with it. At present the industry is practically blocked by the absence of any really successful means of separating the fibre from the stems, and preparing it cheaply and effectively. This, after all, is the problem which has baffled solution for the last 50 years.

XXIV.—RAMIE—(continued).

(*Boehmeria nivea*, Hk. & Arn.)

[K. B., 1889, pp. 268–278.]

Readers of the *Kew Bulletin* will have noticed that considerable attention has been devoted in its pages to the subject of the present note. The previous history of Ramie or Rhea, and of the various efforts that have been made in recent years to render its valuable fibre available for commercial enterprise, have been already fully summarised. During the present year interest in Ramie appears to have become more and more general, and judging by the correspondence addressed to this establishment the subject is followed with keen interest at home as well as in India and the Colonies.

In connexion with the Paris *Exposition Universelle*, 1889, a special series of trials was held of machines and processes for decorticating Ramie (Exposition Universelle: Essais spéciaux de machines et appareils pour la décortication de la Ramie), and at the request of the India Office, and in continuation of similar action taken last year, Mr. D. Morris, F.L.S., the Assistant Director, was appointed to represent this country and to prepare a report of the results. This report, with the permission of the Secretary of State for India, is reproduced below :—

Royal Gardens, Kew, October 26, 1889.

A series of interesting trials of machines and processes designed for the decortication of Ramie was held by the French Minister of Agriculture at Paris in 1888, and a report on the subject, which I had the honour to prepare for the information of the Secretary of State for India in Council, was published in the *Kew Bulletin*.

The trials were resumed this year as an integral part of the *Concours spéciaux des instruments agricoles* of the Exposition Universelle, and opened on the 23rd September last. The jury consisted for the most part of the members of the Commission of 1888. The attendance of foreign representatives was considerably larger than in 1888, and the greatest interest was manifested in the proceedings by a large concourse of visitors.

The machines and processes this year were confined to those which had been shown as a regular part of the general exhibition. As will be seen later, all the competitors were French, and this in spite of the fact that more than a dozen machines and processes have lately been designed in this country, which are now in course of being carefully tested.

In my previous report it was pointed out that amongst the French there was attached an importance beyond their value to machines for cleaning Ramie in the dry state. I ventured to express the opinion, that as regards India and our own Colonies it was essential that Ramie machines and processes should be competent to deal successfully with the green stems and not the dry; and that until this end was gained Ramie fibre would, I feared, continue to remain unavailable for commercial enterprise. At the recent trials this was all changed. It was a noticeable feature throughout the proceedings this year that no importance whatever was attached to the decortication of dry Ramie stems. The trials were entirely confined to results obtainable with

green stems, and in order to make them still more applicable to field operations some of the stems were supplied freshly cut with leaves and some without leaves.

The following six machines and one process were submitted to the jury :—

1. E. Armand—Paul Barbier, 46, Boulevard Richard-Lenoir, Paris.
2. P. A. Favier—Société la Ramie Française—14, Rue Saint-Fiacre, Paris [for treatment of dry and green Ramie stems].
3. P. A. Favier—Société la Ramie Française—14, Rue Saint-Fiacre, Paris [for treatment of green Ramie stems].
4. Norbert de Landtsheer, 2, Place des Batignolles, Paris [large machine].
5. Norbert de Landtsheer, 2, Place des Batignolles, Paris [small machine].
6. Félicien Michotte, 43, Rue de Saintonge, Paris.
7. Ch. Crozat de Fleury et A. Moriceau, Villiers-le-Bel, Seine-et-Oise [process for the treatment of green Ramie stems in the field].

Barbier Machine.

The machine of M. E. Armand, constructed by M. Barbier, and more generally known as the Barbier machine, was in every respect the same as that tried in 1888, and described in my previous report. It is constructed to be worked by hand or by steam power. It weighs 625 kilos., and the price is 48*l*. The construction of the machine is comparatively simple, and consists of a number of cylinders and beaters with a reverse action attached. This latter allows the stalks to be withdrawn when about five-sevenths cleaned, and of the other ends being put in to complete the operation. The disadvantage of this method, as regards time and output of ribbons, is more fully discussed below under the de Landtsheer (small) machine. During the trials this machine caused a considerable loss of fibre, carried away with the pith and wood. In the first trials 10 kilos. of green stems without leaves were passed through the machine in six minutes. The result was 1·300 kilos. of wet ribbons of fair quality. This would be at the rate of 130 kilos. of wet ribbons per day of 10 hours; or of 96 pounds (avoir.) of dry ribbons for the same period.

In the second trials 24 kilos. of stems with leaves were put through the machine in $10\frac{1}{2}$ minutes. The result was 1·200 kilos. of wet ribbons of moderate quality. This would be at the rate of 68·500 kilos. of wet ribbons per day of 10 hours; or of 50 pounds (avoir.) of dry ribbons for the same period.

Taking into consideration the cost of this machine and the power necessary to drive it, the out-turn of ribbons is much too small to prove remunerative, and the machine in its present form is useless. Better results than these have been obtained by decorticating Ramie by hand.

Favier Machine.

Two machines were shown by M. P. A. Favier, whose name is well known in connexion with the Ramie industry. Machine No. 1 was designed for the decortication of green Ramie stems, while Machine No. 3 was designed for the treatment of dry stems. In this report the remarks apply only to Machine No. 1. This machine was 2 m. long, 80 cm. broad, and weighed 800 kilos. The price was not stated. It

required three-quarter horse power to drive it, and two persons to feed and receive the ribbons. The machine is adapted to be worked by four persons, but at the trials, owing to want of space, it was worked with only two persons. M. Favier stated that it was designed to produce ribbons entirely free from wood and pith, ready to be converted by a chemical process, also by the same inventor, into the finest filasse ready for weaving. In outward appearance the machine was a long narrow iron box furnished with numerous small cylindrical crushers and beaters. These were entirely covered by a number of moveable iron sheets, which both protected the intricate system of cylinders and prevented the escape of dust and *débris*. The feeding apparatus consisted of a long narrow trough, in which the stems were arranged in lots of four to six and fed to the machine at two apertures leading to the rollers. The first pair of rollers was furnished with fine corrugations to grasp the stems and pass them on to a somewhat complicated system of crushers and beaters. The ribbons passed continuously through the machine, and were ultimately delivered into the hands of a workman at the other end perfectly free from wood and pith. In the first series of trials 10 kilos. of green stems without leaves were passed through the machine, in $4\frac{1}{2}$ minutes. Once or twice some of the ribbons were caught in the rollers and the machine had to be stopped. The time occupied in the stoppages was not counted. The wet ribbons yielded by 10 kilos. of stems weighed 2·820 kilos. This would be at the rate of 376 kilos. of wet ribbons per day of 10 hours; or 276 pounds (avoir.) of dry ribbons for the same period. In the second series stems, more or less with leaves, weighing 60·350 kilos. were passed through the machine in 18 minutes. They yielded 18·100 kilos. of wet ribbons. This would be at the rate of 603 kilos. of wet ribbons per day of 10 hours; or 443 pounds (avoir.) of dry ribbons for the same period.

The ribbons in both cases were well cleaned. There appeared to be no waste. The *débris* under the machine consisted almost entirely of wood and pith.

These results I regard on the whole as satisfactory.

The somewhat intricate character of the various parts of this machine would be against its general use by planters in the Colonies, but there can be but little doubt it is a great advance on most other Ramie machines now available. It might, however, be adapted for use in central factories or *usines* where skilled labour would be obtainable, and for this and similar purposes the Favier machine may be recommended.

Michotte Machine.

The Michotte Machine, called "La Française," at first glance resembled the Barbier and de Landtsheer (small) machines. It was driven by steam-power, and consisted of a pair of large rollers, each furnished with helicoidal grooves running their whole length. The large rollers first crushed the green stems and then passed them on to beaters with moveable bars intended to get rid of the wood and pith. In the first trials, 7 kilos. of green stems were passed through the machine in $1\frac{1}{2}$ minutes, yielding 1 kilo. of badly cleaned ribbons. In the second trial, 17·400 kilos. were passed through in $2\frac{1}{2}$ minutes, yielding 6 kilos. of similar ribbons. In both cases the ribbons were mixed with crushed and mangled stems, full of wood and pith. The fibres were also cut transversely (probably by the helicoidal grooves) and rendered useless.

This machine in its present state possesses no merit whatever. It is difficult to realise under what circumstances it could have been entered for trial.

DE LANDTSHEER MACHINES.

M. de Landtsheer exhibited two machines. The small machine was very similar to that exhibited by him in 1888, but meanwhile it had received some slight modifications intended to accelerate its movements.

It was driven by steam power and required two men to attend to it. It had a horizontal feed plate and consisted of a series of rollers and beaters which received eight or ten stems at a time. These were cleaned for about five-sevenths of their length, and by a reverse action (operated by a long handle pushed by the workman) they were then withdrawn and the other ends put in and cleaned. It will be noticed that each lot of stems, under this arrangement, had to be presented twice to the machine before they were cleaned. This involved a considerable loss of time and reduced the daily out-turn of ribbons. In the Favier machine, as also in the de Landtsheer large machine, this difficulty has in a great measure been overcome. The de Landtsheer small machine was used for green stems in the second trials only. In these 24·400 kilos. of stems, with leaves, were passed through the machine in 10 minutes. The yield was 6·500 kilos. of wet ribbons of good quality. This would be at the rate of 390 kilos. of wet ribbons per day of 10 hours ; or 286 pounds (avoir.) of dry ribbons for the same period.

In the first trials this machine was used by de Landtsheer to complete the cleaning of ribbons previously passed through the large machine. In this instance 15 kilos. of partially cleaned and wet ribbons were passed through the machine in $6\frac{3}{4}$ minutes. The yield was 10·500 kilos. of excellent fibre worth, according to the opinion of experts, about 70 to 80 centimes per kilo.

The large machine of M. de Landtsheer, like the Favier machines, had a continuous movement by means of which the stalks passed through the machine, without withdrawal, and the ribbons were delivered at the other end ready for drying. This is an important point gained. Indeed, this was the principal improvement noticed in the machines presented at the Paris trials of 1889, and in all in which it had been adopted there was a marked increase in the out-turn of ribbons. M. de Landtsheer's large machine consists of two pairs of cylinders. The first pair is furnished with grooves opposite one another, while the second have the grooves alternate. Beyond these are two sets of beaters (*batteurs à ailettes*) which break and get rid of the wood and pith and deliver the ribbons on a revolving stage placed beneath, whence they are quickly picked up by a workman and laid on one side. The particulars of weight and price of this new machine were not obtainable. It was driven by a two-horse power engine, and required two men to feed it and remove the ribbons.

In the first trial, 36 kilos. of stems without leaves were passed through the machine in $2\frac{1}{2}$ minutes. They yielded 10 kilos. of wet ribbons, but these ribbons had a considerable quantity of pith and wood lightly adhering to them, and in one instance the amount of wood and pith probably reached 20 to 25 per cent. of the gross weight. Taking the yield of wet ribbons as they left the machine, the 10 kilos. above mentioned would be at the rate of 2,400 kilos. of ribbons per day of 10 hours ; or of 1,763 pounds (avoir.) of dry ribbons for the same period. Even allowing for the presence of pith and wood, which when dry, might be removed by a light shaking or scutching, it is

evident that this machine will prepare more than half a ton of dry ribbons per day. It is not at all improbable that M. de Landtsheer will be able to effect some further improvement in this machine. In any case the machine is worthy the attention of planters, who with a single instrument could work off about 50 tons of green stems per week. This is an exceptionally good result, and it serves to show what progress has now been made in perfecting machines for treating the Ramie plant on a commercial scale.

In the second trials 46 kilos. of stems with leaves were put through the machine in 11½ minutes. The result was 15 kilos. of wet ribbons (with particles of wood and pith adhering to them as before). This would be at the rate of 783 kilos. of wet ribbons per day of 10 hours; or of 575 pounds (avoir.) of dry ribbons in the same period. There is a considerable difference between the results obtained by this machine in the first and second trials. This was also noticeable in the Barbier machine. The construction of these machines evidently does not enable them to cope with stems with leaves attached. On the other hand the Favier machine did better with stems with leaves than those without leaves. This, however, is not a matter of great importance. In the field the leaves could be easily detached during the cutting; and if not removed then, they would fall off of their own accord after lying in a heap (inducing a slight fermentation) for a few hours.

Fleury-Moriceau Process.

Only one process was shown. This was singularly simple, and consisted of steeping the fresh (or dry) stems for a short period in boiling water and removing the ribbons by hand. An open galvanised tank about 6 feet long, 2 feet wide, and about 4 feet deep, filled with water, was raised on bricks (or stones) about 18 inches from the ground over an open fire. When the water had reached boiling point a crate containing 50 to 100 fresh stems was lowered into it (and depending on their age and character) left in it for 5 or 15 minutes. At the end of that time the crate was lifted out, the stems left to drain while another lot was put in. The stems already steeped were then taken up by a couple of workmen and quickly and effectually cleaned by hand. The action of the boiling water had apparently thoroughly loosened the attachment of the cortex to the wood, and ribbons were produced perfectly clean and regular, and apparently without any loss of fibre.

This method was tested in the first trials only. The operation began by placing 18 kilos. of fresh stems in boiling water and allowing them to remain there for 10 minutes. In 36 minutes (or in 46 minutes including the time occupied in immersing the stems) the workmen, apparently not specially trained in the work, produced 5·600 kilos. of excellent ribbons. This would be at the rate of 73 kilos. of wet ribbons per day of 10 hours; or of 161 pounds (avoir.) of dry ribbons for the same period.

This process, it will be noticed, is of the simplest possible description. The only apparatus necessary is a tank. This tank could easily be moved from place to place in the field, and the wood of the stems after the ribbons are removed would probably furnish most of the fuel necessary. The process can, however, only be utilised in a few special countries where labour is very cheap.

M. Crozat de Fleury states that ribbons produced by this process can be dried, baled, and delivered ready for shipment at a cost not exceeding 8 to 10 centimes per kilo. (about 85 shillings per ton). In Tonkin it could be done for even less than this.

It will be noticed that the Fleury-Moriceau process follows somewhat on similar lines that of the Favier process of 1882. In this latter the stems were steamed for some time in a close fitting cylinder. The former is, however, much simpler, and requires absolutely no skilled labour, [no chemicals], nor any plant except an open tank, large or small, according to the circumstances of the grower.

The inventors of the Fleury-Moriceau process are evidently of opinion that wherever cheap labour is obtainable it is in every way preferable, in the production of Ramie ribbons, to the best machine. After all, placing the Ramie stems in boiling water is only a modification of the old retting process practised so long by the Chinese, and by means of which probably the China grass of commerce is still produced. In any case the Fleury-Moriceau process deserves to be carefully considered, and especially in its applicability to the circumstances of India. There the ryots might grow Ramie in small areas, prepare the ribbons and sell them to merchants for export, or to a neighbouring factory or *usine*. The steaming process of M. Favier, designed for use under similar circumstances, failed no doubt on account of the restrictions placed on the use of the patent, and the uncertainty of the demand for ribbons. The Fleury-Moriceau process re-opens the question under circumstances much more favourable, and the subject is one which deserves careful consideration wherever labour is sufficiently abundant to permit of ribbons being produced at a price that will compete with machine-cleaned ribbons.

The relative value of the several machines, and of the Fleury-Moriceau process, tried at Paris in 1889, may be gathered from the following tables :—

TABLE 1.—FIRST SERIES of TRIALS. Green stems, without leaves.

Machine.	No. of Hands employed.	Weight of Green Stems. (Kilos.)	Time employed.	Quantity of Wet Ribbons produced. (Kilos.)	Estimated Quantity of *Dry* Ribbons producible in a day of 10 hours (pounds Avoir.).*
Armand-Barbier ...	2	10	6 m.	1·300	96
Favier (No. 1)	2	10	4½ m.	2·820	276
Michotte	2	7	1½ m.	1·000	—
de Landtsheer (large machine.)	2	36	2½ m.	10·000	1,763†
Fleury-Moriceau process.	2	18	46 m.	5·600	161

* In preparing this estimate the wet ribbons are calculated to yield one-third of their weight of dry ribbons, and the kilo. is taken as equivalent to 2·204 pounds avoir.

† This large yield of ribbons must be reduced by about 20 per cent. on account of the pith and wood lightly adhering to them.

TABLE 2.—SECOND SERIES OF TRIALS. Green stems, with leaves.

Machine.	No. of Hands employed.	Weight of Green Stems. (Kilos.)	Time employed.	Quantity of Wet Ribbons produced. (Kilos.)	Estimated Quantity of *Dry* Ribbons producible in a day of 10 hours (pounds Avoir.).
Armand-Barbier -	2	26	10½ m.	1·200	50
Favier (No. 1) - -	2	60·350	18 m.	18·100	413
Michotte - - -	2	17·400	2½ m.	6·000	—
de Landtsheer :					
(*a.*) Large machine -	2	46	11½ m.	15·000	575
(*b.*) Small machine -	1	24·400	10 m.	6·500	287

AWARDS OF THE JURY.

As was the case last year, the official report of the jury will probably not be published till the appearance of the December number of the *Bulletin de l'Agriculture*. In the meantime it may be mentioned that the jury, following the rules applicable to the other exhibits at the Exposition Universelle, awarded a gold medal to M. Favier; a gold medal to M. de Landtsheer; and a silver medal to MM. Fleury-Moriceau. These awards, it will be noticed, follow closely the results already detailed above, and they may be accepted as affording a clear indication of the relative value of the several machines and processes submitted to the jury.

To those generally interested in Ramie culture it may be mentioned that the trials of 1889 have proved much more favourable than those of 1888, and the subject is evidently ripening for solution in many directions not thought of before.

This can be best shown by comparison of the results as follows :—

TABLE 3.—RESULTS obtained in 1889 compared with those obtained in 1888.

Machine.	Quantity of Dry Ribbons producible in a day of 10 hours (pounds Avoir.) working on Green Stems.	
	1888.	1889.
de Landtsheer :		
Large machine - - -	—	1,763*
Small machine - - -	120	287
Barbier - - - - -	71	96
Favier (No. 1) - - -	—	443
Fleury-Moriceau - - -	—	161

* See note in Table 1.

It will be noticed that the best results obtained in 1888 were at the rate of 120 pounds of dry ribbons per day of 10 hours. This was with the de Landtsheer small machine. In 1889 this machine, with improvements, produced at the rate of 287 pounds of dry ribbons (more than double the quantity) for the same period. With the large machine (make due allowance for the pith and wood lightly adhering to the wet ribbons) the returns of dry ribbons would be at the rate of over half a ton per day.

Other Machines and Processes.

Before closing this report it is desirable to pass under review a few of the machines and processes not represented at Paris which have recently come into notice in this country and elsewhere. In the absence of carefully arranged public trials under the control of men thoroughly conversant with the subject, it must be understood that it is impossible to express an authoritative opinion as to the merits of such machines and processes. They are noticed here solely for the purpose of furnishing a more or less complete record of Ramie experiments which have been undertaken during the present year, and of affording information that otherwise would not be available to persons interested in the subject in India and the Colonies.

The Doty System.

A system brought forward by Captain Doty (inventor of the Doty light) is based on the assumption that no decorticating machine, however meritorious, will fully meet the requirements of Ramie planters, who are obliged, with the aid of unskilled labour, to deal with a large quantity of green Ramie stems within a short time. Captain Doty is of opinion that where labour is cheap, women and children might be employed to strip the fibre from the freshly cut stems by hand, and leave 80 per cent. of the weight of the crop (the wood) on the field. Under such circumstances the ribbons alone would be carried away, either to be dried for exportation or to be treated at central factories or *usines*, firstly by a process of fermentation, and subsequently by chemical cleaning and washing to produce filasse ready for spinning.

"Notwithstanding," says Captain Doty, "the failures of all previous "attempts to deal with this fibre by fermentation it is almost self-"evident that a fermentive treatment is the only possible solution of "the problem. No mechanical process that can be devised will ever "eliminate the gum by which the fibres are cemented together, and "without the elimination of the gum the division and sub-division of "the fibres necessary to produce a delicate filasse can never be "obtained."

A trial of the Doty system recently took place near Rome, and a report thereon was prepared by Signor G. Trombetta, Secretary to the Italian Ministry of Agriculture, and published in the *Bolletino di Notizie Commerciale*, Sept. 1st, 1889, pp. 689–690. In this report it is stated that the system is based on the disintegration to which the gummy substance in the Ramie ribbons is exposed by an acid fermentation. The ribbons are first of all tied up in bundles and placed in fermenting vats, where they remain for about a week. They are then taken out and washed. Afterwards they are boiled with certain chemical ingredients for two hours, washed in cold water, and dried and combed. The report concludes by stating that the fibre was in some cases of unequal character as regards colour and quality, due to the provisional nature of the appliances used; but the results obtained on a

small scale gave hopes that with larger quantities and suitable boiling vessels, properly closed, and with proper machinery to agitate the mass, the fibre would be obtained in a more satisfactory condition.

The Till Machine.

As far as can be gathered from a description privately communicated by the inventor (Mr. C. G. Till), this is a large machine, weighing nearly two tons, driven by steam-power, and costing about 150*l*. It is furnished with rollers and beaters, about 3 feet long; it has a continuous action, similar to the Favier and de Landtsheer (large) machine, and takes about 36 stems of green or dry Ramie at a time. It has not yet been fully tested for the out-turn of ribbons, but the inventor estimates that it will clean between half a ton and a ton per day.

Papleux System.

In consequence of letters which appeared in the *Melbourne Argus* at the time of the Centennial Exposition held at Melbourne, inquiries were addressed to Kew respecting the Papleux system for cleaning Ramie.

This system was at one time in operation by Messrs. W. H. Spencer & Co., of Hitchin, Herts, but is now abandoned. Recent experiments have been carried on with a formula invented by Messrs. Spencer themselves, and by means of this they have been successful in preparing small samples of fibre of excellent quality. It is probable that Messrs. W. H. Spencer & Co. will eventually be able to treat Ramie ribbons on a large scale and convert them by mechanical and chemical means into filasse or finished yarns. It is understood, however, that at present the process is not available to the public.

Plaisier Machine.

A machine, the invention of a Dutch engineer named Plaisier, is the subject of an extended notice in *de Indiche Mercur* of the 19th January 1889, by Van Gorkhom. This machine, driven by an engine of $1\frac{1}{2}$ horse power, has been successfully worked at Deli, in Sumatra, for some months, and it is stated to treat 5,000 kilos of green stems per day, yielding 125 to 150 kilos of ribbons.

General Remarks.

In the Diplomatic and Consular Reports, Series 1889 (p. 37), there is given an account of an experimental planting of Ramie at a colony in the Province of Santa Catharina, Brazil. This colony obtained the first prize for a collection of Ramie fibres at the Antwerp Exhibition.

In the same Reports, No. 525, on the trade of Hankow, attention is drawn to the facilities which exist there for procuring and manipulating Rhea fibre on a large scale. The Consul adds, "it would give me much "pleasure to know that a good business in this article could be started "here. But until machinery for preparing it is perfected, exports "would be premature."

On the 23rd August last a despatch was forwarded by the Foreign Office from the Acting Consul at Carácas, dated the 25th July 1889, giving an account of the formation of an Italo-Venezuelan Company to plant Ramie on a large scale. Experimental plantations had already proved so successful that machinery had been imported to begin the operation of preparing the fibre.

As described in the *Kew Bulletin*, 1888, pp. 145–149, a Ramie factory established in Spain, at Torroella de Montgri, Gerona, in the neighbourhood of large Ramie plantations, appears to have proved successful. This factory employed the Favier decorticating machines. In a letter dated the 19th October 1889, Mr. Wooldridge, Her Britannic Majesty's Consul at Barcelona, informs us that "Ramie is still being "cultivated with important results near Torroella," and that "they con- "tinue to use the Favier machines, which are believed to be the most "perfect machines of their kind."

It may be mentioned that these factories are being worked privately, and probably the methods and machinery are not available to the public, except under a special arrangement with M. Favier. The fibre prepared is utilised in France, and does not come into general commerce.

In British tropical possessions, both in the East and West Indies, Ramie is being grown experimentally, in the hope that some machine or process will eventually be produced to enable the fibre to enter into commerce and become a regular article of trade.

The results of the Paris trials last year naturally discouraged Ramie growers, and little if any extension of Ramie planting has taken place since that time. The results of the recent trials will no doubt be closely scanned by those interested in the subject. The first aim of planters should be to produce ribbons of good quality at the lowest possible cost. In other words, planters have to solve the question how to produce Ramie ribbons, that is, to secure the complete removal of the cortex (which contains the fibre) from the green stems, at such a cost as will prove remunerative to themselves and at the same time allow sufficient margin for the cost of converting these ribbons into filasse ready for the spinners. Hitherto the want of success in the production of ribbons has apparently been the only obstacle to the development of a Ramie industry. And probably on this account the Paris trials were wholly devoted to the production of ribbons and not of filasse. The conversion of ribbons into filasse is a subject believed to be more easily dealt with. In fact there are several systems exclusively devoted to this department which appear to accomplish it. Some machines, it is true, have attempted to produce filasse by a single process from the green stems. The result has not been satisfactory, and it is very unlikely that this can be done with a plant like Ramie, in which the individual fibres are so completely immersed in gummy matter. Hence the subject has been divided in two parts. The first is concerned alone in the removal of the fibre in the form of ribbons from the green stems, either in the fields or in their immediate neighbourhood. The second is devoted to the treatment of these ribbons and to their conversion by chemical and other processes into filasse, or fine white silky fibres ready for the spinner. The first process will naturally take place where the plants are grown in the colonies or elsewhere, and machines like those of Favier and de Landtsheer, or processes like that of Fleury-Moriceau, may be adopted according to the special circumstances of the planter. Sufficient progress has now been made in the working of these machines and processes to justify careful trials being undertaken with them both in India and the colonies. If these machines or any others that may be forthcoming prove entirely satisfactory, and ribbons can be produced at a low initial cost, the question of their conversion into filasse is one which will naturally come into prominence. The conversion of ribbons into filasse will very probably, at first, at least, take place in Europe, where chemicals and skilled labour are the more readily available. In some countries it may be found advisable later on to establish central factories or *usines* on the spot (to save freight charges on the ribbons), and ship only the filasse

to Europe. In any case, once a Ramie industry is well started, there can be no doubt that numerous countries will seek a share in it, and only those possessing special advantages for the growth of the plant, a supply of cheap labour, and good facilities for transport and shipment, can hope to make it a success.

The best market for Ramie at present appears to be France. What little is imported into this country, in the form of China Grass, or Rhea, is bought up for the French market. In the Monthly Circular of Messrs. Ide and Christie for the 15th October 1889, China Grass is quoted "quiet" at 31*s.* to 35*s.* per cwt.; and Rhea, "no business," at 14*s.* to 10*s.* per cwt.

With regard to what is known in commerce as "China Grass," this is hand-cleaned fibre shipped usually from Chinese ports. It arrives in this country in small parcels, the yearly importation being only about 100 tons. It is nearly all taken up by Continental buyers. Rhea is the term applied to machine-cleaned fibre, generally in the form of ribbons or half-cleaned stuff. The price is much less than China Grass, and in case of large shipments would probably not exceed about 7*l.* or 8*l.* per ton. It is important therefore for Ramie planters to aim at the production of ribbons at a cost not exceeding about 4*l.* or 5*l.* at the port of shipment. Important elements in such production would be to plant Ramie only in places where the soil and climate will allow of three or four crops being reaped per annum; where labour is very cheap and abundant, and where good facilities exist for transport and shipment.

D. MORRIS.

XXV.—RAMIE—(continued).

(*Boehmeria nivea*, Hk. & Arn.)

[K. B., 1889, pp. 284–287.]

The report on the results of the trials of machines and methods for decorticating Ramie stems, held at Paris on the 23rd September 1889, is given in the preceding pages.

It is evident from this report that considerable progress has been made towards a solution of the problems involved in the treatment of Ramie fibre, and it remains for those interested in the subject in India and the Colonies, to initiate locally such further experimental trials of machines and methods as will determine, with an abundance of green stems at hand, whether Ramie fibre can now be made available for commercial enterprise.

The Foreign Office has communicated the following letter addressed to Lord Lytton, Her Majesty's Ambassador at Paris, by Mr. J. A. Crowe, C.B., Commercial Attaché for Europe, respecting the results of the trials of Ramie fibre machines:—

MY LORD, Paris, October 29th, 1889.

WITH reference to Lord Salisbury's Despatch (No. 124 of the 23rd instant), on the subject of the awards and official reports in the matter of Rhea fibre-cleaning machines at the Universal Exhibition, I have the honour to enclose copies of the general list of awards which has just been made public, to which I have added a list of the special awards for decortication of Ramie fibre.

The [official] reports which have been asked for will probably not appear, so I hear from Mr. Berger, till some time next year.

I have, &c.
(Signed) J. A. CROWE.

[Enclosure.]

EXPOSITION UNIVERSELLE, 1889.

Concours de Décortiqueurs pour la Ramie.

First Prizes.

P. A. Favier, Société la Ramie Française, 14, Rue Saint-Fiacre, Paris [for machines for treating Ramie stems].

Norbert de Landtsheer, 2, Place des Batignolles Paris [for machine for treating Ramie stems].

Second Prize.

Ch. Crozat de Fleury et A. Moriceau, Villiers-le-Bel, Seine-et-Oise [for process for the treatment of green Ramie stems in the field].

In regard to M. Favier's machines, which were awarded a first prize for cleaning green Ramie stems, this gentleman, well known as having devoted during the last 10 years much time and attention to the development of Ramie industry in France, Spain, and other countries, has forwarded further particulars of his machines to supplement those already given in Mr. Morris's Report :—

M. FAVIER TO ROYAL GARDENS, KEW.

Paris, 14, Rue Saint-Fiacre,
11th November 1889.

SIR,

I HAVE duly received a copy of the *Kew Bulletin* of miscellaneous information, which you have been good enough to send me, and I beg to thank you for the compliment.

Since the trials upon which you have reported I have added some improvements to my machine, to prevent the ribbons from being entangled in the rollers, and on the 23rd October I carried out further experiments in the presence of numerous people interested in the subject.

I passed through my machine, with two workmen, 100 kilos. of green stems, more or less with leaves, in 12 minutes. This is equivalent to 5,000 kilos. of green stems (and assuming the rate of yield at 5 per cent. of dry ribbons) to about 550 pounds (avoir.) of dry ribbons per day of 10 hours. With the full complement of four workmen, necessary to do justice to the machine, it will work off 7,500 kilos. of green stems, and give a return equivalent to 775 pounds (avoir.) of dry ribbons per day of 10 hours. The ribbons, as you saw at Paris, are perfectly free from pith and wood.

The intricate nature of my machines to which you allude is only apparent. They consist really of repetitions of similar parts of crushers and rollers, weighing 10 or 12 kilos. each, so arranged that they can be easily taken in and out. The work of putting up these machines is very simple, and they can be easily regulated by anyone.

The little power required to drive my machines (three-quarter-horse power) clearly indicates that the several parts are not heavy to move, and that there is really nothing in them cumbersome or involving strain on the fibre as in other Ramie machines hitherto produced.

* * * *

The cost of my machine (for treating green Ramie stems) will probably be 80*l*. to 100*l*., with a royalty, which is not yet fixed.

I have, &c.

(Signed) P. A. FAVIER,
Directeur de la Société "La Ramie Française."

D. Morris, Esq.

At the date of the publication of Mr. Morris's report, the demand for Ramie ribbons in the London market was so slight that the prices quoted may possibly have offered little inducement for embarking in Ramie growing in the Colonies.

The information received from Messrs. Ide and Christie, in a letter dated 29th October 1889, was as follows :—

"There is very little inquiry for ribbons at present, and we do not "think they would fetch more than 8*l*. to 10*l*. per ton. We may "confirm our circular report by simply saying 'Nothing doing.'

"There are some parcels of highly prepared Ramie in London just "now, some of Indian and some of English manufacture, the values of "which range from 28*l*. to 50*l*. nominally. Those are on sale, but the "demand is almost *nil*."

Since that time, however, it appears that a considerable improvement has taken place in the price of Ramie ribbons, and Messrs. Ide and Christie, in a letter dated the 5th November last, were able to report as follows :—

. . . . "During the past week some considerable investment "has taken place in Ramie ; the whole stock in London of ribbons has "been sold at prices ranging from 14*l*. to 16*l*. per ton, and a good "deal of this was out of condition and somewhat perished. We believe "that this stock has gone into consumption by English manufacturers. "There is an inquiry for further parcels, and we are now disposed to "think that the bases of a real trade in the article are in process of "formation. At least we feel sure there are buyers in the market of "100 tons of ribbons up to 12*l*. per ton, and we could not perhaps "have said this a few months ago."

In Messrs. Ide and Christie's monthly circular, dated 15th November, it is stated :—

"*China Grass.*—Improved inquiry, and a large turn over has occurred "from 30*s*. to 34*s*. [per cwt.].

"*Rhea.*—Stocks of raw ribbons cleared out up to 16*s*. [per cwt.]. "Market bare, with plenty of inquiry."

It may be mentioned that the remarks on the Papleux system, which appeared at p. 73, may be supplemented by the information that Messrs. W. H. Spencer & Co. are associated with the Boehmeria Company, Limited, at Hitchin, Herts, formed for the purpose of converting Ramie and other textiles into yarns.

XXVI.—RAMIE AS FOOD FOR SILKWORMS.

(*Boehmeria nivea*, Hk. & Arn.)

[K. B., 1890, pp. 174–175.]

The Ramie or Rhea plant (*Boehmeria nivea*) is being experimentally cultivated in numerous parts of the world as a fibre plant. Particulars in regard to the numerous attempts that have been made to prepare the fibre of the Ramie on a commercial scale have already been given in these pages. It now appears that the leaves of the Ramie plant may be used as a food for silkworms, in the same way as those of the mulberry and Osage orange (*Maclura aurantiaca*). All three plants belong to the same natural order *Urticaceæ*, and there should be no reason why they should not be found equally suitable. The following account of the use of Ramie leaves for feeding silkworms in the United States was communicated to the Foreign Office by Mr. A. de G. de Fonblanque, H.B.M.'s Consul at New Orleans :—

"A discovery has been made by a lady in Columbia, S.C., that may have a marked effect upon two great industries. For a number of seasons this lady has amused herself by feeding silkworms and sending a few pounds of cocoons to the Women's Society for the Encouragement of the Silk Industry in Philadelphia. The extraordinary warmth of this winter caused the eggs to hatch far in advance of the season, and as the young leaves of the mulberry and the Osage orange had not put forth, our amateur was at a loss what to do. An account adds :

"'Seeing that the foliage of the Ramie in a neighbouring field was putting out, she gathered some and put the worms upon it. They fed ravenously, and she kept up the supply until the Osage orange leaves appeared. Then she divided her worms equally, feeding one set with Ramie, the other with Osage orange. She kept the cocoons separate and sent them to Philadelphia. The experts there were astonished at the size of those spun by the Ramie eaters, and wrote to the lady to know what she had done to secure them. They were not only larger, but the silk was finer.'

"If further experiments should prove that Ramie leaves can be depended upon for silkworms' food, then a great impetus will be given to the production of this valuable article in the South, while it will add to the profits of those who raise that plant for its fibre."

NOTE ADDED, 1894.—With regard to the above statement, Professor Riley, Entomologist to the U.S. Department of Agriculture, remarks in *Insect Life*, vol. iii., p. 301 :—"We should be glad to receive an authoritative account of such "an experiment, as the discovery is a valuable one, if true. We have endeavoured "to secure an authentication, but have not succeeded as yet. In spite of the fact "that Ramie is closely related to the mulberry, botanically speaking, we rather "incline to the opinion that the published statement is a canard. The editor of the "*American Druggist* (where it first appeared) writes us that the item must have "been published in his advertising pages, and that he cannot vouch for the "reliability of the statement."

XXVII.—PARIS RAMIE TRIALS, 1891.

[K. B., 1891, pp. 277–278.]

The subject of Ramie has once more been brought forward in France, and a trial of methods and appliances for decorticating and preparing Ramie was held at Paris under the auspices of The *Société des Agriculteurs de France* on the 25th to the 30th September last. It will be

recollected by those who take an interest in this subject that previous trials were held at Paris in 1888 and 1889, and owing to the importance of Ramie as a possible industrial plant for India the Secretary of State for India in Council sanctioned an arrangement whereby the Assistant Director of Kew was enabled to attend the trials and prepare reports embodying the results for the information of the India Office. A summary of these reports was afterwards published in the *Kew Bulletin* for November and December 1888, and November and December 1889. At the trials in September last the Director of Kew was able to be present as representative for India. The trials took place at Gennevilliers, a suburb of Paris, in a field where Ramie (the white-leaved sort) had been grown specially for the purpose. After the trial of the decorticators had been completed the ribbons were passed on to be treated by the chemical processes so as to test exactly the amount of filasse (or marketable fibre ready for spinning) produced by each system. The chemical processes have necessarily occupied some time, but as the report by the jury and the awards have been officially made known there will be sufficient evidence forthcoming to enable a tolerably clear estimate to be formed of the advance which has been made towards solving the difficulties hitherto connected with the Ramie question.

XXVIII.—RAMIE OR RHEA IN IRELAND.

[K. B., 1892, p. 251.]

What little interest is being taken at present in extracting Ramie Fibre from *Boehmeria nivea* appears to be centred at Belfast. Numerous applications have been received at Kew for Ramie stems for experimental purposes, but owing to the unfavourable conditions of last winter the plants at Kew have yielded a poor crop of stems. It may be useful to state that investigators of Ramie in Ireland could very well obtain stems either from the Royal Botanical Gardens at Glasnevin, or from growers of the plant in the mild climate of the South of Ireland. Mr. F. W. Moore, Keeper of the Glasnevin Gardens, writes that the plant is "quite hardy" with him, and he would be pleased to send specimens, as far as his resources allow, to those who apply to him for them.

XXIX.—RAMIE MACHINE TRIALS AT NEW ORLEANS.

[K. B., 1892, pp. 304–306.]

The latest information connected with the extraction of fibre from Ramie (*Boehmeria nivea*, Hk. & Arn., and *Boehmeria nivea* var. *tenacissima*, Gaud.) is contained in a Report on the recent trials of Ramie decorticating machines held under the authority of the U.S. Department of Agriculture at New Orleans. The trials took place on the 30th September last, and the Report of the Board of Experts, acting as jury, has just been published.*

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* The United States Department of Agriculture. Division of Statistics. New Series: Report No. 99, September and October 1892. Washington Government Printing Office, pp. 347-354.

The results of the New Orleans trials do not appear to carry us any nearer to the solution of the problem that has been so long under consideration in regard to the extraction of Ramie fibre. The machines presented do not appear to possess any advantages over those tried at Paris in 1888 and 1889, and fully discussed in these pages, while they are apparently inferior to the machines tried also at Paris under the auspices of the *Société des Agriculteurs de France* in September 1891.

The following extracts are taken from the United States Report :—

Machines Entered.

"The official trials of Ramie machines, under the auspices of the office of fibre investigations of the U.S. Department of Agriculture, set for the last week in September at Audubon Park, New Orleans, came off on the 30th of September, and included trials upon jute stalks as well as upon stalks of Ramie.

"Three machines were entered for trial as follows :—The Kauffman machine, by the Kauffman Fibre Company of New Orleans, La. ; the Felix Fremerey Decorticator, by the Felix Fremerey Decorticator Company, of Galveston, Texas ; the Fibre Delignating machine (known as the J. J. Green machine) of the United States Fibre Company of Versailles, Ky.

"*The Kauffman machine.*—According to the entry of this machine it requires 15-horse power ; it works upon green stalks stripped of leaves and upon dried stalks. Four attendants are required to run it ; floor space occupied 6 by 14 feet. The machine is termed a decorticator for Ramie, jute and hemp. . . . . .

"*The Fremerey machine.*—In the entry of this machine about 5-horse power is stated. The machine is arranged to work upon green stalks, either stripped or with the leaves and upon dry stalks. It occupies a floor space of about 5 by 18 feet. The machine requires five attendants, three of whom may be boys. . . . . .

"*The J. J. Green machine.*—Ten-horse power is named as the power required to drive this machine. The entry states that it works upon dried stalks (but it is also expected to work green stalks with or without leaves). Five attendants are required for full capacity, three of whom may be boys ; it occupies a floor space of 8 by 12 feet."

Trials on Green Stripped Ramie.

"The first trial was with the Kauffman machine, 500 pounds of green stripped stalks having been weighed out for the test. Of this amount 332 pounds of stalks were run through the machine in 42 minutes, when the machine clogged. The result in wet ribbons was 88 pounds, and 168 pounds of stalks remained unworked, owing to the inability of the machine to proceed further.

"The second trial was with the J. J. Green machine, 500 pounds of green stripped Ramie stalks having been weighed out for the test. Of this quantity 225 pounds of stalks had been delignated in 1 hour and 35 minutes, producing 57½ pounds of wet ribbons, 275 pounds of green stalks remaining unworked, owing to the inability of the machine to proceed further.

"Mr. Fremery declined to enter this trial after 500 pounds of green stripped Ramie stalks had been weighed out, claiming that the stalks were too uneven in size, the construction of his machine requiring medium stalks."

Conclusions.

In a review of the results of these trials, Mr. Charles Richards Dodge, special agent in charge of fibre investigations, reports as follows:—

"While the figures for a day's work, based on the results of short running, are wholly misleading, it is interesting to note that the output of the Kauffman machine, during the 42 minutes of continuous work before it clogged, represents 4,743 pounds of green stalks in 10 hours of continuous action, or a little over 2 tons, with an output of 1,257 pounds of wet ribbons, equal to about 420 pounds of dry ribbons, which weight would be considerably reduced after the loose hurds and woody matter remaining in the ribbons produced by this machine had been eliminated.

"In like manner, were the J. J. Green machine to run continuously for 10 hours, turning out ribbons at the rate of speed shown when in actual operation (that is, deducting the 67 minutes spent in cleaning and re-adjustment) the output would have shown a capacity of 4,821 pounds of stalks and 1,232 pounds of wet ribbons, equal to about 410 pounds of dry ribbons. But, as shown, both machines were unable to finish the 500 pounds of stalks weighed out to each for the trial.

"The results of the New Orleans trials are satisfactory as far as they have demonstrated the status of the machines entered, and established an American record that gives a starting point for future comparison, as the results of other trials are made known. It is to be regretted, however, that a larger number of machines was not represented. In this report comparisons cannot be made with the best foreign machines, though I shall endeavour to cover the whole ground in a special report, Bulletin No. 5, Fibre Investigations, to be issued at an early date."

The trials with Jute stems were very similar in their results to those noted in the case of Ramie stems. There was no conclusive evidence either way. The best results with Jute stalks as far as they went, were given by the Kauffman machine. This cleaned 100 pounds of stalks in 20 minutes, yielding 32 pounds of wet ribbons. The ribbons were described as "well delignated with a very small per-centage of woody waste. The fibre occasionally was somewhat broken."

XXX.—CHINA GRASS. 1891 ONWARDS.

[K. B., 1898, pp. 209–224.]

In former articles in the *Kew Bulletin*, the names China grass, Ramie, and Rhea, have been applied, as had been customary, indiscriminately to the products of *Bœhmeria nivea* and *B. tenacissima*. It is now generally agreed to employ them with more precision.

China Grass is obtained from *Bœhmeria nivea*, easily recognised by the white under side of the leaves, which yields an annual crop of stems in the open air, even in England.

Ramie or Rhea is obtained from *B. tenacissima*, which has the mature leaves green underneath, and in this country can only be grown under glass.

Paris Trials.

Trials of machines for the preparation of China grass were held at Paris in the years 1888, 1889, and 1891.

The first were under the direction of the French Government: the results were given in the *Kew Bulletin* for 1888 (pp. 273–280). The

second were in connexion with the Paris Universal Exhibition of 1889; the results were also published in the *Kew Bulletin* (1889, pp. 268–278; 284-287). The third was not a Government competition, but was held under the auspices of the Société des Agriculteurs de France. A brief notice is given in the *Kew Bulletin* (1891, pp. 277, 278). It was attended by the Director on behalf of the India Office.

The trials of 1891 took place at Gennevilliers, near Paris, on the Ramie plantation belonging to the Société Agricole de la Ramie. The plant cultivated was China grass (*Bœhmeria nivea*), and it was understood that its cultivation had the advantage of a supply of Paris sewage. The growth of the crop was extremely vigorous and in that respect left nothing to desire. The stems succumb to the first frost, which, however, does not appear to injure the roots.

Six machines were submitted for competition; of these only the four which received rewards require notice.

Faure Machine.

This received a gold medal. It admitted of being worked by hand, but the most satisfactory results were obtained when driven by a steam motor. It exhibited great mechanical ingenuity in the details. The leafy stems of China grass as cut from the plantation were fed on to a table from which they were drawn in leaf-end foremost by two revolving rollers. Behind these was the decorticating apparatus. This consisted of a drum carrying twelve beaters which appeared to be made of simple T iron. The bed against which these beaters worked was a quarter of a cylinder, the radius of which was smaller than that of the drum carrying the beaters. The space between these and the surface of the bed therefore varied. The beaters first strike the stems, and, without injuring the fibrous cortex, break up the woody core into segments about an inch long. As the stem passes on into the wider space the beaters operate with a scraping action which dislodges the core-segments from the cortex. This, now converted into a ribbon, is again seized by the beaters as it leaves the bed, and when released is blown on to an endless cord which catches each ribbon in the middle and carries it to dry at any distance from the machine that may be desirable. The leaves, which it was thought would be available for fodder, and the fragments of the core are driven away by the centrifugal force of the drum. The Faure machine in this form produced clean ribbons without apparently bruising the fibre, but did not remove the epidermis. It had the advantage of working continuously, but did not always disengage the core from the butt-end of the stems. It required the attention of three men; two to feed and one to remove the ribbons. The result of one trial was to obtain from 1 cwt. of fresh stems 4 lbs. (when dried) of ribbons in six minutes (or 400 lbs. of dry ribbons for a day of 10 hours); these ribbons after degumming yielded 1½ lbs. of filasse, or 2·6 per cent.

The Faure machine of this type has, however, been apparently abandoned by its inventor. The form at present in use will be described subsequently.

De Landtsheer Machine.

This was not materially different in principle from that exhibited at previous competitions. It is described in the *Kew Bulletin* for 1888 (pp. 275–276) and 1889 (pp. 271–272). It received a gold medal partly on the ground of the long services of the inventor to the solution of the problem.

Barbier Machine.

This also did not appreciably differ from that shown at previous trials. It has already been described in the *Kew Bulletin* (1888, p. 276 ; 1889, p. 269).

Subra Machine.

This resembled in some respects the two preceding machines. But the beaters work continuously without reverse action. There was an arrangement by which the workman in charge could elevate the upper feeding cylinder and so release the stems which were then reversed by hand. The jury was, however, of opinion that the Subra machine, except in the hands of exceptionally skilled workmen, would probably lead to serious accidents. It had, however, the advantage of removing the epidermis in great part as well as the woody core from the ribbons.

Like the Faure, the Subra machine in the form now described has also been abandoned.

Since 1891 the problem of treating the fresh stems of China grass by mechanical methods has engaged incessantly the attention of inventors. The results up to the present time are reviewed in the following pages. For convenience a general summary is given in the first place of the facts relating to the raw material.

Source of Material.

Perhaps the most important advance has been in the complete abandonment of the attempts hitherto made to treat the dry stems. This has been definitely acknowledged to have been a mistake, experience having proved that to obtain the full advantage of the many valuable qualities of the fibre the stems must be treated in the green state.

The original China grass so long cultivated by the Chinese under the name of *Tchou Ma* is *Bœhmeria nivea*, Hk. & Arn. The leaves in this are white-felted beneath. The plant is moderately hardy in temperate countries, and it grows well during the summer months in the South of England. During 1895 an exceptionally good crop was harvested in Kew from a small plot that had been established in the open ground for more than five years. An equally large crop is being produced this year (1898). The plants are, however, regularly cut down by the first frosts in October and do not sprout again until the middle or end of May. Thus only one crop is capable of being produced yearly. *Bœhmeria nivea* is the plant chiefly cultivated in the South of France, Algiers, the United States, and many parts of India. The plant is more readily propagated by division of the rhizome or rootstock than from seed.

Ramie or Rhea is probably only a geographical variety of China grass, but from an economic point of view the differences between them are so important that the two plants should be kept quite distinct. The Ramie or Rhea (*B. tenacissima*, Gaud.) is sometimes known as the green-leaved China grass. This name has been given it as the leaves are green on both surfaces. On this account it can be readily distinguished from ordinary China grass in the field. In habit the plant is more robust and the stems under favourable conditions are larger and more numerous. Ramie or Rhea is a native of Assam, the Malay Peninsula, and the neighbouring islands. Rhea is the Assam and Ramie the Malay name for one and the same plant. The Malay name is the one

generally used in this country; in India, Rhea is chiefly used. This plant thrives only in tropical countries and it is useless to attempt to cultivate it elsewhere. At Kew it will only grow well when kept under glass all the year round.

Both plants require good deep soil such as is found in alluvial deposits in tropical countries. The climate should be warm and humid and without a prolonged dry season. In the systematic treatment which China grass receives at the hands of the Chinese it is abundantly supplied with moisture and manure, and by these means several crops are produced in one season. Hence poor soil and rather dry situations are quite unsuitable for growing these plants. The relative yield of China grass and Ramie over large areas has not yet been definitely determined. This is a matter that deserves careful investigation, as also the relative quality of the fibres and their suitability for various textile purposes. The two plants are kept distinct in Jamaica. Mr. W. Fawcett, F.L.S., Director of the Botanical Department in Jamaica, states:—"The green-leaved "Ramie (*Bœhmeria tenacissima*) is evidently the best for low elevations, "while China grass with the white under-surface (*Bœhmeria nivea*) is "the best for the hills. At Cinchona (4,800 feet, with a mean tempera- "ture of 61·4° F.) the latter is growing 10 to 12 feet high." As regards difference in growth, Mr. W. Cradwick at the Hope Gardens (elevation 600 feet, mean temp. 75·4° F.) finds that the "green variety pro- "duces with similar treatment about double the number of canes per "root."

In the *Agricultural Ledger* (1894, No. 6, p. 4), issued by the Government of India, Dr. Watt draws attention to the different requirements as regards climate between China grass and Ramie in the following words:—

"It would obviously be a mistake to attempt the cultivation of the temperate-loving plant (*B. nivea*) in the tropical plains of India. But so far as can be ascertained this is actually what has been done in the majority of experiments hitherto conducted in India. From time to time fresh supplies have been imported from China and distributed all over this country, so that India may fairly be characterised as having fully attempted the acclimatisation of China grass, but done little or nothing towards endeavouring to extend the production of Ramie (*B. tenacissima*) which, for the sake of convenience of expression, we may characterise as its indigenous stock."

As regards other points of difference between China grass and Ramie the following opinion was expressed in a letter addressed by Kew to the India Office, dated the 8th May, 1890:—

"Whether the fibre of Ramie is at its best really as good as the best China grass (*Bœhmeria nivea*) is a point that appears not to have been definitely settled. It may turn out to be simply a question of soil and climate. China grass may give a larger and better supply of fibre under cool conditions, whereas Ramie or Rhea may do equally well under essentially tropical conditions. The question as regards India may easily be settled by cultivating under various conditions of climate and soil authentic specimens of each plant, and by instituting, as suggested by Dr. Watt, a careful chemical and microscopic analysis of the fibres yielded by Indian-grown plants of both *Bœhmeria nivea* and *B. tenacissima*."

In the United States, with a comparatively temperate climate, except in the extreme south, the plant so far cultivated is China grass (*Bœhmeria nivea*). In a "Report (No. 7) on the Cultivation of Ramie in the United States," by Mr. Chas. Richards Dodge, issued by the

U.S. Department of Agricultnre (Washington, 1895), the distinctions between China grass and Ramie are not so clearly kept in view as could be wished. Practically the former only is dealt with. But the name Ramie or Rhea is unfortunately applied to it. It is probable that China grass (*Bœhmeria nivea*) is the more common plant under cultivation at the present time, but it is possible also that, where Ramie or Rhea (*Bœhmeria tenacissima*) is grown, sufficient emphasis is not laid on the fact that it is not the ordinary China grass of commerce. As pointed out by M. Charles Roux in *Notice sur la Ramie*, "this error has crept "into many publications and has been extremely prejudicial to the "development of this culture. It has been represented that Ramie "(*Bœhmeria tenacissima*) is successfully grown in France, but well "organised experiments have proved that this is a mistake. Ramie is "essentially a plant of warm countries." The plant chiefly cultivated in France, and possibly in Algiers also, is China grass (*Bœhmeria nivea*). The fibre at present known in commerce as China grass is the produce of *B. nivea*, prepared entirely by hand labour in China. The stems are first stripped and the epidermis removed by scraping and washing, but a good deal of the gum is still left in contact with the fibre. This has subsequently to be removed by chemical means in Europe. The quantity of this China grass fibre available is somewhat limited. It forms, however, the chief source of the raw material used for China grass fabrics hitherto produced in this country and the Continent.

Ramie in commerce is a term applied indifferently to the produce of either *B. nivea* or *B. tenacissima*. Its chief use in Trade Reports appears to be to distinguish between machine-prepared fibre ("Ramie") and the hand-cleaned fibre of the Chinese ("China grass"). The machine-cleaned fibre in commerce consists of (1) ribbons or strips which are merely the cortical layer removed from the stems and dried; or (2) the grey, brown, or whitish fibre in a more or less cleaned condition, freed from wood, and from the epidermis and gummy matters.

The use of the term China grass applied to the hand-cleaned fibre shipped from China is free from objection. It is really the produce of *B. nivea*, and no confusion is likely to arise. The term should, however, be applied to all fibres, whether cleaned by hand or by machine, if originally derived from *B. nivea*. The latter might be called "machine-cleaned China grass." On the other hand the term Ramie should be strictly limited to the produce of *B. tenacissima*. A classification of the hand- and machine-cleaned fibres appearing in commerce (showing also their origin) might be adopted as follows :—

1. Commercial China grass (hand-cleaned in China). 2. China grass ribbons or *lanières* (hand- or machine-cleaned). 3. China grass raw fibre (machine-cleaned).	Produced from the China grass plant, *Bœhmeria nivea*.
1. Ramie or Rhea ribbons or *lanières* (hand- or machine-cleaned). 2. Ramie or Rhea raw fibre (machine-cleaned).	Produced from the Ramie or Rhea plant, *Bœhmeria tenacissima*.

The completely cleaned and bleached fibre or *filasse* could be easily distinguished as China grass filasse or Ramie or Rhea filasse, according to the plant from which it was orignally obtained.

During the last five years more interest appears to have been taken in these fibres in the new world than in the old.

The United States Department of Agriculture has organised a systematic series of experiments in different sections of the country, and these are likely to produce very interesting results. Mr. Richards Dodge's report (No. 7) already mentioned contains a large mass of very useful information. In fact, it may be regarded as containing, from the American point of view, all that is known practically of the cultivation and treatment of China grass.

Planting.

The following is extracted from the *Foreign Office Report, Annual Series*, 1897, No. 2017, p. 8 :—

"The cultivation of the Ramie plant [probably China grass], the fibre of which is superior to flax, on the lands owned by the Imperial domains at Chakva, near Batoum, is attracting a good deal of attention just at present. The climate and soil of the low-lying land in that locality appears to suit this plant extremely well, and within two years it has developed to so great an extent that the Administration of the Imperial domain lands is able to furnish a considerable quantity of the dried stalks to the Government Paper Mills at St. Petersburg, where it is to be used in the manufacture of the paper from which rouble notes and stamped bill of exchange forms are made."

As already stated, both China grass and Ramie have been grown experimentally in Jamaica, and a very useful Memorandum has been published by Mr. W. Fawcett, F.L.S., in the *Bulletin of the Botanical Department* (1894, pp. 33-34). This contains, also, a Report of the Jamaica Committee with reference to a prospective trial of the Allison Fibre Machine. The following extracts give the cultural results obtained in Jamaica (*Report of the Director*, 1894–95, pp. 221–224) :—

"From experience I think there is little reason to doubt that the best part of the plant to propagate from is the bottom of the ripe stem. If a field is being reaped, and it is desired to increase the area, then the canes should be reaped, cutting them to within two inches of the ground. Some one should then follow and grub out the remainder of the stalk, going low enough, if possible, to secure a little root on it. This will generally give a piece about 4 inches long, and if inserted into the ground with about half an inch left above the surface will make a strong plant in an incredibly short space of time. The old plants will be all the better for the removal of the stems for propagating. In the event of not wishing to propagate, care should be taken to cut the stems as low as possible, as the plants grow much stronger than when the old stumps are left 5 or 6 inches above ground.

"The best distance to plant is 12 inches apart, with 18 inches between the rows on fair land, but on strong land 18 inches to 2 feet would be quite close enough. If planted 9 inches apart they have to be hand-weeded when young, which is very expensive, whereas at 18 inches or 2 feet they can be hoed through. If the land is fairly rich and they are kept clean while they are young, they will grow so thickly, even at 2 feet, that very little weeding is required, except, perhaps, after cutting. The piece which was planted 3 feet apart is now so thick as almost to prevent any weeds growing, except when the crop is reaped."

For a long period Rhea has been grown in small quantities by the natives of Assam. A note on its cultivation was issued by the Agricultural Department, Assam, in April, 1897. This was prepared by Mr. F. J. Monahan, Officiating Director of Lands Records and Agriculture. He states that the Rhea of Assam at the present day is *Bœhmeria nivea*.

A useful memorandum on the cultivation of *Bœhmeria nivea* in Mysore was issued in 1897 by Mr. J. Cameron, F.L.S., Superintendent of the Lal Bagh Gardens at Bangalore. This contains an excellent, almost life-size illustration of the plant in flower and fruit.

A note on the same subject was published by Mr. Ridley in the *Agricultural Bulletin of the Malay Peninsula* for June, 1897.

A very interesting correspondence relating to the introduction of Ramie cultivation into Perak appeared in *Perak Museum Notes* (Vol. ii. pt. 2, pp. 103–124).

Yield of Stems and Fibre.

More accurate observation has shown the probable yield that may be obtained both in stems and fibre from a given area.

From a small patch of China grass (*Bœhmeria nivea*), five years old, growing in the open air at Kew, it has been found that 4 square yards yield 100 stems. The weight of these, without leaves, was 24 lbs. This gives a yield at the rate of 29,000 lbs. (say 13 tons) per acre In Algiers, Hardy found that an acre yielded 27,000 lbs. of similar stems without leaves. De Mas, at Padua, found that Ramie (*Bœhmeria tenacissima*) yielded in the second year stems, without leaves, at the rate of 26,300 lbs. per acre ; in the third year two crops yielded at the rate of 32,360 lbs. per acre. The weight of raw fibre (ribbons ?) per acre obtained by De Mas from 32,000 lbs. of green stalks, without leaves, was 1,280 lbs. or exactly 4 per cent. Favier gives somewhat similar results. His actual yield was 1,285 lbs. per acre. In California, Hilgard gives it at 1,935 lbs. per acre. It is probable that the yield of clean ribbons per acre on a large area, with two or three cuttings, will average about 900 to 1,000 lbs. per acre. Mr. Charles Richards Dodge, of the United States Department of Agriculture, is of opinion "that two " cuttings of second year's growth, when properly cultivated, will produce " 20 tons of green stalks with their leaves." Further, "as each ton of " green stalks, with leaves, will yield 46½ lbs. of clean, dry ribbons or raw " fibre, giving 25 lbs. of degummed fibre," we have, therefore, a return per acre from two cuttings equal to 930 lbs. of clean ribbons and 500 lbs. of degummed fibre or filasse. No returns of the actual fibre have, however, been made continuously on a sufficiently large scale to justify absolute confidence in them. At Wenchow, China, it has been found that an acre, in one cutting, yields 80,000 stems, giving 312½ lbs. of fibre. This would probably be the ordinary ungummed China grass as received in this country. Three crops would, therefore, yield at the rate of 937½ lbs. per acre.

Machines.

In this country many machines and appliances have been brought into notice, but owing to the absence of a suitable supply of green stems no exhaustive trials have been held. Such trials are only possible when a large area specially cultivated for the purpose is available. As already shown, the conditions in this country, except in specially mild situations, are not favourable for the cultivation of China grass. The stems grown at Kew have, however, been placed at the disposal of persons making application for them.

An experiment with these stems (*Bœhmeria nivea*) was made with a Subra machine in October, 1895. It must be understood that the results here given represent a single trial only, and no opinion is intended to be

expressed as to the capabilities of the machine working continuously on a large scale. The stems were divided into two series as follows :—

SERIES A.—Green stems : selected.

Series.	Condition.	No. of Stems.	Weight in grammes.	Weight of Wet Ribbons delivered by machine.	Wet Ribbons after shaking by hand.
I.	Stems with leaves attached.	27	1,361	454	318
II.	Stems without leaves.	29	1,134	567	319

SERIES B.—Green stems : rather woody.

Series.	Condition.	No. of Stems.	Weight in grammes.	Weight of Wet Ribbons delivered by machine.	Wet Ribbons after shaking by hand.
III.	Stems with leaves.	21	2,722	907	459
IV.	Stems without leaves.	22	2,268	1,021	599

The Subra machine (in its present form) weighs about 3 to 4 cwts., and has the appearance of an ordinary chaff-cutter. The stems, 12 to 20 in number, are fed at one end, and pass quickly through a series of crushers and rollers, and are delivered on a revolving apron, from which they are taken by hand and well shaken. The latter treatment gets rid of most of the adhering wood. The ribbons are then ready to be hung up to dry. The machine requires one-half horse power, but was worked during the trial entirely by hand. The stems can be treated either with or without the leaves. There is no reverse action as in most machines, and hence the whole of the stems pass rapidly through, and are at once delivered on the apron ready for shaking and drying. It is impossible to speak conclusively of a single trial, and with such a very limited number of stems. The following reports on the trial, furnished to the Subra Company by Messrs. Cross & Bevan, give, however, the results actually attained :—

No. 1.

MESSRS. CROSS AND BEVAN to THE SUBRA COMPANY, LTD.

Laboratory, 4, New Court, Lincoln's Inn, W.C.,
October 16, 1895.

DEAR SIRS,

HAVING been present at your request at a trial of the working of your Decorticating Machine (Subra, Eng. Pat. 23,642/94) we now beg to report as follows :—

China Grass Stems (*green*).—The stems were supplied from Kew The results obtained on the machine were quite satisfactory. The

ribbons prove on examination to be intact, and are, therefore, stripped without injury to the filasse. The wood was quite free from fibre, and on the other hand the ribbons retained only a fractional percentage of wood. We, of course, had no opportunity of making a continuous run with a large weight of stems, and can therefore only form an estimate of the behaviour and output of the machine under ordinary conditions of work. Our estimate is favourable. We were not able to see any weak point in construction or operation calculated to interfere with continuous working and steady efficiency.

Yours faithfully,

(Signed) CROSS & BEVAN.

Messrs. The Subra Fibre Co., Ltd.

No. 2.

MESSRS. CROSS AND BEVAN TO THE SUBRA COMPANY, LTD.

Laboratory, 4, New Court, Lincoln's Inn, W.C.,
October 21, 1895.

DEAR SIRS,

WE beg to hand you the further results of our examination of the samples of China grass ribbons referred to in your favour of the 9th instant. Each sample was received sealed.

The following are the results :—

—	1.	2.	3.	4.
Weight as received by us, in grammes - - -	318	319	459	599
Weight when air-dried - - - - - -	72	68	129	148
Weight of adhering wood - - - - -	4·5	2·0	2·0	3·8
Percentage of adhering wood - - - -	1·4	·6	·43	·6
Weight of filasse - - - - - - -	—	—	76	—
Percentage of filasse on green ribbons - - -	—	—	16·5	—
Percentage of filasse on dry ribbons - - -	—	—	58	—
Percentage of cellulose in filasse - - - -	—	—	80	—

Yours faithfully,

(Signed) CROSS & BEVAN.

Messrs. The Subra Fibre Co., Ltd.

The result of the investigation in regard to Sample 3—mature stems with leaves—may be summarized as follows :—The green stems with leaves weighed 2,722 grams., and yielded air-dry ribbons weighing 129 grams. This is at the rate of 4·7 per cent. The same dry ribbons yielded filasse weighing 76 grams. This is at the rate of 58 per cent. on the dry ribbons, and at the rate of 16·5 per cent. on the wet ribbons. On the other hand the percentage of filasse obtained from the green stalks with leaves is 2·8 per cent. According to this, 100 tons of green stems with leaves (of *B. nivea*) will yield 4·7 tons of air-dried ribbons, and 2·8 tons of pure fine filasse.

While the yield of air-dried ribbons closely agrees with the Paris trials, the yield of filasse is nearly double.

The following report was made by Messrs. Ide and Christie on a sample of China grass ribbons prepared by the Subra machine from green stems grown at Kew :—

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, E.C.
2nd October 1895.

SIR,

YOUR favour of the 29th instant, with the sample of China grass ribbons, is duly to hand. The latter appear to be fairly well done, but we notice many bits of the wood still adhering to them. This should not be, as it is a fatal objection with many.

We value them at 10*l.* to 12*l.* per ton, but would require a few tons for distribution before being able to say definitely whether in this state they would be preferable or otherwise to the ordinary cleaned China grass.

Yours faithfully,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., C.M.G., D.Sc.

Faure's Decorticator.

The Faure machine, as already stated, has taken a new form since the Paris trials of 1891. The improved machine was under trial at Limoges in July of 1897. In the construction, the inventor has aimed at the production, in one operation, not of ribbons or strips, but of fibre "free "from woody matter, from skin, and with the least amount of 'juice' in "it." He claims that the product is equivalent to commercial "China grass," but in a more uniform condition, and free from the possibility of adulteration. The new Faure machine "is fed by two men, working "alternately, each holding in his hand about 10 stems. The stems are "treated green in the same condition as cut, with the leaves attached. "The operation of feeding is as follows :—The stems are passed twice. "They enter the machine leaf end first, and after being treated about "two-thirds of their length they are withdrawn, an operation easily "carried out, and fed in a second time, the thick end first, so as to "complete the operation . . . The machine is simple in construction. "Practical experience shows that two men working at one machine can "treat 360 pounds of fresh green stems per hour, or about 35 cwts. per "day of ten hours. The amount of dry fibre produced depends on the "nature and growth of the stems . . . On a 5 per cent. basis, the "net production of dry fibre by each machine per day is 180 pounds. ". . . . Under ordinary circumstances, a production varying from "160 to 200 pounds of dry fibre in ten hours per machine may be "expected."

This is the inventor's own account of the capabilities of the machine. The first point that will occur to those acquainted with the numerous efforts to extract the fibre by mechanical means is the necessity that still exists, even in this improved machine, to pass the stems twice into it. About two-thirds of the stem are first cleaned and withdrawn, they are then reversed, and fed in a second time to complete the operation. This practically reduces the capabilities of the machine almost by one-half.

Experience in the cleaning of Agave leaves (a problem now happily solved) has shown that the only effective way is for the raw material to be presented once only to the machine and it should pass through without further handling. When this is the case a boy of 15 can do

the work of two men, and feed a machine yielding half a ton of dry fibre per day.

It is to be noted that the prepared fibre from the Faure machine is claimed to be "equivalent to commercial China grass." The latter is hand-cleaned fibre with an average value in the London market of about 30*l.* per ton. With a possible maximum yield of 2 cwts. of dry fibre per day from the Faure machine the gross value would be 3*l.* This would be the approximate value of fibre "produced on a 5 per "cent. basis from a ton of green stalks with leaves."

The most complete and recent account of the Faure machine is given in the report of a lecture delivered before the Indian Section of the Society of Arts by Mr. Thomas Barraclough on the 25th March 1897. This is published in the *Journal Soc. Arts.* (Vol. xlv., April 2, 1897, pp. 424–440); see also *British Trade Journal* (May 1, 1898).

"The machine, which weighs 11 cwt., is very strong and not liable to get out of order. It consists mainly of the framework and driving-gear, the decorticating drum carrying beaters and the feed-bed. This latter is the important feature of the machine, by reason of its special contour which varies at different parts to suit the various descriptions of work which the machine has to perform. The first part of the bed is curved outwards, the second is straight, and the third is curved inwards. The stems are fed into the machine over the first part of the bed, where the woody portion becomes immediately broken and partly removed: the strip passes on to the second part, and as the speed of the beaters is considerably greater than that at which the stems are fed into the machine, a scraping effect is produced on the strips, seeing that the distance between the beaters and the surface of the bed is less than the thickness of the strip. This scraping action effects a double purpose: it attacks the outer skin and also all matters extraneous to the fibre. The strips then pass down vertically into the machine, and the separated matters, viz., most of the woody parts, the skin, and gummy substances, are thrown out to a distance by the centrifugal force of the beater drum. When the stems have entered to within a short distance of their end, the return movement is effected and they are withdrawn. During the withdrawal the following action takes place: At the inward curve or third part of the bed, the filaments are slightly and gradually grazed by the beater blades, which throw out the coarser of the *débris* still adhering. The operation is performed with great delicacy; the fibres assume the position of the chord of the curve, and are constantly agitated by the beaters. When the fibres arrive at the second part of the bed, as the space between it and the beaters is infinitely reduced, the entire removal of matters still adhering to the fibres is effected, and these latter leave the machine white, parallel, and free from woody matter, from skin, and from the major portion of the juice. The concave bed or breast is mounted in such a way that its position to the action of the beaters is easily regulated. The brackets which carry the bed are supported by spiral spring cushions and flexible legs, the object being to obtain a rubbing action between the beaters and the fibre, having for its special object the loosening and removal of the skin. The elastic bed gives way or vibrates an enormous number of times per minute, and this produces the desired rubbing or 'knuckle-joint' action between the beaters and the fibres on the bed. The shape of the feed-bed causes it to remain clean and free from extraneous matter through the action of the beaters. Choking is thus rendered impossible. All abnormal strains are avoided, and the machine can be kept at work from morning till night without stoppages for cleaning. The refuse falls

underneath the machine, and is removed from time to time. In the case of a number of machines working together, an endless band or conveyer, passing under the machines, removes the refuse continually, and so keeps the neighbourhood of the machines perfectly free from it."

McDonald-Boyle Decorticator.

This machine, also constructed on the plan of a revolving drum and beaters with a reversing process, has been carefully tried in Trinidad and Jamaica, and appears to be under trial at the present time in the Malay Peninsula.

The results of the operations in Trinidad are given in the *Proceedings of the Agricultural Society* (1897, pp. 149–153). The following is an extract :—

"The McDonald machine the committee saw at work simply produced 'Ramie ribbons' by breaking up and detaching the woody core of the stems, which it did far more expeditiously and cheaply than could be done by the cheapest hand labour, and the operation is so easy that the machine cannot get clogged or out of order, and requires no skilled labour. The machine was under the disadvantage of being run by a steam engine not under proper control, but in ten minutes we saw it decorticate 18 lbs. of stem, giving 2½ lbs. of green fibre, which would equal 1 lb. of dry. Working under proper conditions, we are of opinion the machine with one trained man would be able to treat about one ton of stems in 12 hours, yielding one cwt. of ribbons, which is estimated to give 75 per cent., or 84 lbs. of 'filasse' or cleaned fibre, after undergoing the degumming process.

"The Boyle process degums the ribbons by treating them with certain simple and inexpensive chemicals, and we saw the process carried out on a small scale."

The results in Jamaica are published in the *Journal of the Jamaica Agricultural Society* (Vol. 1, 1897, pp. 271–272). The summary of five tests was as follows : Weight of green stems passed through the machine, 99 lbs. 14 ozs. ; time occupied in treatment, 81 minutes ; weight of wet ribbons produced, 18 lbs. The Committee added, "We " think the whole process can only be operated successfully on a large " scale by the central factory system."

In a report issued by the Foreign Office (No. 2,139, Annual Series, 1898) on the trade of Guatemala, Mr. Consul Trayner states that experimental trials have been conducted by a wealthy inhabitant of that country who claims that, with a machine prepared locally, "the Ramie " can not only be decorticated, but also degummed without damaging " the fibre." It is impossible to offer an opinion on the merits of this machine with our present information, but, if it realises the expectations of the inventor, we shall doubtless hear more about it.

Degumming.

No machine can do more than decorticate the stems of China grass, and more or less clean the fibre. There is still the further task of converting this into filasse fit for manufacture. One intricate element in the problem is the dovetailing of the two processes, one mechanical, the other chemical. It was at first supposed that the degumming processes could effectually deal with ribbons, from which they would remove everything except the filasse. But there is some risk of injuring this by the prolonged action of chemicals, the treatment with which it is desirable to reduce to a minimum. Hence mere conversion into ribbons

was thought to be no longer sufficient ; the epidermis must be got rid of, and the fibre as far as possible mechanically separated. But at present the tendency appears to be to fall back on ribbons, and this implies the existence of methods which will produce filasse uninjured by the chemical treatment. Great hopes have been entertained of the Favier process, which still seems to hold the field in great measure. The United States Consul at S. Etienne in a report quoted in the *Journal of the Society of Arts* (Nov. 16, 1894, p. 946), describes this as "a chemical process of which M. Favier keeps the secret, but which is "supposed to consist of a weak alkaline solution in which the fibres are "boiled." Mr. Barraclough, in the lecture already quoted, says (p. 431) : "Manufacturers use a variety of processes and apparatus. As a rule, "the most successful of them keep their processes of degumming and "bleaching to themselves, and do not patent them."

Boyle Process.

The following information respecting this process is taken from the *Glasgow Herald* (Aug. 13, 1895) :—

"The Midland Spinning Company of Long Eaton claims that for the past twelve months it has 'been engaged in treating and degumming 'Ramie, and spinning the result into yarns which are being sold in the 'open market at very remunerative prices.' The process is the invention of Mr. H. H. Boyle, and is patented. The China grass or Ramie arrives at the works in the form of ribbons or *lanières*. It is passed through a series of tanks, or chemical baths, which remove the gum and subsequently soften and bleach the fibre. The Ramie is drawn slowly through these, clasped between two endless chains kept moving by suitable gearing. At the feeding end the chains are kept about one foot apart one above the other, but as they near the first tank they approach until they firmly grasp the bundles of Ramie placed between them. As the fibre passes from one tank to another the chains again separate and allow the Ramie to pass between rollers, which are fluted breaking cylinders in the first stage and wringing rollers in the latter part of the process. The gum is dissolved in the first tank, and when the Ramie has passed the rollers the fibre is sufficiently loosened to be pulled out free from the woody part of the bark. When the Ramie finally emerges at the end of the apparatus it is a pure white filasse, and after drying in a heated room is made into 'sliver.' The time occupied is a little over five hours. The sliver is gradually reduced to yarn by the usual roving and spinning frames, which are exactly similar to those for spinning silk and long-staple wools. Thus there can be no difficulty in working the Ramie-sliver in other spinning mills with their ordinary machinery. Twines, fishing-lines, and sail-cloth are also manufactured."

Gomess' Process.

A chemical process, the invention of Mr. A. F. B. Gomess, for the treatment of China grass or Ramie ribbons, has been much discussed during the last three years. It is not intended to deal with hand-cleaned commercial China grass, but with "Black Rhea," by which is probably meant the stiff brown ribbons obtained by drying the bark when removed from the stems without any preparation beyond getting rid of the moisture in it. The ribbons may be stripped either by hand or by machine. From these dry hard ribbons it is claimed that by chemical means all woody particles, the epidermis and gum are removed,

and that the fibre is delivered in the form of filasse ready for being combed and spun into yarn. This is practically all the information so far obtainable in this country. It appears, however, that an effort is being made to grow the China grass plant (*Bœhmeria nivea*), and the Ramie or Rhea plant (*B. tenacissima*) in India in order to supply the raw article in a suitable condition to be treated by this process. The following particulars are taken from the *Madras Weekly Mail* (July 1, 1896) :

"The owners of the Gomess process, who are represented in England by the Rhea Fibre Treatment Company, Limited, 17, Shaftesbury Avenue, London, W., and in this country by the Indian Rhea Fibre Parent Company, Limited, Bombay, are prepared to contract for the purchase of large quantities of dried ribbons of bark, and in regard to this the London Company report :—

"(a.) That they require the raw material in the shape of ribbons ; that is, the whole bark hand-stripped from the stem, thoroughly dried, and packed in bales.

"(b.) That they prefer the species *Bœhmeria nivea*, but that they can also use the *Bœhmeria tenacissima* and Ban-rhea (*Villebrunea integrifolia*).

"(c.) That the quantities required by the London Company would be continuous and very large ; that it would be difficult to give exact figures, but that they could do with 10,000 tons to commence with.

"(d.) That they are at present prepared to contract at prices equivalent to from 10*l.* to 11*l.* per ton. delivered in London, or at 7*l.* a ton at port of shipment in India."

Further particulars may be obtained from a publication entitled "Rhea, its Cultivation, Decortication, and Baling, and the subsequent "treatment of the Ribbons by the Gomess Process," issued by the Rhea Fibre Treatment Company, 17, Shaftesbury Avenue, W.

Summary.

Few practical problems have consumed so much time and energy as the attempt to bring China grass and Ramie into use for manufacturing purposes. Notwithstanding all the expenditure of mechanical skill and inventive ability, the conclusion cannot be evaded that we are still as far off as ever from being able to place upon the market a finished product which will effectually compete with silk, flax, and the better qualities of cotton.

The plants can be grown with the greatest ease. But when the problem of treatment is solved, the supply of the raw material will be limited to warm countries. The cultivation of China grass in temperate regions will never be able to compete successfully with that of Ramie (or perhaps of China grass) in the tropics. It is known that when ribbons can be produced sufficiently cheaply, these can be degummed and turned into filasse at a small cost. The whole question then still turns, as in 1888, on the production of ribbons. We are still waiting for a decorticator which will not merely turn out ribbons fit for further manufacturing processes—that has been accomplished—but will turn out, say, half a ton a day at a small cost. Till this has been found, the planter cannot profitably deal with his crop, and the degumming processes now almost entirely dependent on hand-cleaned fibre from China are paralysed for want of a supply which will allow the finished product to compete with other fibres.

The ribbons must be susceptible of being delivered to the degumming factories at a cost not exceeding 7*l.* to 9*l.* per ton. This would pay the planter if he had a decorticator which would enable him to prepare the ribbons at a cost which would leave a profit. At present he cannot produce ribbons under 12*l.* to 15*l.* a ton.

Then the degumming processes should turn out filasse at a total cost of 36*l.* to 40*l.* per ton. At this price the demand would be considerable and a large and prosperous industry would result. To put the position in other words, filasse must be put upon the market at about 4*d.* a lb. To use the words of one of the speakers in the discussion at the Society of Arts, "unless it could be brought down to something like the price of "cotton or flax, it was impossible to make any profit out of it."

XXXI.—MANILA HEMP.

(*Musa textilis*, Née.)

[K. B., 1887, April, pp. 1–3.]

This is one of the most important of cordage fibres, and the whole supply comes from the Philippine Islands. The imports of Manila hemp to Great Britain amount to about 170,000 bales, and to the United States about 160,000 bales, equal to about 50,000 tons per annum. The fibre is yielded by a member of the banana or plantain family known locally as Abaca (*Musa textilis*), the apparent stem of which is made up of sheathing leaf stalks. The habit of growth and treatment of the plant under cultivation are identical with those so well known in the case of the common banana. The fruit of *Musa textilis* is green and hard and useless as food.

From a report by Consul Honey, dated Manilla, 10th April 1879, we gather that this plant thrives best in soils largely composed of decayed vegetable matter. Hence, freshly cleared forest land is essential. Hilly land, about 200 feet to 500 feet elevation, is considered more suitable than low-lying land, probably on account of drainage. The Manila hemp plantations are situated where there is a rich volcanic soil, and where the climate is hot and humid with a heavy rainfall. The plants suffer severely during drought. Although seed is produced plantations are usually established by means of suckers put out when about 3 feet high, and about 8 to 9 feet apart. These form a root-stock, from which numerous stems are successively produced. The land is cleaned of weeds about twice a year. The first crop is reaped at the end of the second year after planting; a full crop is not obtained until the fourth year. The yield is then continued for 15 to 20 years, after which the plantation is exhausted. The stems are fit to be treated for fibre just before they begin to flower. In stems that have been allowed to flower the fibre is said to be weaker and of less value. They are cut about a foot from the ground and the leaves removed. Each stem is then stripped or resolved into its component layers, and these are again divided into strips or ribbons about 3 inches wide. Usually each layer or leaf-sheath is divided into three strips. The outer layers contain a coarser and stronger fibre than the inner, while fibre from near the middle is of a fine silky texture, and capable of being utilised for purposes of spinning or weaving and made into articles of dress and ornament.

The method of preparing the fibre is very simple but effective. Each strip, in a fresh succulent condition, is taken up by hand and drawn

deftly "between a blunt knife and a hard smooth board," which are attached to a light portable frame. This process, repeated several times if necessary, removes all the watery particles and pulp, and there remains in the hands of the operator a beautifully white and lustrous fibre. The fibre is thoroughly dried in the sun and afterwards packed in bales for shipment. Hemp not properly dried, or exposed to rain, becomes discoloured and loses strength. On the other hand, hemp from the outer layer of the stem is of a reddish colour, but is quite sound. It is a characteristic of Manila hemp that it readily absorbs moisture, and in an ordinary dry condition it contains 12 per cent. of water. In a damp climate it has been known to contain not less than 40 per cent. of water.

Cordage, ropes, and indeed everything made from Manila hemp can be easily converted into paper of excellent quality.

The cost of establishing a Manila hemp plantation in the Philippines, including cutting down forest, cleaning and planting, is about 5*l.* to 8*l.* per acre. This does not include the cost of the land. After this the yearly expense of weeding and maintaining the plantation in full bearing is at the rate of 30*s.* to 35*s.* per acre. The yield during the fourth and subsequent years is at the rate of 400 to 700 pounds of dry hemp per acre. "A labourer working under pressure can clean nearly "20 pounds of hemp per diem; but as a rule the quantity cleaned by "one man working steadily, day by day, averages about 12 pounds." Usually two men work together, one cutting down the stems and splitting them while the other cleans the fibre. "At the current "value of hemp in 1879 one labourer's earnings were 7½*d.* to 8*d.* "per diem." Several attempts have been made to introduce machinery, but so far nothing has been so successful as the primitive method above described. It is essential that any machinery introduced should be of a light and portable character, and that it should clean the fibre at a cheap rate, without breaking it.

From these particulars it will be seen that the Manila hemp industry is, to a large extent, supported by special circumstances which happen to be favourably combined in the Philippines, and hence there is produced an exceptional article in large demand at a comparatively cheap rate. The conditions of soil and climate may possibly be found elsewhere, but, as a necessary adjunct to these, there must be an abundant and cheap supply of labour adapted to a rural industry.

A plant of Manila hemp (*Musa textilis*) may be seen in the Palm House at Kew. For the purpose of illustrating the industry there are very complete sets of exhibits in the Kew Museum, No. 2. These include the raw fibre, cables, ropes, twine, fine muslin fabrics, "half stuff," and paper of all kinds, the latter being made from old Manila ropes.

The valuable character of the fibre yielded by *Musa textilis* has naturally drawn attention to it as a valuable industrial plant, and during the last 60 years it has been introduced to India and elsewhere for experimental culture. Plants of *Musa textilis* were cultivated at Calcutta in 1822; specimens were introduced to the Madras Presidency direct from the Philippines in 1858; while in the Andaman Islands this fibre plant has been thoroughly established.

Experiments in India so far have shown that plants of *Musa textilis* can be successfully grown in many districts; but it is not yet clearly shown that the fibre can be cleaned so expeditiously and so cheaply as to compete successfully with fibre from the Philippines.

After a systematic series of trials made by the Glenrock Company at Madras in 1885, it is stated that plants put out in 1864 grew well and yielded numerous shoots. 179 stems, weighing about 60 pounds each, were cut down for experimental purposes and passed through Death and Ellwood machines. These produced 159 pounds of clean fibre, or 1·49 per cent. of the green stem. The cost of cleaning the fibre was at the rate of 6*l.* per ton, while the fibre itself, described as "poor, weak, and flaggy, with some clean fibre of good colour," was valued in London at 10*l.* per ton; the best alone was valued at 25*l.* per ton. The minute upon this of the Government of Madras is that "unless much improvement both in the method and cost of production of "this fibre can be made, the cultivation cannot be made remunerative."

Manila hemp plants have been introduced from Kew to Jamaica, and to other portions of the West Indies. In favourable situations they grow well; but not so readily as the ordinary bananas and plantains. As the fruit is valueless they can only be grown for the sake of the fibre and this alone does not appear to offer sufficient inducement to plant up large areas. Usually the return from a fruiting stem of the common banana or plantain would be from 6*d.* to 2*s.*, depending upon the size of the bunch. The return from the Manila hemp plant would according to experience in the Philippines be about one pound of fibre, the local value of which would be only 2*d.* to 3*d.*

XXXII.—MANILA HEMP IN BRITISH NORTH BORNEO.

[K. B., 1892, p. 243.]

The following note on Manila hemp in British North Borneo is taken from Mr. Consular Agent Pryer's Report, published by the Foreign Office [1892, Annual Series, No. 1,111]:—

"Manila hemp is the fibre of the stem of a sort of banana, *Musa textilis*, which hitherto has been grown only in the Philippine Islands, where it is a source of great wealth to the growers, the Government, and all concerned, and is the means of affording freight to a large number of vessels. The soil and climate of North Borneo have also been proved, owing to a series of experiments conducted during several years past, to be particularly favourable to the proper growth of the plant; satisfactory samples have been sent home, and the cultivation is now being considerably extended. Owing to the heavy taxes, &c. in the Philippines, it is claimed that North Borneo can put its hemp on board the export ship at a lower price than the Philippines can, and the first steps of North Borneo to rival the Philippines in this production are being watched with much interest, as once started this industry may become of very large proportions in the future."

XXXIII.—PLANTAIN AND BANANA FIBRE.

(*Musa sapientum*, R. Br.)

[K. B., 1887, April, pp. 5–8.]

In connection with Manila hemp some reference may be made to fibres produced by other species of the genus *Musa*. Mr. Morris, the late

director of the Botanical Department, Jamaica, discusses the subject as follows :—

"It would appear that the fibre of the ordinary plaintain and of the "banana is valued at about 12*l.* or 15*l.* per ton. This it will be noticed "is only one-third the value of the best qualities of Manila hemp. There "are in both the East Indies and West Indies numerous wild species of "*Musa* which might yield good fibre, but so far none appears to have "been found equal to the plant yielding Manila hemp. The following "facts have been elicited by recent experiments. A banana stem just "after fruiting, cut as is usual with the country people, about 2 feet "above ground, and denuded of its foliage, weighed 108 pounds ; this "being divided into three lengths of $2\frac{1}{2}$ feet each and split longitudi- "nally into several pieces was prepared by beating and washing by "hand, and yielded 25 ounces of clean marketable fibre, which is at the "rate of 1·44 per cent. of the gross weight. The fibre of the lower "portion of the stem, as also the fibre in the petioles of the leaves was "not extracted.

"A smaller banana, cut under similar circumstances, that is, 2 feet "from the ground, and denuded of its foliage, weighed 41 pounds. "This was divided into two lengths of $2\frac{1}{2}$ feet each, and after being "split longitudinally into several pieces was prepared by hand, and "yielded $6\frac{3}{4}$ ounces of good clean fibre or at the rate of 1·02 per cent. "on the gross weight.

"At the Hope Plantation similar experiments were conducted with "banana stems which yielded very much the same results. Two banana "stems cut after fruiting, at two feet from the ground, and denuded of "their leaves, weighed 147 pounds. These yielded 33 ounces of clean "fibre, or at the rate of 1·44 per cent. on the gross weight.

"From ordinary stems of banana, cut after fruiting at about $1\frac{1}{2}$ to "2 feet above ground, a settler might easily prepare about $1\frac{1}{2}$ pounds "of clear fibre, but if the stems are large, and if the whole length is "used as well as the petioles of the leaves, the amount of fibre might "be increased to $2\frac{1}{2}$ pounds if not 3 pounds per stem.

"With plantain stems* the results are more satisfactory than with "the banana, both as regards the yield and the quality of the fibre.

"At the Castleton Gardens, a plaintain stem weighing, when cut and "dressed, 25 pounds, was prepared in exactly the same manner as the "banana stems above described and yielded $7\frac{1}{4}$ ounces of clean fibre or "at the rate of 1·81 per cent. on the gross weight. At the Hope "Plantation a plantain stem weighing exactly the same. viz., 25 pounds, "yielded 9 ounces of clean fibre or at the rate of 2·25 per cent. on the "gross weight. The plantain fibre is whiter and finer than the banana "fibre, and it approaches more nearly to the fine glossy character of the "fibre of the Manila plantain.

"For purposes of comparison I had the fibre of a small stem of the "Manila plantain, which, cut at 6 inches above ground and trimmed, "weighed 10 pounds, prepared in the same manner as the banana and "plantain fibre, and the result was 3 ounces of a beautifully fine and "glossy fibre. This is at the rate of 1·87 per cent. on the gross "weight.

"In Jamaica another plantain is known as the Abyssinian plantain, "*Musa Ensete*, which is the largest species of this genus. It was

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*It is to be understood that in these notes the plantain is what is used as a vegetable, while the banana is the soft sweet fruit seen on tables for dessert. In India the name plantain appears to be applied indifferently in both of these.

"discovered by the traveller Bruce in Abyssinia, and is remarkable as "being represented on ancient Egyptian sculptures. Specimens of this "plantain growing at the Government Cinchona Plantations at 5,000 "feet have often leaves 20 feet long, the stem is about 8 feet in circum- "ference at the base, rises to a height of 25 feet and weighs probably "about a quarter of a ton.

"Specimens of fibre prepared from this plantain are of excellent "quality. Taking a portion of the central stem about 4 feet long and "weighing 73 pounds, clean fibre, weighing 13 ounces, was obtained "by beating and washing by hand. This is at the rate of 1·16 per "cent. on the gross weight.

"This plant might be grown extensively for its fibre, and it should "prove valuable, but of course not equal to *M. textilis*, which is un- "approachable as a fibre plant."

It may be mentioned that samples of all the banana and plantain fibres noticed above are to be seen in the Kew Museum, No. 2.

From the same source we find that about 2,000,000 banana stems, after the fruit is gathered, are cut down every year in Jamaica, which are allowed to rot on the land without any attempt being made to utilize the fibre they contain. It is suggested by Mr. Morris that the merchants who purchase the fruit from the negroes should offer a small sum for clean and well-dried fibre, and take it in small lots as it comes to hand. The merchant might afterwards sort and pack the fibre and put it up in tightly compressed bales for shipment. Some such plan as this, suited to local circumstances, evidently offers the best means of starting a banana-fibre industry in the West Indies.

In the course of the energetic efforts made by Governor Sir William Robinson, K.C.M.G., to develop what are called "minor industries" at Trinidad, attention has naturally been directed to the utilisation of fibre from both the cultivated and wild species of *Musa*.

A "red banana," very commonly cultivated as a shade and fruit plant, and the supply of which is said to be almost inexhaustible, has been brought forward as a possible source of commercial fibre.

A sample of fibre prepared from this red banana was recently sent to Kew, and the opinion of Messrs. Ide and Christie obtained upon it. Their report, dated 29th October 1886, is as follows :—

"We think highly of this fibre, for which we consider there might "be a considerable demand, provided it could be produced of a better "colour. We are inclined to think its dull hue is probably the result "of inexperience in its treatment, either by allowing it to steep too "long in rather foul water or from the leaves being too old and "discoloured before treatment. The attention of planters should be "directed to the production of a fibre of the bright natural colour of "the enclosed specimen of Manila hemp, and were quantities of the "new fibre produced of this appearance we think they would command "24*l.* or 25*l.* per ton, to-day, in the London market. Colour is of great "consequence when fibres are used for the production of 'white hemp' "ropes. Of course, in the manufacture of tarred rope colour is of no "moment, but the white 'hemp,' from Manila, Yucatan, and New Zealand "are seldom tarred."

It is quite possible that, in spite of many years of experimental trial, the fibres of the banana and plantain may not assume great commercial importance. In that case attention might be turned in another direction, and they might be partly prepared on the spot and utilised for paper-making. But to compete successfully with esparto and wood-pulp the fibre or "half-stuff" of banana and plantain should be delivered in

Europe at a cost not exceeding 4*l.* to 6*l.* per ton, depending on condition. For paper-making it might be sufficient to cut the stems into short pieces, and then divide them longitudinally into numerous narrow strips. These, after being passed between rollers to get rid of the water and mucilage, might be dried in the sun, and afterwards put up in compressed bales for shipment.

The whole subject resolves itself into a question of cost, and it can only be practically solved in countries like Demerara, Trinidad, and Jamaica, where several thousand acres are occupied by banana plantations, and where sufficient material lies close at hand to maintain a moderately large industry.

For some years considerable interest has been taken by the Government of Bengal in the subject of the utilisation of plantain stems for the manufacture of paper. In a report presented by Dr. King, Superintendent of the Royal Botanic Gardens at Calcutta, he mentions :—"Since receiving these papers I have gone into the whole "matter with some care, and I now give you the results. Before "proceeding further, I wish to explain that in the following remarks "the term *plantain fibre* is used to designate the fibres of the various "kinds of plantain found wild and cultivated within the Indian "Empire, but does not include the fibre of the Manila plantain (*Musa* "*textilis*), which is a fibre of an altogether exceptional kind. The "fibre of the Manila plantain, usually known as Manila hemp, is one "of the most valuable fibres known, and is worth in London from "30*l.* to 40*l.* a ton, a price that takes it quite out of the range of raw "materials for paper.

"I have ascertained by reference to a large English paper-maker, "that if it can be delivered cheap enough, plantain fibre would be "readily bought in England for paper-making. Quotations as to the "exact value of the fibre can hardly be given until a trial shipment "has been put on the home market. Esparto is the fibre against "which plantain fibre would be pitted as a raw material for the paper-"maker, and the price of the best Spanish esparto now (1883) stands "in London at about 10*l.* per ton. It is not likely that plantain fibre "would be so valuable as esparto, but it might bring as much as 7*l.* to "8*l.* per ton."*

It appears that the Bally Mills Company, near Calcutta, has for some time utilised the stem of the cultivated plantain for paper-making, and the results are said to be satisfactory. The company purchase the roughly dried stems from contractors who collect them from villages in the neighbourhood. The price paid by the mill is 3*s.* 6*d.* to 4*s.* per cwt., according to quality. In this instance the preparation of the fibre is very simple. The plantain stem is cut down after fruiting, and the outer sheathing portions are cut into strips and thoroughly dried in the sun. The leaves and central core being useless, only about two pounds of rough fibre are obtained from each stem. By this rough mode of preparation the fibre is not freed from the cellular tissue, and although it can be utilised on the spot it is doubtful whether it could be exported in this state.

An attempt was made in the latter part of 1883 to utilise the thousands of acres of wild plantains growing in the Chittagong Hill tracts, which it was thought might yield large quantities of fibre at cheap rates. It was found, however, that any attempt at crushing the

* Spanish and Algerian espartos are quoted in London (Dec. 1886) at 70*s.* to 110*s.* per ton. The estimated value of plantain fibre must therefore be reduced to one half of the above.

stems in a fresh state entailed heavier machinery than could be easily moved from place to place, and the idea was ultimately abandoned without any practical results being achieved. In spite of this, however, Dr. King is of opinion that plantain stems in India will eventually become available as paper material, and considering the immense number grown for shelter, shade, and food purposes, the subject is of considerable importance, both to the people of India, and to paper-makers.

XXXIV.—PLANTAIN AND BANANA FIBRE—(continued).

[K. B., 1894, pp. 289–293.]

[EXTRACT.]

The fibre produced by the stems of various sorts of Musas has received attention from the earliest times. Dampier noticed that at Mindanao, in 1686, "the ordinary sort of people wear cloth made of plantain-tree which they call *Saggen*, by which name they call the plantain." To prepare this cloth they cut the plantain stem into four quarters, "which, put into the sun, the moisture exhales; they then take hold of the threads at the ends, and draw them out; they are as big as brown thread; of this they make cloth, which is stubborn when new, wears out soon, and when wet it is slimy." About the beginning of this century the Government of Jamaica offered rewards of 20*l.* "for the best specimens of plantain hemp produced in each county of "Jamaica." Dr. Stewart West, then acting-botanist in charge of the Bath Garden, gained the premium for the best specimen produced in the county of Surrey. The particulars are given by Lunan, vol. ii., pp. 75–76. The fibre was cleaned by being passed through a "cramp" fixed in the ground, and hung up to dry as soon as possible. It was pointed out that "the goodness of the fibre depends upon completely evaporating the sap, otherwise the least fermentation greatly impairs its strength; it cannot therefore be too thoroughly dried before it is packed for use or exportation." A nine-thread rope, 1 inch diameter, of plantain fibre made at the Dockyard, Port Royal, broke with a weight of 728 pounds; whilst a similar rope, known as "the King's nine-thread inch rope," broke by a weight of 714 pounds.

The most valuable *Musa* fibre is undoubtedly that yielded by *Musa textilis*, known in commerce as Manila hemp. There are about 12 different varieties under cultivation all differing in habit and in quality of the fibre yielded by them. They thrive best in fresh clearings of jungle on low hills, and under shade of trees left standing at distances of about 60 feet. They do not do so well in open plains, and in swampy lands not at all. Manila hemp takes the chief place as a material for making white ropes for rigging and other purposes, and old ropes made of Manila hemp make excellent paper material. The magnitude of the industry connected with the Abaca or Manila hemp plant may be gathered from the fact that about 50,000 tons of fibre are annually exported from the Philippine Islands, of the value of about three millions sterling. This subject is more fully discussed in *Kew Bulletin*, 1887, April, pp. 1–3. The fruit of the Abaca is green and hard and unfit for food.

It is important to bear in mind that the Manila hemp plant is exclusively produced in the south-eastern part of the Philippines. All attempts to successfully cultivate it in the western and northern parts have hitherto proved abortive. The plants grew barely 2 feet high,

and the produce never covered the outlay. The cause of these failures in the Philippines (as possibly in other countries where experiments have been made) is attributed to the dry season which continues for several months, while in the eastern provinces there are copious rains all the year round. Evidently the plant will only thrive under the latter condition, and it would be useless to attempt to grow it in countries

Musa textilis, Née.

1. Pistillate flower. 2. Staminate flower. 3. Fruit. 4. Section of fruit showing seeds.

where the rainfall is not large and well distributed all through the year.

There is a very complete set of specimens illustrating the Manila hemp industry in the Kew Museum. Various qualities of the raw fibre are shown from the Chatham Dockyard. In 1864 good fibre was stated to be worth 46*l*. per ton. A sample of "Quilot," one of the two specially selected qualities of Manila hemps, was received in 1890 from Messrs. Ide and Christie. It sells usually about 20*l*. per ton higher than ordinary Manila hemp. A sample of Manila hemp prepared in British Guiana in 1892 was valued at the time at 29*l*. per ton. A "two-inch" Manila rope from the Chatham Dockyard is shown side by side with similar ropes made at Calcutta and Madras. The Chatham rope had a breaking strain of 3,549 lbs. (avoir.). The manufactured articles from Manila hemp consist of mats, cords, hats, plaited work, lace handkerchiefs of the finest texture, and various qualities of paper. The best qualities of stout packing and other similar papers in the United States are made from old Manila ropes. One of the latest applications of Manila hemp is the manufacture of lace and materials for ladies' hats and bonnets. The seat of the industry is at present at Wohlen in Switzerland. The lace for millinery purposes is made from pure Manila (Lupiz) hemp. It is used plain and dyed. The fancy hats and bonnets are woven from similar fibre stiffened and made into various patterns. Some of the hats are made of Manila hemp with a border woven from Sisal hemp. Hats are also made from a straw prepared from several strands of Manila hemp arranged side by side, immersed in gum and pressed. This straw is smooth, polished, and very pliable, exactly resembling the finest wheat straw.

The stems of many of the fruit-yielding bananas and plantains also yield fibre but not of so good a quality. Such fibre has long been used by the natives of India for cordage purposes, for mats, and to a smaller extent for making coarse paper. Dr. Royle devoted a considerable amount of attention to the subject. His conclusion, after numerous experiments, was as follows: "It is evident that plantain fibre possesses sufficient tenacity to be applicable to many at least of the ordinary purposes of cordage. The outer fibres may also be converted into a useful kind of coarse canvas as has been done by Dr. Hunter; and the more delicate inner fibres most probably into finer fabrics as is the case with those of *M. textilis* when equal care has been taken in the preparation and separation of the fibres, and there is some experience in weaving them."

In Jamaica a series of experiments, undertaken by Mr. Morris in 1884, showed that plantain fibre (*Musa sapientum* var. *paradisiaca*) was whiter and finer than ordinary banana fibre and that it approached more nearly to the fine glossy character of Manila hemp. A banana stem weighing 108 lbs. yielded 25 ounces of cleaned fibre, or at the rate of 1·44 per cent. of the gross weight. A plantain stem weighing 25 lbs. yielded 7¼ ounces of cleaned fibre. This was at the rate of 1·81 per cent. on the gross weight. A sample of fibre prepared from a red banana at Trinidad in 1886 was valued in London at 24*l*. to 25*l*. per ton. Usually, however, banana fibres are not worth more than 12*l*. to 15*l*. per ton. They would only fetch even these prices when there is a high demand for "white-hemp fibres" and there happens to be a short supply of Manila and Sisal hemps. (*Kew Bulletin*, 1887, April, pp. 5–8, with woodcut.)

In the catalogue of contributions from British Guiana to the Paris Exhibition of 1867 the following remarks are made in regard to the

prospects of a plantain-fibre industry in that Colony. The figures supplied are very valuable :—

"The fibre of thousands of acres of plantains is lost annually in this Colony from the want of a simple and inexpensive machine for separating it. The tree must always be cut down to obtain the fruit, and the stem containing the fibre is allowed to rot on the ground. Could an efficient and cheap machine be invented, the fibre would be almost entirely profit to the planter. The banana yields less fibre than the plantain tree, and its fibre is generally tinted.

"Various attempts have been recently made to construct machinery for manufacturing the plantain fibre. Subsequent to the Exhibition at Paris, in 1855, strenuous efforts were made to establish the production of fibre in this Colony as an article of export, and the Messrs. Watson had fibre-making machinery put up and tried on their estate, *Haagsbosch*, but it was not found well adapted for the purpose, the stems in their natural state being so much more bulky than was allowed for in constructing the machines.

"Mr. A. D. Van Der Gon Netscher, when proprietor of plantation *Klein Pouderoyen*, on the west bank of the River Demerara, in 1855, furnished the following interesting particulars relative to fibre from the plantain :—The experience of 10 years on a cultivation of from 400 to 480 acres in plantains has shown that—1. On every acre from 700 to 800 stems are cut per annum, either for the fruit, or in consequence of having been blown down by high winds, or from disease or other reasons. 2. The planting of the suckers at distances of 8 feet apart has never been tried ; but I am of opinion that if so planted and cut down every eight months for the stem alone, an acre would give from 1,400 to 1,500 good stems every cutting, or about 4,500 in two years. 3. On plantation *Klein Pouderoyen*, after repeated trials, the plantain stem on an average has been found to give $2\frac{1}{2}$ lbs. clean, and $1\frac{1}{2}$ lb. discoloured and broken fibre, the latter only fit for coarse paper. This result, however, has been obtained by very imperfect machinery. 4. The average weight of the plantain stem is 80 lbs. 5. The stems can be transported from the field to the buildings for one dollar per hundred."

Owing to the increasing cultivation of bananas in the West Indies, and the fact that when once the stems have borne fruit they are cut down and allowed simply to rot on the ground, some plan might be devised for turning the fibre to account. There are at least 50,000,000 banana stems cut down every year in the West Indies, and at present little or no use is made of the fibre. It is evidently not sufficiently good to compete with first-class rope fibres, but it might possibly be used for making coarse paper, as a packing material, or in the manufacture of *papier mâché*. Its chief competitors in some of these directions would be Esparto, and the wood pulp prepared on so large a scale from poplar and other trees in Norway and Sweden. This wood pulp is delivered in this country at a cost not exceeding 2*l*. 10*s*. to 3*l*. 10*s*. per ton, and it is now very largely used by paper-makers.

Banana fibres from *Musa sapientum* are shown in the Kew Museum from the Andaman Islands, Jamaica, Mauritius, Ceylon, British Guiana, Madras, Australia. The Jamaica samples cleaned by the late Nathaniel Wilson are of excellent quality. A sample from British Guiana was valued in 1892 at 25*l*. per ton, but usually the price is much lower, and when other fibres such as Manila and Sisal hemps are low, banana fibre is practically unsaleable.

The facility possessed by banana fibre for taking up colour is shown in a specimen from Mr. Dickson. Paper prepared from banana fibre and rags is shown from the late Mr. T. Routledge. Also various papers made from banana fibre in India. From Mr. F. S. Reisenberger, in 1886, were received: 1, Half stuff from banana fibre; 2, paper from pure Jamaica banana fibre; 3, paper from equal parts of banana fibre and rags; and 4, paper from banana fibre loaded with China clay. There is also a portion of a leaf, gluten and prepared paper stock from the *pisang utang* from Sarawak, contributed by the late Mr. T. Routledge in 1875.

Fibre extracted from the Abyssinian banana (*Musa Ensete*) in Jamaica by Mr. Morris was yielded at the rate of 1·16 per cent. of the gross weight. The fibre was somewhat weak and dull-looking; it had none of the lustre of the best plantain fibre, and it was valued in London at 12*l.* to 14*l.* per ton.

Musa Basjoo is said to be grown in Southern Japan for the sake of its fibre. It is known amongst Europeans as the "Japanese plantain." The fibre is woven into cloth of an exceedingly durable character. Specimens are in the Kew Museum from Mr. J. H. Veitch, 1894.

Mr. Ridley (*Trans. Linn. Soc.*, iii., p. 385), speaking of a new species described by him (*M. malaccensis*) from the eastern coast of the Malay Peninsula in 1893, adds:—

"An attempt has been made to utilise the fibre, but it is apparently not so good as that of *M. textilis*; still as it is not only very abundant throughout the centre of the Peninsula, but also springs up like a weed in many places where old jungle is felled and forms an impenetrable thicket, it will probably be found to be well worth extracting the fibre." A sample of this fibre, as already noted, is in the Kew Museum.

A very interesting series of articles prepared from the fibres of the stem of the banana was forwarded recently to Kew from the Solomon Islands by the Rev. R. B. Comins. The fibre itself is shown in a prepared state, some of it white and some black, ready for weaving. There is a native loom of a very primitive construction, apparently similar to the one used in West Africa for weaving native "pagns" (*Kew Bulletin*, 1894, 191). It is capable, however, with dexterous manipulation of turning out cloth of a close texture and a very durable character. Two garments are shown made from banana cloth ornamented with small tufts of leaves of a *Pandanus*. There are also shown a decorated bag for holding betel and a sleeping mat of full size. On one of the garments there is woven a tasteful pattern by means of the dark-coloured threads. These garments are singularly well made, and they are, next to the Abaca cloth (from *Musa textilis* in the Philippines), the best fabrics in the Museum from bananas and plantains.

A fibre of a coarse character but evidently very strong, marked "Siune firigo," said to be derived from a species of *Musa*, was received from the Government of Queensland in 1890. It was obtained from the Kiwai Fly River, New Guinea.

Lace work ornaments worked with banana thread are in the Kew Museum from Jamaica, sent in 1855.

XXXV.—MANILA HEMP PLANTS.

(*Musa textilis*, Née.)

[K. B., 1895, p. 208.]

There are numerous varieties of *Musa textilis* yielding the Manila hemp of commerce. The two better kinds are known in the Philippines as *lanoot betul* and *lanoot batang*. The stems of the latter are said to yield as much as one catty (about $1\frac{1}{3}$ lbs.) per stem. Great stress is laid on the fact that Manila plants can only be successfully grown in virgin soil, in partial shade, and with a regular rainfall. A writer in the *British North Borneo Herald*, 1 February 1894, states that "Anything less than a well distributed rain-fall of four or five inches per month will stop their growth . . . even in the Philippines there are districts too dry for them." If placed under unsuitable conditions the plants are said to revert to a stunted form known as *lanoot grotee*, yielding a small quantity of fibre or hardly any fibre at all. The cultivation and preparation of Manila-hemp have been fully discussed in the *Kew Bulletin*, 1887, April, pp. 1–3, and 1894, pp. 289–291 (with plate). Recently an interesting article with illustrations showing how the fibre is prepared appeared in the *Bulletin* of the Colonial Museum at Haarlem for March, 1895. It is stated that all the fibre exported at present is prepared by hand. Machines have often been tried, but owing to the abundant and cheap labour supplied by the natives it has been found more advantageous to continue the hand-cleaning methods. The enormous development which has taken place of late years in the Manila-hemp industry may be gathered from the fact that while the exports were only 126,000 piculs in 1841, they had increased in 1893 to 1,283,000 piculs. Manila-hemp is regarded as the most valuable of the white rope fibres which include Sisal and Mauritius hemp, Phormium and Sansevieria. Manila-hemp, in fact, governs the market in these commodities. Hitherto Manila-hemp plants have not thriven on a large scale outside the Philippine Islands. The character of the Manila-hemp plants grown at Kew and distributed to the West Indies and tropical Africa gave hopes that it might be possible to obtain plants with a more robust habit and capable of yielding a larger quantity of fibre. An application was made with this view to Mr. William Stigand, Her Majesty's Consul at Manila, who was good enough to obtain and forward to Kew a case containing 47 suckers "from a well-known grower." These arrived in November last. They yielded a number of strong healthy plants which so far promise to do much better under cultivation than the previous plants. Of the new sort it is intended to distribute a few to all the botanical establishments in the West Indies and West Africa, where they will receive special attention.

XXXVI.—MANILA HEMP IN BRITISH NORTH BORNEO.

(*Musa textilis*, Née.)

[K. B., 1898, pp. 15–18.]

Information respecting the important cordage fibre obtained from *Musa textilis*, the whole supply of which comes from the Philippine

Islands, was given in the *Kew Bulletin* for April, 1887 (pp. 1–3). More recent information was published on the same subject in the number of the *Kew Bulletin* devoted to an account of the "Species and Principal Varieties of Musa," for August 1894 (pp. 248 and 289, 290, with a figure). A further brief note appeared in the following year (*Kew Bulletin*, 1895, p. 208).

At the request of Kew, Mr. W. B. Pryer, who is engaged in agricultural enterprise in British North Borneo, has been good enough to prepare the following notes respecting the experiments now being carried on in that part of the world in cultivating Manila hemp :—

The stems of all the *Musaceæ* yield fibre of more or less strength, but that obtained from *Musa textilis* is the best. From the indigenous or wild *Musa textilis*, however, the percentage of fibre of proper strength is so small that it does not pay to extract. It is from a cultivated variety that marketable Manila hemp is obtained.

The wild plant of *Musa textilis* is known by the natives as *Saying Grotei* or *Gerōtei*, and the fibre-yielding variety as *Saying Lanut*, *Saying* being the name for all bananas and plantains. Of *Saying Lanut* there are several sub-varieties, such as *Lanut pula* (red *lanut*), *Lanut batang*, and others. In general appearance *Musa textilis* varies very little from *M. paradisiaca*, the ordinary banana, but a sharp eye will soon notice that the leaves are narrower and more pointed, and of a paler or more sea-green colour, while the stems are of a dark pickled-cabbage colour with broad irregular streaks of a dirty green.

Musa textilis requires a more equable climate than *M. paradisiaca*, and does not thrive in any country in which there is a distinct dry season ; it also demands a good soil and a warm temperature. Its present cultivation is restricted almost entirely to certain parts of the Philippine Islands and to the adjacent coast of Borneo. In fact, the requisite conditions of climate and soil are found in that part of the world only. It does not die absolutely if exposed to a drought of two or three weeks, but if spells of dry weather occur at too frequent intervals its growth is stunted very materially ; but again, although it prefers rain every two or three days, it does not like a continuously wet season. Even in the Philippines its range is restricted. It is chiefly found on the eastern side, and there only it thrives really well.

In districts where it does well it requires little attention. The cheapest way of planting it is to get natives to fell and clear the forest and plant hill rice under an agreement that when (or before) they have taken their crop they are to put in Manila hemp suckers. These suckers are planted some 10 or 11 feet distant from each other, and it is well to give them two or three rough weedings during the first few months to give them a start. After this they can be left almost to take care of themselves ; in fact, a few of the coarser large-leaved weeds may be left, as they tend to keep the ground cool and draw the plants up into larger stems than would otherwise be the case. When the plants are well up, however, it is best to cut down all other large plants, and the plantation will then take care of itself with only one day's going over every three months or so.

Almost any lay of land will do for Manila hemp as long as it is not too swampy or too steep, but it thrives best on rich flat land, and does not much mind a flood as long as the water does not stop too long on the land or leave it swampy afterwards.

Manila hemp suckers take longer to sprout than the ordinary banana, and send up fewer shoots, but in three weeks or so from the time the sucker is put in, if the weather is fairly favourable, the first shoot will

be seen, which will be succeeded by one or two more. It will at least be 16 months before the main shoot is fully matured and ready to throw out its fruit spathe. This is the best time to cut it down for fibre. If so desired, however, it can be utilised at an earlier age, but the percentage of hemp obtained is very small. This is to some extent compensated for by the better quality of the hemp obtained.

Within three or four months of the first shoot showing, a careful man should go over the entire place to destroy any plants that have come up *Gerōtei* instead of *Lanut*. The same process should be repeated later on, as several which looked like true *Lanut* at first will ultimately be found to have developed into *Gerōtei*. Once a stool is well established as *Lanut* it always remains so.

At the age of 12 months when the main stem will be nearly fully grown, though not fully matured, two or three others will be of considerable size and some four or five small suckers will be coming on. In time the ground will be pretty well covered. As the older stems are cut down the young suckers grow up and take their place. When it has arrived at this state a Manila hemp plantation requires scarcely any attention as long as the workers do not open it up too freely by cutting over many stems, or allow the jungle plants to encroach too much. As an instance of the longevity of *Musa textilis*, I may mention one stool twenty years old that has not cost a cent, but has yielded stem after stem for treatment at frequent intervals during that period.

The above remarks are based upon Manila hemp in North Borneo. In the Philippines it would seem to take (if there is not some mistake in the observation) nearly double the time to mature.

The "stem" of the plant is composed of overlapping layers of the leaf stalks, somewhat similar to a stick of celery, but firmly bound together. The fibre is found just below the surface on the outer side of these stalks. A stem weighs from 50 to 80 lbs. No machine that I am acquainted with has yet been discovered that will extract it to pay. The native method is simple and cheap. The stem is cut down and each leaf stalk detached from the others. After this the operator sits down with the end of a stalk in his lap, he then makes a slight incision just beneath the fibre at the end, and giving a smart twitch, brings away a strip or ribbon of the cuticle with the fibre in it, from the whole length of the stalk, much in the same way that the fibrous part of a rhubarb stalk is taken off when preparing it for cooking. This operation is best performed on the plantation itself, as the discarded portions of the stem remain as manure. When a sufficient number of ribbons are obtained they are carried to a hut for treatment. The appliances used for the actual extraction of the fibre are of the most primitive and inexpensive character. A blunt knife is obtained and a hole is made in the front end of it, through which a string is passed and to which a couple of bricks or stones are tied. The knife is then attached to a block of softish wood, the blade of it pressing on the wood against which it is held by the weight of the tied-on stones. Another piece of thin rope or string is tied through the same hole in the knife, running over a bit of wood above it, to a treadle worked by the foot. All is now complete. The operator twists the end of one of the ribbons round a small piece of wood so as to get a firmer hold, and slipping it under the knife allows the blade to descend upon it; a steady pull drags the fibre underneath the knife, which holds back all the pith, weak fibre and other useless matter. As the strain is heavy it constitutes a guarantee that all the fibre that is not broken is of proper strength, and the result is pure strong fibre. A boy can clean in a similar way the few inches of the

end which was wrapped round the piece of wood, and the fibre is then hung over a pole to dry. This is soon done if it is a fine day, and the hemp is then ready for market.

These operations are quite simple and can be performed by anyone; but some force is required to pull the fibre under the knife, and the particular muscles brought into play soon tire if the operator is new to the work. Men who have been brought up to hemp pulling can go on for hours without any discomfort.

Some men claim to be able to make half a picul (66 lbs.) of hemp in a day; but the most I have ever seen produced by one man in a day was 37 catties (a shade less than 50 lbs.). With the fibre at $6 a picul this quantity would sell for $2·24, a high rate of pay in a country where wages are normally 32 cents a day.

It is needless to add that it would not be advisable to employ men on day wages to prepare Manila hemp, as so much depends upon the amount of force put into the work and consequently the quantity of hemp produced.

W. B. PRYER.

XXXVII.—PINE-APPLE FIBRE.

(*Ananas sativus*, Baker.)

[K. B., 1887, April, p. 8.]

A note may here be added on the fibre yielded by the leaves of the pine-apple plant. Although not at present in commercial use, this fibre has a future of considerable importance before it. It is finer and stronger than that yielded by any other plant, and in the Philippines, where the West Indian Ananas has become thoroughly naturalized, a beautiful fabric known as "pina cloth" is made from it. A rope of pine-apple fibre $3\frac{1}{4}$ inches in circumference bore a strain, at Calcutta, of 57 cwt.

There are several samples of fibre of a wild pine-apple (*Bromelia sylvestris*, Willd.) from the West Indies and Central America at Kew, but there is no record of their commercial value. A sample supposed to be from this plant was lately sent from Trinidad, upon which the brokers reported as follows:—"Not yet in commercial use, but destined, "we think, to a successful future; fine, soft, supple fibre, strong and "good colour, ample length; say 30*l*. per ton and upwards."

The fibre of the Jamaica pinquin (*Bromelia Pinguin* L.) would appear not to be of high value. The plant covers hundreds of acres in the plains and lowlands of Jamaica, and an effort was made some time ago to prepare the fibre for commercial purposes. The report of brokers upon a sample of 90 pounds was as follows:—"A long towzelled weak "fibre, of bad colour, coarse, no strength, and only fit for breaking up. "Similar to St. Helena hemp tow, but not so good. We should think "12*l*. to 10*l*. per ton the utmost value." Several samples of this pinguin fibre from Jamaica and elsewhere, cleaned both by hand and by machine, are to be seen in the Kew Museum, No. 2.

If the leaves of this plant were cut up, roughly dried, and placed in compressed bales, they might prove of value for paper-making. To establish this point it would be necessary to forward to England about half a ton of dried leaves in compressed bales, in order that paper-makers might be able to test them on a sufficiently large scale.

XXXVIII.—CARAGUATÁ FIBRE.

(*Bromelia argentina*, Baker.)

[K. B., 1892, pp. 191–195.]

Under the name of Caraguatá the late Mr. Thomas Routledge forwarded to Kew, in 1877, for determination, "the leaves of a plant "from the Argentine Republic, with the remark, that the 'fibre when "abstracted no doubt will make good paper.' After some trouble, we "arrived at the conclusion that the leaves belonged to one of the "singular South American species of *Eryngium*, which have before "flowering quite a Bromeliaceous habit." [Kew Report, 1877, p. 37].

A few years later Mr. Edwin H. Egerton, C.B., then Her Majesty's Chargé d'Affaires at Buenos Ayres, referred to the Caraguatá plant in a report forwarded to the Foreign Office, dated 31st July 1881, as follows:—"But by far the best fibre of the country is that of the "Caraguatá Ibera, a Bromeliad which is something like the Pine-apple "plant, and which is very abundant in Paraguay, the Misiones, and the "Chaco. It is very long and silky, and has long been used by the "Indians, and much money has already been spent in endeavours to "find some practical machine for the economical preparing of this "fibre. I am assured that the desired result has now at length, after a "long series of experiments, been attained by a French machine "invented for the purpose which has just been set up not very far "from Asuncion, the process being a simple one without previous "maceration.

"Should this invention prove a success (and I am promised further "particulars from the persons undertaking this work) the caraguatá "fibre will become an extremely important article of export, and if half "I hear of it be true, should compete with advantage against jute.

"I am assured, but I cannot vouch for the assertion, that there is "immense superiority in the quality of the Paraguayan fibre over that "of the Chaco and Misiones caraguatá."

In 1884, Mr. F. E. Harman, who had undertaken a mission to the Plate River for the Santa Fé Land Company, brought with him numerous species of Argentine grasses, which were determined at Kew, and also some living plants of what were believed to be Caraguatá from the Gran Chaco. With these plants, Mr. Harman brought a dried specimen of an inflorescence. The plants have grown at Kew, and are now in a flourishing condition in the Temperate House. As will be shown later, they are not true Caraguatá, and they possess no merit as fibrous plants. On the other hand, the dried inflorescence, brought at the same time, belonged to the fibre-producing species. It is probable that the name Caraguatá is used in a generic sense in the Argentine and neighbouring countries; and, as already shown, it is applied indiscriminately to plants of a very widely different character. There is, however, a plant known as Caraguatá or Caraguatá Ibera, which yields a very valuable fibre. It has been frequently noticed in works of travel, and its valuable properties have been highly extolled. The difficulty was to obtain authentic specimens of the true fibre-yielding plant, and find out exactly what it was. Under these circumstances a further, and as it proved, a successful, effort was made to obtain specimens as shown in the following correspondence:—

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew.

SIR, November 20, 1889.

I AM desired by Mr. Thiselton-Dyer to inform you that in the year 1877 the late Mr. Thomas Routledge forwarded, for determination,

to Kew some fibre and leaves of a plant from the Argentine Republic known locally as Caraguatá. The leaves were broken and in an imperfect condition. Moreover it was considered doubtful whether they belonged at all to the plant which yielded the fibre. The leaves, as far as could be ascertained from the scraps sent, belonged to a species of *Eryngium*. (Kew Report, 1877, p. 37.)

2. At the recent *Exposition Universelle* held at Paris in 1889, I noticed in the Paraguayan Court some leaves and fibre called Caraguatá said to be derived from *Bromelia Caraguata*. There is no plant known to European botanists under this name. The Caraguatá of Paraquay is a plant which it is very desirable to investigate, and specimens of it in a living and dried state would be very acceptacle for the collections at Kew.

3. Mr. Thiselton-Dyer ventures to express the hope that the Secretary of State will approve of the kind offices of the Minister at Buenos Ayres being invited to procure information respecting the Caraguatá plant, its distribution, and local uses, and also small specimens of living plants, packed in a dry box, and seeds for this establishment. For a botanical determination of the plant, it is desirable to obtain dried specimens of the leaves, flowers, and fruit. These latter might be forwarded by post between sheets of paper protected by cardboard.

4. Any reasonable expense, incurred on account of this service, will be defrayed in usual course.

I have, &c.
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

The Hon. FRANCIS J. PAKENHAM to FOREIGN OFFICE.

MY LORD, Buenos Ayres, February 3, 1890.

ON the receipt of your Lordship's despatch of this series, No. 39, of the 25th of November last, instructing me to procure specimens of the Caraguatá plant for the Royal Gardens at Kew, I communicated its contents to Dr. Stewart, Her Majesty's Consul at Asuncion, from whom I have received the reply of which copy is enclosed.

The box containing the specimens in question reached me a few days ago, and I have the honour to transmit it to your Lordship herewith, unopened, as it arrived.

I have, &c.
(Signed) F. PAKENHAM.

The Marquis of Salisbury, K.G.

[ENCLOSURE.]

SIR, Asuncion, January 12, 1890.

I BEG to acknowledge the receipt of your letter of the 27th ultimo, and enclosed copy of a letter, dated 20th November, Royal Gardens, Kew.

By the steamer "Saturno," of the Platense Company, I have the pleasure to send to you this day a box containing samples of the

Caraguatá plant, and of its fruit and inflorescence, which I hope will prove satisfactory for the purpose of determining its scientific classification.

I have, &c.
(Signed) WILLIAM STEWART, M.D.

The Hon. F. J. Pakenham.

The material obtained through the Foreign Office, as shown above, and that obtained upon a subsequent occasion from Dr. Stewart direct, were submitted to Mr. J. G. Baker, F.R.S., Keeper of the Herbarium at Kew, who has furnished the following account and description of the Caraguatá plant as now known to us :—

We have now received for the first time, through the Foreign Office full material for the botanical determination of this plant, procured for us by Dr. W. Stewart, H.B.M. Consul at Asuncion. It proves to be a true *Bromelia*, nearly allied to *Bromelia Pinguin*. In the monograph of the Brazilian Bromeliaceæ just published by Dr. Mez, which forms part of the great "Flora Brasiliensis" of Endlicher and Martius, two species which are nearly allied to it are described for the first time, viz., *B. Balansæ*, Mez, from Paraguay, and *B. Regnellii*, Mez, from Central Brazil. The latter, which comes nearest to it of the three species, is figured on Plate 53. The description of *Rhodostachys argentina* in my *Handbook of the Bromeliaceæ*, p. 29, so far as regards the inflorescence in a state of fruit, relates to the present plant ; but now that we have the flowers, they show that the plant is not a *Rhodostachys*, but a *Bromelia*, and that the leaves that were originally sent with it do not really belong to the same species as the flowers. We are therefore very much indebted to Dr. Stewart for enabling us to clear the matter up, and I give now a full description of the plant under the name of *Bromelia argentina*, drawn up entirely from his latest specimens, received Feb. 10, 1892.

Bromelia argentina, *Baker, n. sp.* Leaves like those of *B. Pinguin*, ensiform, rigidly coriaceous, 5 feet long, $1\frac{1}{2}$ inches broad exclusive of the prickles above the dilated base, tapering very gradually to the point ; prickles large, deltoid cuspidate, uncinate, brown and horny in the upper half, about an inch apart in the centre of the leaf. Peduncle stout, nearly a foot long, covered by the closely imbricated ovate-lanceolate scariose bract-leaves, the lower of which are about 3 inches long, and the upper 2 inches long. Inflorescence a dense oblong head, which is half a foot long in the flowering stage ; lower bracts ovate, toothed at the top, with a bright red lanceolate point ; flowers many in each cluster, subtended by a large ovate bract; flower-bracts oblong, acutely keeled, $1\frac{1}{2}$ inches long; ovary in the flowering state oblong, trigonous, tomentose, an inch long, $\frac{1}{3}$ inch diam. Sepals oblong, obtuse, an inch long. Petals red, lingulate, a little longer than the sepals. Stamens and style shorter than the petals. Fruit oblong, coriaceous, $1\frac{1}{2}$ inches long when dried.

It will be noticed that Mr. Baker considers the Caraguatá plant to be nearly allied to the Pinguin (*Bromelia Pinguin*, L.) of the West Indies and Central America. It has also some resemblance, as regards leaf character alone, to *Karatas Plumieri*. The latter is a well-known and valuable fibre plant. It is said to be used by Indians in making the finest hammocks in Central America, Guiana, and Brazil. The fibre of the Pinguin, as already stated, was carefully investigated by the Botanical Department in Jamaica in 1884. The plant covers hundreds of acres in the island, and it would readily support a large industry. Great difficulty

was, however, experienced in extracting the fibre by machinery, without maceration, and the results were by no means satisfactory. Several samples were forwarded to London and New York for the opinion of brokers, and the London reports were as follows :—"Poor dull fibre, "gummy, fair strength, value about 20*l*."—"Almost unsaleable in the "form sent, not well dressed, not good colour, and in some parts rather "tender."—"If this was better dressed, it might have a sale here, but "in the present form, when so gummy, it is difficult to form an estimate "of it. It comes from one of those plants that suggest the effect of an "alkali upon it for melting away the gum, to see if a better product "could not be produced."

It is possible that the Caraguatá may yield fibre more closely resembling that obtained from Karatas than from Pinguin. There are specimens of leaves and fibre of all three plants shown in Museum No. II. at the Royal Gardens, and some samples of Pinguin fibre in this collection cleaned by hand are of better quality than those prepared by machinery in Jamaica. The fibres obtainable from species of Bromeliaceæ, including those from the common pine-apple (*Ananas sativus*), as well as from *Karatas*, Pinguin, and the Caraguatá now under consideration, are all of commercial importance ; but, like many others, they require suitable appliances for their extraction, and until these are forthcoming they will remain unavailable for any but the most limited purposes.

In regard to the local utilisation of Caraguatá fibre, the following extract is taken from a recent Report by Mr. Arthur Herbert [Foreign Office, 1892. Annual Series, No. 1,006. Diplomatic and Consular Reports on Trade and Finance. Paraguay] :—

"The textile plant called Caraguatá abounds and grows naturally in every part of the Paraguayan Republic.

"In the year 1879 Messrs. Branlio Artecona and Louis L. Lenguas made experiments with machinery that they established in the department of Arroyos y Esterios, having obtained from the Government a concession for the working of this product freely for the space of 15 years in all fiscal lands, and to export the same when manufactured free of duty.

"This industry did not give satisfactory results, owing to the inexperience of those in charge and the imperfection of the machinery. After several fruitless attempts they retired, and their concession lapsed.

"In 1889–90 Mr. Artecona again organised the same industry with modern machinery, and took a contract from the company 'Tejidora,' of Buenos Ayres, for all he could remit. He remitted altogether 400 tons, and the result of the sale might have been remunerative if he had not committed the fault of employing inexpert hands and spent his capital in useless experiments, and he again suspended operations.

"Attending to sundry requests from Europe, certain commercial men have lately remitted samples that arrived in perfect condition, from which a profitable result was obtained ; but when they remitted large quantities in the year 1890 it fermented on the voyage, and arrived in Europe in an unacceptable condition.

"The *ibera* is a sort of Caraguatá, and its fibre is of a finer quality than that of its congener, but neither of them has obtained any importance in commerce, owing to the cost of cleaning and separating the fibre from the leaves. Several attempts as above mentioned have been made, but so far without any great success. From the interest which has been awakened in this product in European markets, it would seem to deserve a more serious study, and the opinion seems to prevail that with

improved machinery and more skilled administration more profitable results might be obtained.

"The flowers have been sent to Kew with a view to determining the exact species, which I believe is still undefined."

[NOTE ADDED, 1892.—The Caraguatá has now been determined, as shown above, and a plate of it with description under *Bromelia argentina*, Baker, has been published in Hooker's *Icones Plantarum*, pl. 2258. Specimens of living plants of this, the true Caraguatá ibera, are much desired for the Kew collections, where, so far, it does not exist.]

XXXIX.—BOWSTRING HEMP.

[K. B., 1887, May, pp. 1–11.]

At present, Bowstring hemp is not an article in commercial use; but attention may well be directed to the capabilities of numerous species of *Sansevieria* for producing fibre of great value. Plants of *Sansevieria*, of which there are 10 or 12 species, are very abundant on both the east and west coasts of tropical Africa, which, indeed, may be looked upon as the head-quarters of the genus. One well-known species (*S. zeylanica*) is indigenous to Ceylon; and this and others are found along the Bay of Bengal, extending thence to Java and to the coasts of China. The leaves of these plants are more or less succulent and abound in a very valuable fibre, remarkable alike for fineness, elasticity, and for strength.

Usually the leaves are not more than $1\frac{1}{2}$ to 2 feet long; in some species, such as *S. guineensis* and *S. cylindrica*, they attain a length of 3 or 4 feet: while in one species, native of tropical Africa [since described as *S. Kirkii*, Baker], under favourable circumstances they attain a length of 9 feet. In this species, for particulars of which and for samples of its fibre we are indebted to Sir John Kirk, G.C.M.G., K.C.B., late Consul-General at Zanzibar, the quality of the fibre is exceptionally good. We have doubtless here a new fibre plant of great value.

In the treatment of the leaves of *Sansevieria* by machinery the great drawback hitherto experienced has been their comparatively small size, and the difficulty of cleaning the fibre contained in them in an expeditious and remunerative manner. These circumstances would not obtain in the case of the plant brought into notice by Sir John Kirk. Indeed, for moist tropical climates, as opposed to the dry, hot, and arid districts of Yucatan where the Sisal Hemp is grown, this and *S. longiflora* if they are really distinct would be likely to prove of exceptional value as fibre plants.

It may be mentioned that all species of *Sansevieria* prefer a rich moist soil and a comparatively humid climate. They are essentially tropical plants and do not thrive in a temperature less than 60° Fahr. Under favourable conditions they grow rapidly and establish themselves permanently by means of large spreading fleshy rhizomes or underground stems. It is true they will grow in comparatively dry districts, and even in soils strongly impregnated with salt; but their growth under such circumstances is very slow and the leaves are seldom large enough to produce marketable fibre.

Dr. Roxburgh proposed that the fibres of Sansevierias might be called *Bowstring hemp*, because the natives of the Circars make their best bowstrings of them. On the other hand, small samples of fibre from *S. guineensis*, which have appeared in the London market, have been

called African bowstring hemp. These fibres are very firm, hair-like and silky, and closely resemble those of the pine-apple; they are said to take dyes very readily; and the tow is mentioned by Royle to have been converted into good paper at Trichinopoly.

Plants of *Sansevieria* are already abundant in a wild or semi-cultivated state in most tropical countries. They are capable of being propagated very readily. Usually the underground stem or rhizome is divided and planted; but plants may also be raised from seed, or from the leaves, which latter, planted whole or cut into small pieces, readily take root in moist situations.

A full botanical description of the several species of Sansevieria may be found in a monograph of the ASPARAGACEÆ, in the fourteenth volume of the *Journal of the Linnean Society* (pp. 546–550), by Mr. J. G. Baker, F.R.S. The description given in the following notes is contributed by Mr. Baker. The species are restricted to those which are now under cultivation at Kew, and of which specimens of fibre have been prepared and examined. The plants may be seen in the West Transept of the Palm House at Kew; while the specimens of fibre are in Kew Museum No. 2.

The species, or well-marked sub-species, of *Sansevieria*,* of which we have living plants at Kew, are seven in number, and they may be readily classified according to their leaves in three groups, as follows:—

I. Leaves comparatively thin and flat:—

1. *S. guineensis.* 2. *S. longiflora.*
3. *S. Kirkii.* 4. *S. thyrsiflora.*

II. Leaves semicircular in transverse section at the middle, deeply hollowed down the face:—

5. *S. zeylanica.*

III. Leaves club-shaped, more like stems than proper leaves:—

6. *S. cylindrica.* 7. *S. sulcata.*

1. **Sansevieria guineensis**, Willd., is one of the two oldest and best known species. It was first figured and described, long before the days of Linnæus, in the year 1701, by Commelinus in his "Horti Medici Amstelodamensis Rariorum Plantarum Descriptio" (tab. 20), under the name of "Aloe guineensis radice geniculata foliis ex viridi et atro "undulatim variegatis." Linnæus classified it under the genus *Aletris*, and so did Jacquin, who figured and carefully described it in 1770 in his Hortus Vindobonensis (vol. I., p. 67, t. 84). It has horny, erect, lanceolate leaves, 3 or 4 feet long, 3 inches broad at the middle, narrowed gradually to an acute apex. not distinctly bordered with red, copiously mottled on both surfaces with broad irregular bands of white. The flowers are in a lax, simple spike, which rises to the same height as the leaves, in clusters of three to six, with a whitish perianth about 2 inches long, of which the six segments are about as long as the cylindrical tube. It is a native of Guinea, from which we have wild specimens gathered by Barter and others. We have it also from Central Africa, collected by Schweinfurth and Grant, from Abyssinia by Beccari, and what is most likely the same from the Zambesi country, gathered by Sir John Kirk in 1860; the latter accompanied it by a sketch made on the spot, when he was botanist to the Livingstone expedition.

On the Zambesi *S. guineensis* appears to be called "Konje," and Sir John Kirk speaks of it as "yielding a valuable fibre similar to

* As regards the spelling, following the *Genera Plantarum*, we have adopted Sansevieria, instead of Sanseviera, as being the oldest name. Thunberg had it Sansevieria; Willdenow altered it to Sanseviera, and Kunth followed. Bentham in *Genera Plantarum* reverted to Sansevieria.

Manila Hemp." It is described as "growing in great abundance in many places, keeping to the shade of woods."

Mr. Horne, Director of the Royal Botanic Gardens, Pamplemousses mentions that—

"This plant thrives well in Mauritius in damp marshy places in the "lowlands. I have no doubt that it would thrive well in the wet "uplands."

It is widely distributed in the West Indies, and has been grown experimentally for the sake of its fibre at St. Thomas, Jamaica, and Trinidad.

As regards cultural treatment, the following information is taken from notes prepared by Mr. Morris when Director of the Botanical Department, Jamaica, on this and *S. zeylanica* :—

"In the first instance plants may be put out at 3 feet by 3 feet, "which, allowing for roads and paths, would give about 3,000 to the "acre. If the soil is kept well broken and moist these plants, by the "extension of root suckers, will spread in all directions, so that ulti- "mately the whole ground, with the exception of certain paths, which "should be kept permanently open, will be covered with plants. As "regards the time which must elapse between planting out and the "first yield of leaves suitable for fibre, there would appear to be a great "difference of opinion. Plants which I saw at St. Thomas at three "years old were only just ready to be cut ; and Baron Eggers, who "had planted them and kept them under close observation during the "whole of that time, was of opinion that Sansevieria plants could not "be depended upon to yield a crop before three or three and a half "years.

"My own experience coincides with this, but necessarily much must "depend upon the nature of the plants when first put out, the character "of the soil, the amount of moisture received, as well as on the system "of cultivation pursued.

"From actual trial tests in India, where one-third of an acre was "cultivated with *Sansevieria zeylanica*, it appears that full grown "leaves of three to three and a half feet long (their actual age is not "mentioned) yielded about 1 lb. of clean fibre for every 40 lbs. of "fresh leaves. That is, the weight of clean dry fibre was at the rate "of $2\frac{1}{2}$ per cent. of the fresh leaves. Dr. Roxburgh calculated that "one acre would yield 1,613 pounds of clean fibre at a gathering, two "of which may be reckoned on yearly 'in a good soil and a favourable "'season, after the plants are of a proper age.'

"This would be at the rate of $1\frac{1}{2}$ tons of fibre per acre per annum at "the end of three or three and a half years, of the gross value (at the "rate of 30*l.* per ton) of 45*l.* Whether this return can be depended "upon for the West Indies on an extensive area I am unable to say."

In an experimental trial carried on at Jamaica, 1,185 pounds of green leaves of *S. guineensis* yielded 29 pounds 10 ounces of dry fibre. This was cleaned by machine. The reports of brokers were as follows :—(*a.*) "Value, 18*l.* per ton, mixed fibre partly uncleaned ;" (*b.*) "Poorly "cleaned, a good deal of mixture in it, not so strong, value about 25*l.* "per ton ;" (*c.*) "No good in the state sent ; it has a lot of bark in it, "and requires more dressing ; both ends are clean, but the centre is "dirty. Price, if dressed properly, would be as good as *S. zeylanica*, "viz., 30*l.* per ton."

In September last, His Excellency Sir William Robinson, Governor of Trinidad, forwarded to Kew samples of fibre of this species, which he stated had been prepared "at the convict depôt at Chaguanas without

"the aid of machinery of any kind." The report of Messrs. Ide and Christie on the Trinidad sample was as follows :—

"In point of cleanliness and softness of fibre it seems well prepared ; "but to compete successfully with Manila hemp it would require to be "of a better colour and of equal if not superior strength. We value it "for rope-making purposes at 20*l.* per ton in London. The small piece of "Manila fibre which we enclose has a value to-day (Sept. 24, 1886) of "31*l.* per ton."

A few leaves taken from plants grown at Kew were recently passed through Death's fibre machine, but the result, owing to the smallness of the quantity and the necessity of adjusting the machine to the size of each leaf, was not satisfactory, but is not devoid of interest. The report of Messrs. Ide and Christie on the sample of fibre submitted to them was as follows :—"Short and only moderate strength. Value 23*l.* per "ton. We reported on fibre from this plant from Trinidad in September "last, when we valued the sample at 20*l.* per ton. The difference now "is due solely to the advance in the price of Sisal hemp."

Of samples of fibre of *S. guineensis*, the Kew Museums contain one specimen machine-cleaned from Jamaica, sent by Mr. D. Morris, 1884, with the following note :—"Leaves $3\frac{1}{2}$ to 4 feet long, broader than *S.* "*zeylanica*, mottled, unarmed, common and easily propagated." A specimen from Trinidad, cleaned by hand, forwarded by Governor Sir William Robinson, and valued by Messrs. Ide and Christie at 20*l.* per ton. Also a leaf, rope, and fibre from S. E. Africa, sent by Mr. T. Baines. A specimen of leaf and fibre from Sir John Kirk appears under the following label, "Maculated Sansevieria, called 'Konje,' near Lupata, 1860." This is probably identical with *S. guineensis*.

2. **Sansevieria longiflora**, Sims, a native of equatorial Africa, was first figured and described by Dr. Sims in 1826 at tab. 2,634 of the Botanical Magazine. The leaves are very like those of *S. guineensis*, but as grown with us, they are larger, flatter, not so firm in texture, and not invariably blotched with green. The best character by which it may be known from *S. guineensis* is the flower, which is $3\frac{1}{2}$ or 4 inches long, instead of 2 inches. We have specimens in the Herbarium with flowers as large as this from Guinea gathered by Barter and Mann ; from the Congo by Prof. C. Smith ; from the Zambesi country by Mr. Buchanan ; from Angola by the late Mr. Monteiro ; from Niam-niam Land by Dr. Schweinfurth. Whether all these are the same species it is impossible to say at present. There is also a large flowered species, called *Sansevieria bracteata*, which was gathered by Dr. Welwitsch in Angola.*

Several plants believed to be this species are grown in the Palm House at Kew, from which it would appear that it is a very free growing and robust species. Some leaves from these plants were lately tested for fibre by means of Death's fibre machine, which yielded at the rate of 1·69 per cent. of clean dry fibre. The report of Messrs. Ide and Christie on specimens thus prepared was as follows :—"A very bright, clean, strong "fibre, and in every way a most desirable commercial article. It would "compete with the best Sisal hemp for rope-making purposes. Value "30*l.* per ton."

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* "In the highlands of Zomba the *Sansevieria longiflora* species grows abun-"dantly and Likanga fibre is obtained from it.

"At lower elevations, such as Lake Shirwa and Livingstonia, another species is "found. The fibre is obtained from the leaf, and it might be used for coarse "manufactures ; but to properly crush the leaves, heavy rollers would be required." (Foreign Office Report, 230, 1887, p. 4.)

3. Of **Sansevieria Kirkii**, Baker, in 1887 we knew the leaves only. It was sent to Kew by Sir John Kirk, G.C.M.G., K.C.B., in October 1881, as a native of the East Coast of Africa. We have had it in cultivation at Kew since that time. The leaf is oblanceolate in shape, and very horny in texture. We have only grown it to a length of 2 feet, with a breadth in the middle of 3 inches. The leaf is dull green, with a distinct brown edge, and is much mottled on both sides. The base is much thicker, and its edges are more incurved than in either of the three other comparatively flat-leaved kinds, and down the back of the lower part of the leaf run about five distinct grooves, a character which distinguishes it readily from *S. guineensis* and *S. longiflora*.

In 1879 Sir John Kirk forwarded through the Foreign Office a specimen of fibre from the leaf of a species of *Sansevieria* found growing on the mainland opposite the island of Zanzibar. The specimen sent was the produce of a single leaf, the length of which was 9 feet. The report of Messrs. Noble on this specimen was as follows :—"We "have carefully examined the fibre from East Africa ; it is worth as a "hemp 22*l*. per ton at the present time" (1879).

Recently Sir John Kirk has been good enough to furnish more detailed information as regards the plant yielding this fibre. In a letter dated 2nd Dec. 1886 he mentions :—

"It grows abundantly near Pangane on the mainland opposite the "island of Zanzibar and in the district between that and Mombasa, and "is used by the natives to yield a long and useful fibre, of which I sent "specimens to Kew some years ago.

"The plant has flowered with me at Mbwéni in the island of "Zanzibar, but the soil being too dry and sandy it did not succeed very "well.

"The flowers are on a stalk crowded in a head, not racemose, or in a "spike, as in another species common on the Island. Unfortunately "my flowering specimens rotted in drying, so that I have never been "able to send home the inflorescence for identification. The leaves "which yield the fibre are at first flat and clouded, but after a time the "lower part becomes much elongated, round and grooved on the upper "side, the end only remaining flattened and not so mottled.

"It is a plant worth being introduced to our tropical colonies."

There is little doubt that from the robust habit and size which this species is capable of attaining, that it is a most valuable fibre plant. As reported by Sir John Kirk, a single leaf (of what we take to be the same species) under favourable circumstances attains a height of 9 feet ; and from one such leaf excellent fibre weighing $\frac{3}{4}$ oz. has been produced. This and other examples of fibre are in the Kew Museum, No. 2.

Specimens of fibre prepared from *S. Kirkii*, yielded at the rate of 1·69 per cent. by weight of the green leaf. They were described by Messrs. Ide and Christie as follows :—"Rather stout, but very clean and good "colour ; the strength fair. Value 27*l*. per ton."

4. **Sansevieria thyrsiflora**, Thunb., is the species on which the genus Sansevieria was first constituted by Thunberg, in the year 1794. The leaf is nearly flat and does not reach above a foot or a foot and a half in length, and is an inch and a half or two inches broad at the middle, with abundant mottling and a distinct red edge. The flower does not differ from that of *S. guineensis*. It is a native of the eastern parts of Cape Colony. Zeyher gives the place of growth as "Uitenhage, in woods of "Zwartkops and many other places in the east of the colony ; *Kei* of "the Hottentots ; a decoction of the root used for dysentery."

The leaves of this species, growing at Kew, were too small to be tested for fibre.

5. Sansevieria zeylanica, Willd., is a very well known and well-marked plant. It is a native of Ceylon, and, long before Linnæus, was figured and described by Royen, Commelinus, and Plukenet. There are 8 or 10 leaves in a tuft and they are semi-circular in transverse section, 1 or 2 feet long, rounded on the back, deeply channelled down the face, $\frac{1}{3}$ or $\frac{1}{2}$ inch thick in the middle, in colour dull green, copiously banded with white, with a distinct red margin. The peduncle and flower spike are each about a foot long, the flowers being rather smaller than in *S. guineensis*, but quite similar in structure. It is well figured in Redouté's Liliaceæ, tab. 290, and in the Botanical Register, tab. 160, in the year 1816.

In Ceylon this species is known under the Singhalese name of *Neyanda*. It is indigenous in the hotter parts of the island, and the fibre yielded by it is used in numerous ways, such as strings, ropes, mats, and a coarse kind of cloth. In India the plant is known as *Moorva*, *Moorga*, or *Marool*. Sir William Jones, in the Asiatic Researches, Vol. IV., p. 271, mentions *S. zeylanica* under its ancient Sanscrit name of *Moorva*, and he says that: "From the leaves of this "plant the ancient Hindoos obtained a very tough elastic thread called "Maurvi, of which they made bowstrings; and which for that reason, "was ordained by Menu to form the sacrificial zone of the military "class." Dr. Roxburgh describes the plant as common on the jungly salt soils along the coasts, growing under the bushes, and easily propagated on almost every soil, from the slips which issue in great abundance from the roots, requiring little or no care, and not requiring to be renewed often, if at all, as the plant is perennial. The leaves, when thus cultivated, are from 3 to 4 feet long.

Mr. Horne makes the following note on this plant at Mauritius :—

"Several species of Sansevieria are common here in waste lands, near "the sites of old gardens, and by the road sides. They are not so "readily nor so cheaply established on land as the *aloës vert*. But they "yield a good fibre, which is used for cordage, &c. It has the reputa-"tion of being one of the strongest of fibres. It is known by the name "of *Bowstring hemp* and *Moorva*."

Generally in Ceylon and India the natives prepare fibre from this plant by retting or by simple beating and scraping. Full grown leaves yield at the rate of 7·87 per cent. by weight of the green leaves. Owing to the smallness of the individual leaves they are difficult to clean by machinery, but if it were possible to separate the fibre by a chemical process, this plant would become of great commercial value.

Of samples of *S. zeylanica* fibre the Kew Museums contain one specimen from Ceylon, sent by Dr. G. H. K. Thwaites, under the name of Neyanda fibre; one labelled Moorga or Bowstring hemp, from Jamaica, from Mr. D. Morris, 1884, with the following note attached: —"Longest leaves $3\frac{1}{2}$ to 4 feet long, narrow, mottled, unarmed, very "common, and very easily propagated either by root, suckers, portions "of the leaf, or seed." There are also samples from the Botanic Garden, Mauritius, sent by Mr. Duncan; from Mysore, obtained from the India Museum, besides rope and twine from Balasore and twine from Cuttack, likewise from the India Museum; a Cingalese whip and nose strings for harnessed bullocks from Kandy, sent by Mr. J. A. Ferdinandus; a sample of paper half stuff from the India Museum; and some fibre, dyed in two colours (red and blue), from Madras, by Dr. Hunter.

BOWSTRING HEMP.

Sansevieria zeylanica, Willd.

a. Flower laid open. *b*. Seeds.

Samples of fibre of *S. zeylanica* prepared at Jamaica by machinery, in 1884, were described as follows by London brokers :—(*a.*) "Beautiful "fibre, rather heavy and hard, might be whiter, value very uncertain, "20*l.* to 35*l.* per ton." (*b.*) "Rather dull in colour and short in "growth, fairly well cleaned. Value about 30*l.* per ton." (*c.*) "Might "be whiter. It is almost too good for roping purposes. Worth about "30*l.* per ton."

6. Of **Sansevieria cylindrica**, Bojer, an excellent figure and a full account by Sir William Hooker will be found at tab. 5,093 of the Botanical Magazine. It is a most distinct and curious looking plant. The leaves are cylindrical, round in horizontal section, faintly sulcate all round, especially in the young state, obtuse at the end, arching, reaching when fully developed a length of 3 or 4 feet and a thickness of about an inch. The peduncle is about a foot long ; the raceme much longer, with clustered cylindrical flowers just like those of *guineensis* in structure, but only about an inch long. It is spread across South Africa from Zanzibar to Angola. Our Kew plants were received by the Foreign Office from Angola in 1859 under the name of Ifé and an abundant supply of its fibre and ship's cables and other ropes manufactured from it were shown in the Portuguese Department of the Paris Exhibition in 1858.

In the description attached to the figure of the plant in the Botanical Magazine mentioned above, Sir William Hooker adds the following particulars :—

"About three years ago (that is in 1857) there were received at the "Foreign Office, and transferred to the Admiralty, samples of a "peculiar fibre and cordage under the name of Ifé, said to be derived "from a new plant at the Portuguese settlement of Angola, west coast "of Africa. These were accompanied by some apparently living "plants, which were placed in the cellars of the Fôreign Office, and "by the kindness of our valued friend, G. Lenox-Coningham, Esqr., "forwarded to Kew where they soon recovered, and have since "flowered. The habit of the plant was that of *Sansevieria*, but the "leaves very dark-coloured, and quite terete and solid in the interior, "very unlike any known species of that genus. My duties at the "Paris Exhibition of 1855 led me to the careful investigation of the "vegetable products, and I was there agreeably surprised to find most "extensive samples, in the Portuguese Department, of the raw mate-"rial fibre, and manufactured articles, ship-cables, rope, beautiful "cordage, &c., of the same material, and amongst 'The Products of "'Angola,' it is thus stated in my 'Report.'—'*Fibre* marked, from *San-*"'*sevieria angolensis*, this latter being a MS. name of Dr. Welwitsch "'for a remarkable species of *Sansevieria*, with long stout terete "'leaves, which is in cultivation at Kew. The cordage and rope "'made of this plant appear to the eye of excellent quality, whatever "'experience may prove them to be.' Experiments recently made "with this cordage have shown it to be the strongest and best fitted "for deep-sea sounding of any fibre known ; indeed this is the less "surprising, seeing that other species of *Sansevieria* (the well-known "*S. zeylanica* and *guineensis*, for example) are cultivated in almost "all tropical countries on account of the strength and durability of the "fibre, under the name of *Bowstring Hemp*."

Of samples of *S. cylindrica* fibre in the Kew Museums there is one specimen from Mauritius, sent by Dr. Duncan ; fibre of the Probo and rope and cordage made from it, probably *S. cylindrica*, Sierra Leone,

Commodore A. Eardley Wilmot, H.M.S. "Rattlesnake." The following note accompanies this specimen :—"Grows abundantly, can be "easily propagated." There is also a specimen labelled Mokhosi fibre and leaf, probably *S. cylindrica*, used for making cordage, &c., marked S. E. Africa, T. Baines, Esq.

Specimens of fibre prepared from plants growing at Kew, by Death's fibre machine, were described by Messrs. Ide and Christie as follows :— "This is the second best fibre amongst the samples sent, and except "that it does not appear as strong, it is almost equal to *S. longiflora*. "Value 28*l.* per ton."

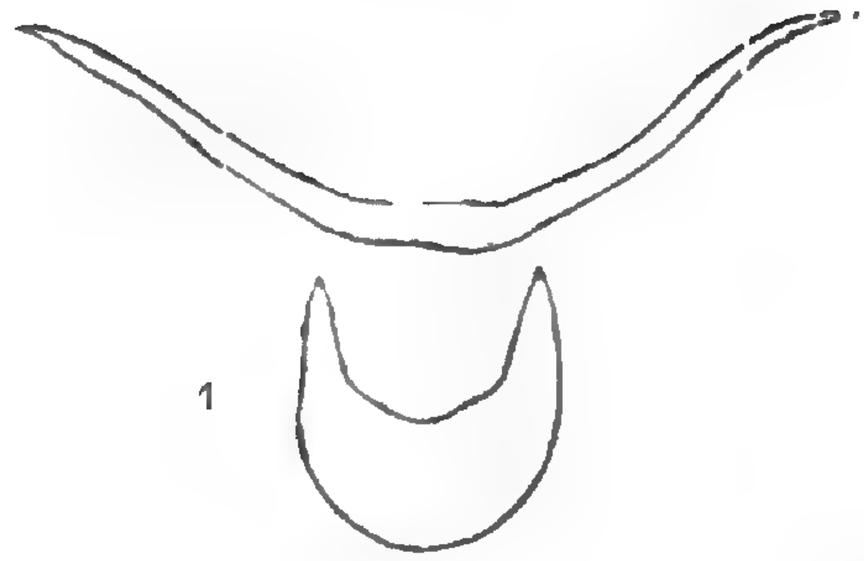
7. We have at Kew a dried specimen, as well as living plants, of **S. sulcata,** which appears to be an unpublished name of Bojer's. The plants, probably from East Africa, have never flowered, but in leaf character they are very similar to *S. cylindrica*. Under cultivation they are shorter and more slender, with rather deeper vertical grooves, but no bands or markings. A small sample of the fibre of *S. sulcata* was prepared, and the brokers' report upon it was as follows :—"Similar to "fibre of *Furcraea cubensis* and of about equal strength. It is, how- "ever, cleaner, and would also compare with Mauritius hemp. Value "26*l.* per ton."

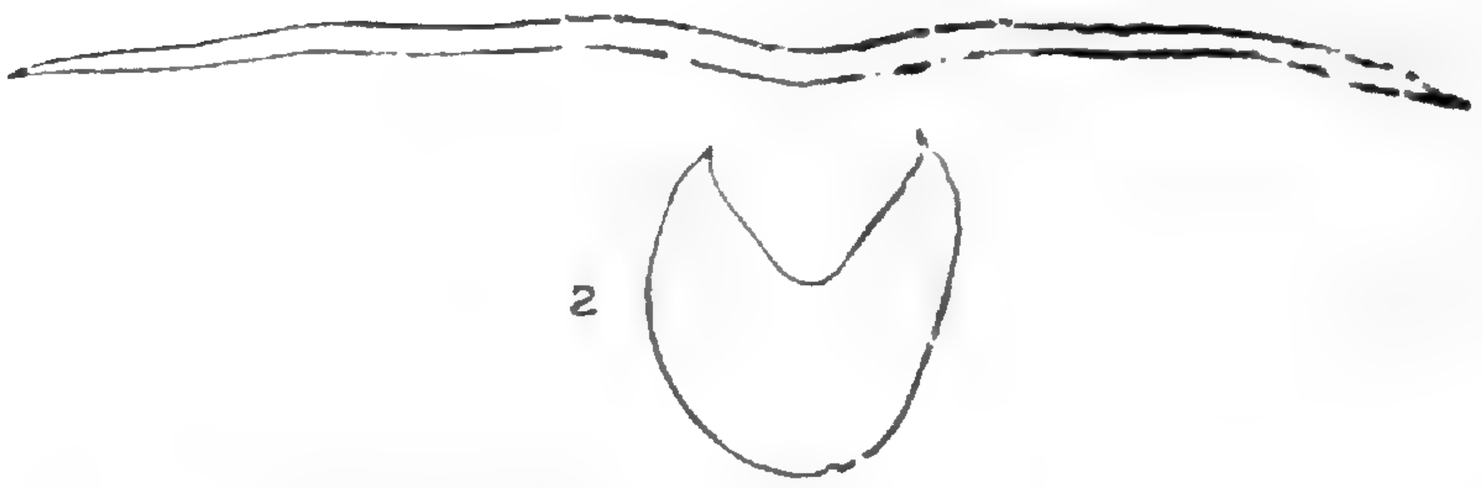
It is quite possible that other species of *Sansevieria* may be found in tropical Africa, while some more or less distinct may be under cultivation in colonial gardens. The illustrations here given will assist in the determination of the species named. Specimens of any others will be gladly accepted for the Kew collections.

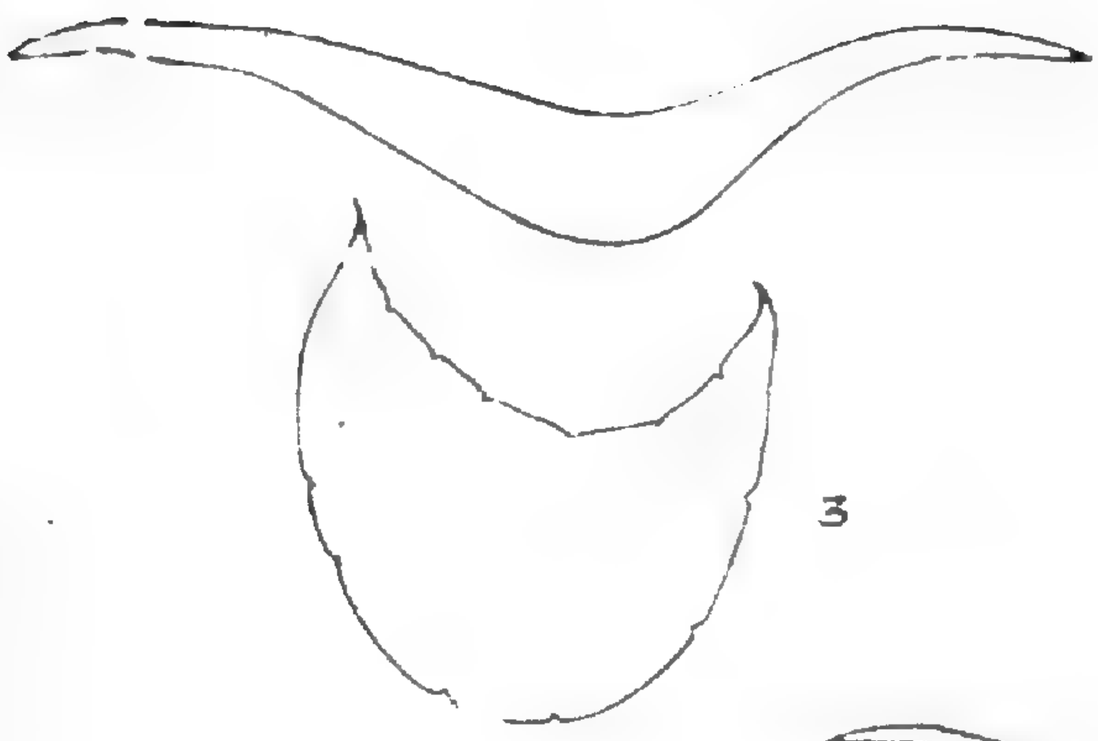
[NOTE ADDED, 1894.—*Sansevieria Kirkii* has flowered at Kew, and is figured in the *Botanical Magazine* (t. 7357). An interesting *Sansevieria*, identified as *S. roxburghiana*, Schult. f., has been found completely naturalised at Antigua, and is likely to prove very useful for fibre purposes. It has the habit of a very tall *S. zeylanica*. A new *Sansevieria* has been described by Mr. Baker as *S. subspicata* in *Gardeners' Chronicle*, 1889, vol. ii., p. 186. This is, however of no value for fibre purposes. A plant with long broad leaves grown in the Palm House at Kew under the name of *Sansevieria longiflora* has flowered, and proved to be *S. guineensis*. It is now doubtful whether true *S. longiflora* is under cultivation in this country. Finally, a most interesting species, *Sansevieria Ehrenbergii*, described in the next Article, has been received in the dried and living state from Somali-land. It produces excellent fibre.]

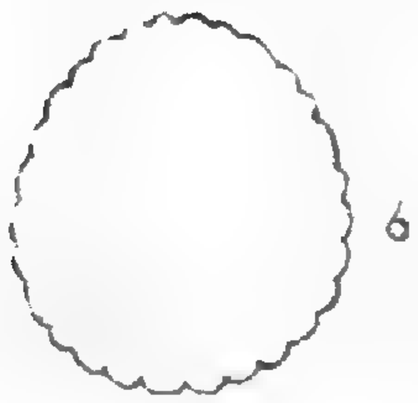
As regards machinery for the extraction of fibre from these plants, the subject is one of considerable importance. Machinery is in use in Yucatan and Mauritius for the extraction of fibre from *Agave* and *Furcraea* leaves, and machines are said to be made suitable for the treatment of leaves of *Sansevieria* and others. We cannot do better, however, than refer to the particular literature given on this subject in Spon's Encyclopædia, Div. iii., pp. 923–930.

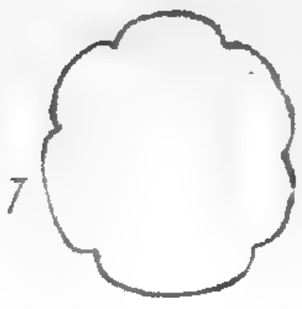
In the chemical extraction of fibres from plants there are several methods under experimental trial, some of which may prove ultimately successful.











Sections of leaves of species of *Sansevieria* :—

1. S. guineensis. 2. S. longiflora.
3. S. Kirkii. 4. S. thyrsiflora.
5. S. zeylanica. 6. S. cylindrica.
7. S. sulcata.

Note.—Where, as in Nos. 1, 2, 3, 4, two sections are given, the lower is from the base of the leaf, and the other exactly across the middle or widest part of the leaf. The sections here represented are nearly the natural size of the leaves grown under cultivation at Kew. In the tropics under suitable conditions all the leaves would necessarily grow to a much larger size.

XL.—SANSEVIERIA FIBRE FROM SOMALI-LAND.

(*Sansevieria Ehrenbergii*, Schweinf.)

[K. B., 1892, pp. 129–132.]

The increased attention devoted to the production of white rope fibres in the Western tropics appears to have had a stimulating effect also in the East Indies. The production of fibre from *Agave vivipara* in Bombay and Manila is now followed by a fibre obtained from Somali-land from a singular species of *Sansevieria*. This fibre was first received in this country as an "Aloe" fibre. It was soon noticed, however, that it possessed characteristics differing from all ordinary "Aloe" fibres, and an inquiry made by this establishment through the Foreign Office has shown that it is one of the many so-called Bow-string Hemps, and probably yielded by *Sansevieria Ehrenbergii*, a plant first collected by Dr. Schweinfurth, and of which little or nothing was known until it was described by Mr. J. G. Baker, F.R.S., in *Journal of the Linnean Society*, xiv. p. 549. Its locality is there stated as "between Atbara and the Red Sea." The details in regard to its utilisation as a fibre plant are contained in the following correspondence :—

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew, March 29, 1892.

I AM directed by Mr. Thiselton-Dyer to acknowledge the receipt of a copy of a Report on the Aloe Fibre of Somali-land, [Foreign Office Miscellaneous Series, No. 225, 1892,] communicated to this establishment.

2. This Report is of an interesting character. It would be desirable to obtain a small sample of the fibre for the Museums of Economic Botany at Kew.

It would be useful also to obtain a large leaf from the plant yielding the fibre and, if possible, a few small plants for growing in the Kew collection.

The leaf and young plants would travel very well in a dry box without any packing, and provided with holes in the sides for ventilation.

3. Mr. Thiselton-Dyer trusts that the Secretary of State will approve of the kind offices of Lieutenant-Colonel Stace being invited to obtain the specimens mentioned, and I am to add that this establishment will be prepared to pay any reasonable expenses that may be incurred.

I have, &c.
(Signed) D. MORRIS,
Assistant Director.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

Sir E. BARING to the MARQUIS OF SALISBURY.

MY LORD, Cairo, February 17, 1892.

I HAVE the honour to forward herewith to your Lordship a Report by Lieutenant-Colonel E. V. Stace, Her Majesty's Consul at Aden, regarding the Aloe Fibre of the Somali Coast Protectorate.

I have, &c.
(Signed) E. BARING.

Aloe Fibre in Somali-land.

Lieutenant-Colonel E. V. Stace to Sir E. Baring.

Sir, Aden, January 31, 1892.

I have the honour to make the following report regarding the Aloe Fibre of the Somali Coast Protectorate, my object being that, should there be no objection, the subject might be brought to the notice of the various Chambers of Commerce in England, with a view to the possible development of a useful industry which would be beneficial to the people, and might be a source of revenue to the Government.

2. In November last a bale of the fibre was sent to the Government of Bombay. This was sent to England, and the reports have just been received. I must state here that the fibre was prepared in the roughest and rudest manner by ignorant Somalis in the manner described in the accompanying copy of a memorandum which I wrote on November 22nd last, yet the price obtained was, I think, a very fair one, and might be considerably increased if the fibre were properly prepared.

3. The report of the Bombay Company (Limited) on the fibre sent by the Government of Bombay states that it was sold at the rate of 16*l.* 10*s.* per ton. "Our London brokers valued the parcel at about the same "price, and it is pretty evident that in larger quantities this article "would meet with a ready sale." And again, "This fibre compares "favourably with the many new types we see from various countries, "which are frequently too poor in colour, or too short, brittle, and full "of pith. Yours is of good strength, very nice colour and length."

The brokers further reported the fibre "all very nice colour, and good "strength and clean . . . . . This seems a very saleable article if "once introduced."

4. I need scarcely say that the small quantity sent was very much against a better price being obtained; the sale was by auction of what was really but a sample.

5. There are vast quantities of the Aloe growing in Somali-land. The people themselves will do nothing towards making a trade in the fibre; indeed, they have not the means to work it profitably, though they use it extensively themselves for ropes and other articles. I have a specimen growing here (Aden) over 7 feet in length, though I admit that this is exceptional, still I am informed that the wild plant might be materially improved. I have no knowledge whatever myself on the subject, but I have thought that if the existence of the plant and value of the fibre be made known in England through the Chambers of Commerce, it is possible that some persons with experience might be induced to make the necessary inquiries regarding a profitable production of the fibre.

I have, &c.

(Signed) E. V. Stace.

P.S.—The specimen mentioned in paragraph 3 of the attached memorandum, as "sent to England," was merely a small hand-parcel. The larger parcel, sent through the Government of Bombay, was the one reported on by the brokers, as mentioned in this letter above.

Memorandum regarding the "Aloe" Fibre of Somali-land.

The following is gathered from various sources in England and Somali-land. I have never seen the fibre prepared myself.

2. The plant is not cut, it is pulled out of the ground—the sharp points are cut off; the plant is then divided in two down the centre;

the pieces are then beaten with a stick until they become soft. The fibre is extracted by placing the divided plant between two pieces of wood, which are fastened tightly together, and the plant is pulled through them, leaving the fibre. This is placed in the sun to dry for about half an hour. No water is used; the Somalis say that that blackens the fibre. The plant should be treated as soon as possible after being pulled up to prevent the drying of the sap.

3. Regarding a specimen of the fibre sent to England (similar to that sent to Bombay), it was considered that the fibre should be whiter, and that it was rather short; but that any quantity of the same as sent would be well received, and it was valued at 21*l.* to 22*l.* per ton. It wanted more bleaching in the sun and washing in water, and should be well cleaned.

Death's patent fibre cleaning machine costs about 70*l.*; it requires either water-power or a 5 horse-power steam-engine of English make to drive it; this costs 150*l.*

If the aloe is left lying for a day or two in the sun it ruins it; it should be treated at once, and under sheds.

4. I know of no water-power within any reasonable distance of the coast.

5. There appears to be any amount of aloe within reasonable distance. I have heard that it would be much improved by being properly cultivated, such as thinned in places where it is growing too thickly.

6. Labour is obtainable at the seaport towns, but the Somali is extremely lazy, and it might be necessary to import Arab labourers at first, though regular employment for the Somalis, who swarm as idlers about the ports, would be very desirable.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

SIR, Royal Gardens, Kew, June 27, 1892.

I AM desired by Mr. Thiselton-Dyer to inform you, in reference to my letter of the 29th March last, that a case containing young plants, stems, leaves, and fibre from Somali-land has been received at Kew from Lieutenant-Colonel E. V. Stace, C.B., Political Agent and Consul at Aden.

The specimens arrived in excellent order, and they have enabled us to determine very readily that the plant yielding the new fibre from Somali-land is not an "Aloe" or Agave like that yielding Bombay Aloe fibre. The plant is a *Sansevieria*, one species of which (*Sansevieria zeylanica*) yields the well-known Bow-string hemp of India (*Kew Bulletin*, May 1887, pp. 1–11). The Somali-land plant is probably *Sansevieria Ehrenbergii* of Schweinfurth, described in the *Journal of the Linnean Society*, vol. xiv., p. 549, and known only from very imperfect material. The leaves are stout and sub-cylindrical, terminating in a strong spine. They are solid throughout, and are 4 to 5 feet in length, and, according to Lieutenant-Colonel Stace, under exceptional circumstances they attain a length of about 7 feet. The circumference of fresh leaves at the base would be about 5 to 7 inches. The flowers have not yet been received. The plant is altogether a very interesting one, and its existence as a source of a valuable supply of fibre is a fact that will be sure to awaken attention amongst commercial men in this country.

Mr. Thiselton-Dyer desires to express his thanks to the Secretary of State for the prompt manner in which his wishes have been met in this matter, and he would venture to ask that the obligations of Kew may

be conveyed to Lieutenant-Colonel Stace for the admirable way in which he forwarded the specimens to this country.

I have, &c.
(Signed) D. MORRIS,
Assistant Director.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London,
June 27, 1892.

SIR,

WE duly received your favour of the 18th instant, accompanying a sample of fibre from a plant known as the "Aloe of Somali-land."

This is an excellent fibre of fair length, and with plenty of "life." In character it strongly resembles the best Sisal hemp, with which we should have classed it but for your statement that it is derived from a *Sansevieria*.

With the exception of its colour, its preparation is perfect, and even as it is, we value it to-day at 25*l*. per ton. We are of opinion that if care were taken to improve the colour, a considerably higher price would be readily obtainable, perhaps as much as 50*l*. per ton, if a pure white fibre could be attained without loss of strength and lustre.

Yours, &c.
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.,
Royal Gardens, Kew.

NOTE ADDED, 1894.—Good photographs of *Sansevierria Ehrenbergii* in flower were received from Lieut.-Colonel Stace in July 1893. The plant has been figured and described in *Hooker's Icones Plantarum*, pl. 2,269. The drawings of the flowers are based upon careful sketches supplied to Kew by Dr. Schweinfurth, the author of the species. The Kew herbarium still requires specimens of the dried flowers, and these Lieut.-Colonel Stace has kindly promised to supply.

XLI.—SANSEVIERIA FIBRE FROM BECHUANA-LAND.*

(*Sansevieria sulcata*, Bojer.)

[K. B. 1889, pp. 222-224.]

In February of the present year Sir Villiers Lister, Under Secretary of State for Foreign Affairs, drew the attention of Kew to the fact that Mr. James Nicolls, of Mafeking on Lake Ngami, had in a report to the Colonial Office stated that "the Makouba tribe is famous for the "beautiful fish nets manufactured by them from the fibre of a species "of Cactus which grows in great abundance along the lakes and "rivers." The use of any cactus for the purpose seeming out of the question, application was made to the Colonial Office, asking if samples of the nets in question, together with specimens of the plant yielding

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* NOTE ADDED, 1894.—The original account of this fibre in the *Kew Bulletin* appeared under, Buazé fibre (*Securidaca longipedunculata*). On receipt, later, of specimens of the plant, it was shown that the fibre was yielded by a species of *Sansevieria*,

the fibre from which the nets are made, could be obtained for the museum of the Royal Gardens.

The following correspondence gives the results of the inquiry :—

CAPE GOVERNMENT to COLONIAL OFFICE.

Government House, Cape Town,
April 27, 1889.

MY LORD,

WITH reference to your Lordship's Despatch, No. 68, of the 4th ultimo, I have the honour to enclose, for your information, a copy of a letter which I have received from Mr. James Nicolls, forwarding a specimen of the fishing nets made by the natives living round Lake Ngami.

The net which accompanied Mr. Nicolls' letter has been forwarded by parcel post.

I have, &c.
(Signed) HERCULES ROBINSON,
Governor and High Commissioner.

The Right Hon. Lord Knutsford, G.C.M.G.,
&c. &c. &c.

Mr. NICOLLS to Sir H. ROBINSON.

British Bechuanaland, Mafeking,
April 16, 1889.

YOUR EXCELLENCY,

I HAVE the honour to acknowledge the receipt through Sir Sidney Shippard of certain communications from Lord Knutsford and the Director of the Royal Gardens, Kew, in reference to fish nets made by the natives around Lake Ngami and mentioned by me in a report made for your information some time since.

I have much pleasure in now forwarding by post this day a specimen of the nets in question, and should feel happy if the authorities at Kew would be willing to accept some. The net I sent is the joint property of Mr. Robert Hicks of this place and myself. Some months since I sent a much finer specimen to Mrs. Nicolls, Belmont, Navan, county Meath, Ireland, and I have not the slightest doubt but that she would be only too willing to present same to the Royal Gardens, if application were made for it.

I beg to forward for information a short description of the plant from which the nets are manufactured.

I am, &c.
(Signed) JAS. A. NICOLLS.

The Right Hon. Sir Hercules G. Robinson, P.C., G.C M.G.
&c. &c. &c.

[Enclosure.]

FISH NETS from LAKE NGAMI and the BOTLETLE RIVER.

The fibrous plant from which the Makouba tribes make their nets is found very abundantly on the shores of Lake Ngami and on the Botletle, as far east as the point where the river bends directly southward. It flourishes in the dense shade afforded by forest trees on the margin of the lake and river banks, and is never discovered growing at a distance of over 300 yards from the water. The plant itself, especially along the river, grows in impenetrable masses, attaining at most a height of about 5 feet. The stems, or, more properly, stalks,

averaging about 1 inch in diameter, the points of such stems being furnished with a wonderfully sharp spear-like head. The fibre is rather thicker than that obtained from flax, and when freshly drawn from the stalk very closely resembles fine fishing gut. In fact it has been most successfully used for angling purposes in the Botletle River. It can be fairly stated that the stalk, in the raw state, is fully as tough, if not tougher than a Manila rope manufactured of the same thickness.

No criterion can possibly be arrived at as to the durability of this fibre from the specimen of net forwarded to the Royal Gardens, Kew, as the Makouba tribes do not take the slightest trouble in drying their nets after using them. It may be interesting to note that in the impenetrable thickets formed by the plant, that beautiful and rare specimen of the spotted bush buck of the Cholie and Botletle Rivers finds secure refuge from the attacks of man and wild beasts.

(Signed) JAMES NICOLLS.

Mafeking, April 16, 1889.

N.B.—Mr. Nicolls, on his return from Lake Ngami, at the close of the present year, will be most happy to furnish the authorities at Kew with specimens of the roots and stalk of the plant in question. At the same time he has to express his regret that, owing to the carelessness of the man in charge of his waggons on his journey from Lake Ngami last year, the entire number of specimens of plants, &c., with very few exceptions, have been unfortunately lost.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street,
May 29, 1889.

SIR,

I AM directed by the Secretary of State for the Colonies to transmit to you for your information, with reference to the letter from this department of the 23rd instant, the papers noted in the subjoined schedule, which relate to the fibre fish nets from Lake Ngami.

I am, &c.
(Signed) ROBERT G. W. HERBERT.

The Director,
Royal Gardens, Kew.

Mr. NICOLLS to Sir S. SHIPPARD.

British Bechuanaland, Mafeking,
April 16, 1889.

YOUR HONOUR,

IN reference to the minute of the 12th instant and forwarded to me by direction, I have the honour to state that by post this day I forwarded to his Excellency the High Commissioner direct a specimen of fish nets made by the natives around Lake Ngami. I regret having to state that a large quantity of fibre from which the nets in question were manufactured has been lost in transit from the lake to Mafeking. As I propose proceeding to the Lake District this year I shall be most happy to supply the Director of the Royal Gardens at Kew with a quantity of the fibre on my return.

I have, &c.,
(Signed) JAMES NICOLLS.

Sir S. Shippard, K.C.M.G.
&c. &c.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street,
April 16, 1890.

SIR,

WITH reference to the letter of the Colonial Office of 29th May last, I am directed by the Secretary of State for the Colonies to transmit to you for your information a copy of a report which has been received from the High Commissioner in South Africa on the subject of a certain plant from Lake Ngami, sent direct to Kew.

I am, &c.,
(Signed) ROBERT G. W. HERBERT.

The Director,
Royal Gardens, Kew.

Mr. HICKS to Sir H. LOCH.

Grand Hotel, Diep River,
March 13, 1890.

YOUR EXCELLENCY,

I BEG to forward specimens of the roots and stalks of the plant which the Makoukba natives of Lake Ngami make their fish nets from. These are the specimens promised by Mr. James A. Nicolls of Mafeking, April 16th, 1889, to the authorities at Kew Gardens.

I am, &c.,
(Signed) ROBERT I. HICKS.

Sir Henry B. Loch, G.C.M.G., C.B.

These specimens entirely agree with *Sansevieria sulcata*, Bojer. We have never had any flowers of *S. sulcata*, and should be much obliged if Mr. Nicolls could get some for us.

Mixed with the bundle of *S. sulcata* was a single plant of a species, possibly *S. Volkensii*, Gurke.

XLII.—SISAL HEMP.

[K. B., 1887, March, pp. 3–8.]

Under this term are included fibres derived from probably more than one species of Agave, and it is probable also that one species of Furcraea is used. According to the locality where the industry is carried on or the port of shipment the fibre produced in Yucatan is called Sisal Hemp, which is the recognised name in the English market; or Jenequen or Henequen Hemp, which would appear to be the term more commonly used in the United States. Pita is another Central American fibre but whether the produce of an Agave (*A. americana*) or of a Bromeliad (*Karatas Plumieri*) is not quite clear. Probably it is loosely applied to both.*

As regards the species of Agave yielding Sisal Hemp, Miller first described *A. rigida* (Dict. Ed. 8, 1768) in the following words: "Long, "narrow, stiff leaves, entire, and terminated by a stiff black spine.

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*According to Miller, Pita fibre is derived from *Furcraea gigantea*, which would make it identical with Mauritius Hemp. Dr. Perrine, on the other hand, mentions *Agave Ixtli* "as furnishing a fine fibre called Pita."

"These leaves are seldom more than two feet long, little more than an "inch broad, being of a glaucous colour. The side leaves stand almost "horizontally but the centre leaves are folded over each other and "enclose the flower bud."

This may be accepted in a large sense as the representative species of which there are several sub-species and varieties cultivated by the natives of Yucatan from time immemorial.

According to Dr. Engelmann (Trans. Acad. Science, St. Louis, Vol. III., Dec. 1875) a common native species in Yucatan called Chelem by the aboriginal inhabitants is identical with *Agave rigida* of Miller; but a number of varieties, characterised by longer leaves or the absence of spines, have been recognised, to which names more or less distinct are now applied.

Mr. Baker has given a Synopsis of the Genus Agave in the *Gardeners' Chronicle* (Vols. VII. and VIII., New Series, 1877). The plants mentioned below are included under the Group *Rigidæ*, having the edge of the thin horny leaf without any distinct border, and the teeth (when present) small but distinct and deltoid. He remarks that this is a considerable group of which *A. lurida* and *A. rigida* may be regarded as the types intermediate between the groups *Americanæ* and *Aloideæ*.

From a study of plants at Kew, Mr. Baker was inclined to look upon *A. Ixtli*, Karw., as the type and *A. rigida*, Mill., *A. elongata*, Jacobi, and *A. sisalana*, Perrine, as synonyms or varieties. But as in the first place *A. rigida*, Mill., has the priority in point of time, and (if we follow Dr. Engelmann) also represents the old aboriginal fibre plant of Yucatan (the Chelem), it would be better to retain this as the aggregate species and place the others among the varieties which have arisen in course of long cultivation in different parts of the peninsula of Yucatan.

We have then—

A. RIGIDA, *Mill.*

var. 1. *A. Ixtli*, Karw.; *A. ixtlioides*, Hk.f., leaves 1½–2 ft. long, teeth distant.

2. *A. elongata*, Jacobi; leaves 4–5 ft., glaucescent and toothed. "Sacqui."

3. *A. sisalana*, Perrine; leaves 4–6 ft. long, pale green, not glaucous, generally without teeth. "Yaxci."

Dr. Engelmann in his notes cited above mentions that the original plant of *A. rigida* was, according to Miller, brought from Vera Cruz, but his own specimens were collected in Yucatan by Dr. Schott. He states that Dr. Perrine and Dr. Schott independently studied and described in Yucatan this interesting plant, with its different forms and economic uses (Senate Doc. 300, Washington, March 12th, 1838), the latter in the Report of the Agricultural Department at Washington for 1869. According to Dr. Engelmann, "both agree that there is a common "native species in Yucatan, called *Chelem* by the aboriginal inhabitants; "but from time immemorial a number of varieties, all characterised by "much longer leaves, and one also by the absence of marginal spines, "and differing among themselves in the quantity and quality of their "fibre, have been cultivated by the natives of Yucatan, and are a staple "product of that country to this day, furnishing the well known Sisal "Hemp. The people know them as *Jenequen* (Schott) or *Henequen* "(Perrine), and distinguish, as Dr. Schott reports, the *Yaxci* (Yashki) "as furnishing the best quality, and the *Saci* (Sacqui) with the largest "quantity of fibre. *Chucumci*, larger than the last, produces coarser

"fibre; *Babci* has fine fibre, but in smaller quantity; *Citamci*, with "small narrow leaves and poor fibre, stands probably nearest to the "wild plant. Dr. Perrine mentions another variety, *Istle*, evidently "the *Ixtli* of Karwinski, as furnishing a fine fibre called *Pita*. "These plants yield a return of leaves when four or five years old, "and may last 50 or 60 years under proper management; the flower- "ing scape is cut off as soon as 4 feet high, when, evidently, axilliary "branches continue the growth of the plant, which is thus kept so "long alive by being prevented from flowering.

"The trunk of the wild plant of Yucatan, which I refer with little "doubt to Miller's old *A. rigida*, is 1–2 feet high; leaves 1½–2 feet "long, and as many inches wide, contracted above the broader base "and widest about the middle; lateral teeth ¾ or even 1 inch apart, "mostly straight, from a broad base 1–2 lines long, rather unequal, "with smaller ones interspersed, dark brown; terminal spine 1 inch "long, 1¾ lines in diameter, straight, or often somewhat twisted, terete, "scooped out at base but not channelled, dark red-brown, a dark "corneous margin extending down the leaf-edge for several inches and "bearing the uppermost teeth. Scape 12–15 feet high: flowers pale "yellowish green, 2¼–2½ inches long, perigone 16, tubes 6–7, lobes 9–10 "lines long; stamens inserted about the middle of the tube, 'blood-red "upwards,' 1-inch longer than the perigone; anthers 10–10½ lines "long; styles at last as long as stamens.

"*A. Ixtli*, which in 1872 flowered in the gardens of the late M. "Thuret at Antibes, is entirely similar, flowers of the same dimensions, "anthers a little larger (11½ lines long); capsules which grow with "the bulbs on the same panicle, oval, over 2 inches long, 1¼ wide, very "short stipitate; seeds uncommonly large, 4½ lines high, with a ventral "hilum (in many other Agaves I find the hilum more basal, a charac- "ter which may be of some value). I believe this is the first time "that the flowers of the Ixtli have been described;* they identify the "plant with the old *A. rigida*, or at least the above-described Chelem. "*A. Karwinskii*, Zucc., is probably the same thing.

"With the name of *longifolia* I designate the variety known as "*Sacci* (Sacqui) and extensively cultivated in Yucatan; it is princi- "pally distinguished by its much longer spiny leaves, 4–5½ feet long, "3–4¼ inches wide; flowers very similar to those of the wild plant, "but filaments greenish. *A. fourcroyoides*, Jacobi, Agav. p. 107, pro- "bably belongs here, and *A. elongata*, Jacooi, p. 108, I would also refer "to this form if the description did not expressly mention a channelled "terminal spine.

"*Agave sisalana* is the name that Dr. Perrine gave to the plant "known to the natives of Yucatan as *Yaxci*, the most valuable of the "fibre-producing Agaves, which was introduced by him into South "Florida some thirty-five or forty years ago, during his efforts to accli- "matize commercially valuable tropical plants in that almost tropical "portion of our territory, efforts which were aided by Congress by a "large grant of land, but which were destroyed, together with his own "life, during the subsequent Indian wars. With this Agave, however, "he has been successful, as it is now fully naturalized, and is quite "abundant at Key West and the adjacent coast. Dr. Parry found it "there in full bloom in February 1871, and gives the following de- "scription of it:—trunk short; leaves pale green but not glaucous, 4–6

* This remark made by Dr. Engelmann in 1872 is, however, not quite correct. The *ixtlioides* form (*Agave Ixtli*) were fully described and figured by Sir J. D. Hooker from a plant which flowered at Kew in 1871. (Bot. Mag. t. 5893.)

" feet long and 4–6 inches wide, generally smooth-edged, but here and " there bearing a few unequal, sometimes very stout and sharp teeth ; " terminal spine stout, often twisted, purplish-black ; scape 20 or 25 " feet high, panicle 8 feet long and half as wide. One of the largest " plants examined had 35 branches in the panicle, the largest (near the " middle) 2 feet long, upper and lower ones shorter. The flowers are " slightly larger than those described, with a shorter, thicker ovary, " stamens inserted a little higher up in the tube. The plants bore no " fruit, but produced an abundance of buds, by which they propagate " themselves and from which this interesting form has been multiplied " in this country and in Europe.

" If this plant is, as is most probable, only a cultivated variety of " *A. rigida*, it is of the greatest importance for the study and the " understanding of the Agaves, indicating, as it does, the extent of " variation which they may undergo. It shows that the size of leaf " and scape, or colour of leaf, are of no great specific value, and also " that the presence or absence of spiny teeth on the margin is not an " unalterable character, not any more than the cartilaginous margin " decurrent from the terminal spine. The presence of a trunk, the " proportions of the leaf (in *A. rigida* and all its varieties the length " equals 12–14 times the width), probably the form of the terminal " spine, the character of the inflorescence, and, above all, the form and " proportions of the flower and its parts, remain constant, and perhaps " also the proliferous character of the inflorescence of some species."

In a Report on fibre plants prepared by the late Director of the Botanical Department, Jamaica, in 1884, it is mentioned that with regard to the value of *Agave rigida* and its allied forms as the sources of the Sisal Hemp of commerce, there were two important points deserving attention. The first was the universal increasing demand which exists in all countries for this fibre ; and the second was the drought-enduring character of the plant and the simple and economical treatment which it requires at the hands of the cultivator.

The fibre of these Agaves under their own name or as Sisal Hemp and Henequen is quoted at the present time at 38*l.* per ton, which is a little over 4*d.* per pound.

In Yucatan the Agaves are planted with about 9 feet between the plants each way, and with intervals of 15 or 18 feet at certain distances for carting out the leaves and young shoots. In regularly planted areas there should be 400 plants to the acre. Plants put out as suckers about 1½ to 2 feet high commence to yield in the fourth or fifth year and it is said they " continue to do so for fifty or sixty years and even longer."

As an example of what the probable returns may be from a Sisal Hemp plantation, it is stated by Dr. Perrine that each plant at four or five years old yields on an average 25 leaves per annum, the aggregate weight of which is one "arroba" or 25 pounds. Out of this weight of green leaves there is obtained by hand scraping one pound of clean, marketable fibre, which at 38*l.* per ton is worth a little over fourpence per pound.

The annual gross return per acre may therefore be set down at 400 pounds of fibre, which at 4*d.* per pound, gives a gross yield of 6*l.* 13*s.* 4*d.* The actual cost of producing and preparing the fibre would vary according to the circumstances of the locality ; but where good facilities exist for the transit and preparation of the leaves, and especially with the aid of simple and effective machinery, the cost should not exceed one penny per pound. Hence the net returns may be set down at about 5*l.* per acre per annum.

The export of Sisal Hemp exceeds that of any other article of Mexican growth. The export value of fibres from Yucatan in 1883 reached the large sum of 658,000*l.*

Dr. Schott, in the Report of the Department of Agriculture, United States of America, for 1869, remarks that "while other products of "Yucatan agriculture may occasionally have become unprofitable either "in consequence of adverse climatic features to which the peninsula is "subject, or through commercial fluctuations, the Sisal Hemp has never "been subject to such drawbacks, a fact attributable to the universal "usefulness of its fibre and the unconquerable vitality of the plant, "which easily survives the effects inherent to the nature of a riverless "rocky desert, and the severe trials of a six months' tropical sun. For "a knowledge of the Sisal Hemp plant," continues Dr. Schott, "its "culture and uses, Yucatan is indebted to the Maya Indians, the direct "descendants of those remnants of the Toltecs who, after the fall of "their empire in the valley of Mexico, emigrated to Central America "and Yucatan."

An account of the Sisal Hemp industry in Yucatan has lately been published by the Government of Jamaica. This was furnished by Mr. Stoddart, who for a time was practically engaged in the industry. It contains information on some points not hitherto available. According to this writer the plant known locally as Sacqui (probably according to Engelmann, the variety *longifolia*) is most generally cultivated. This is said to yield the largest quantity of fibre, which is characterised by flexibility, whiteness, strength, and weight. It has been already mentioned that Dr. Schott selected the Yaxci (*sisalana*) as furnishing the best quality, and the Sacci (Sacqui) the largest quantity of fibre. It is, however, generally agreed that the bulk of the fibre exported from Yucatan, and called from the former port of shipment Sisal Hemp, is the produce of the Sacqui (*elongata*). The chief port of shipment now is Progresso.

The land which supports the fibre industry in Yucatan is of a gravelly, stony, and in some places of a rocky character. The plants thrive best and yield the largest amount of fibre in comparatively arid districts, only a few feet above the level of the sea. Moist or rich land is considered unsuitable, for although the plants would grow in the latter, the quantity of fibre yielded would be comparatively small. For convenience of carriage and general management level land is preferred.

Plantations are established by simply clearing the land of trees and scrub. Stumps are uprooted to give an even surface. Shade is a disadvantage. Plants are generally put out during the rainy season, at 12 feet by 6 feet (equal to 605 to the acre) in holes proportional to their size. All fibrous roots and lower leaves are removed before planting, to facilitate new growth. It is estimated to cost "four shillings and six-"pence per acre to line, dig holes, drop suckers, and plant." A well established plantation has an extensive system of roads all converging on the works, which latter are placed in as central a position as possible.

After planting, the chief cultural operations are confined to keeping the fields clear of weeds, and removing suckers which grow around the parent plants. These latter are utilised to extend cultivation by being planted in nurseries, or are thrown away. Their removal is considered necessary to the success of the plantation.

A fibre plantation started with plants about 1½ feet high, begins to yield in about three years after planting Any appearance of the "pole," or flowering spike, is watched, and when 3 or 4 feet high it is cut out. Otherwise the usefulness of the plants for fibre purposes would immediately cease.

The length of leaves cut for fibre should not be less than 3 feet; their ripeness is judged by the colour and by their position in the rosette. Consequently the outer leaves are always cut first, being the oldest. The harvesting of the leaves, which goes on all the year after once started, is effected in the following manner:—Men armed with suitable knives select ripe leaves, cut them close to the trunk, remove prickles from the edge, and point and make them up into bundles of 50 each. Thirty such bundles is a day's task. These bundles are put out on the edge of the cart road, and are taken up by drays, carrying 1,500 leaves to a load, to the works. Cutters, carters, and machinists are paid so much per 1,000 leaves.

The works are placed near a regular supply of water. The power of the engine and the number of machines required all depend on the size of the plantation. One fibre machine is stated to be required for every hundred acres of plants.

After the fibre has passed through the machine it is placed on a drying stand fully exposed to the sun and thoroughly dried. If it is desired to bleach the fibre to a high degree of whiteness it is left out all night and during the next day and carefully turned. The fibre is made up into bales by means of a screw or hydraulic press, care being taken to keep the fibre straight and prevent "fringes."

Each plant when matured yields 30 to 35 leaves per annum, and the return of hemp is at the rate of 1,000 to 1,200 pounds per acre, or about half a ton per acre per annum. The net return on a fibre plantation in Yucatan is estimated at between 4*l*. and 5*l*. per acre.

Plants received at Kew from Yucatan marked "Sisal Hemp" are now growing in the Succulent House No. 5, and lately an experiment was made to test the quality of the fibre yielded by them.

The fibre was extracted by Mr. W. E. Death's fibre machine, and the following report was received upon it from Messrs. Ide and Christie, fibre brokers, of Mark Lane:—

"We are in receipt of the parcel containing a leaf of *Agave rigida* and
"sample of hemp made from leaves grown in the gardens. These are
"most interesting to us, and we have much pleasure in reporting
"favourably on the hemp. The quality and strength are very satis-
"factory, while in respect of colour, lustre, and fineness of fibre, your
"sample is superior to the average Sisal Hemp that comes to this
"country. The value of this article is exceptionally high at present,
"27*l*. per ton in London. You will see from the statistics given in
"enclosed circular that this material is an important one and is exten-
"sively used both in England and America. It enters into competition
"with Manila Hemp and was regarded as an adulterant of the latter in
"rope; but as its price is now nearly as high as that of Manila the
"ropemakers have not the same inducements to mix the hemps."

XLIII.—FIBRE INDUSTRY AT THE BAHAMAS.

[K. B., 1889, pp. 57–61.]

At the request of the Secretary of State for the Colonies, the following correspondence is published in the *Kew Bulletin*, respecting a fibre industry at the Bahamas, in which the Governor, Sir Ambrose Shea, takes a deep personal interest. A supplementary note is added, giving

the most recent information which has reached Kew respecting fibres from *Agave* and other plants :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street,
December 24, 1888.

SIR,

I AM directed by Lord Knutsford to transmit to you a copy of a despatch from the Governor of the Bahamas, enclosing copies of a circular which he has addressed to the Resident and Assistant-Resident Justices of the Islands, on the present position and prospects of a fibre industry in the Colony, and to state that his Lordship would be glad if a copy of the circular could be inserted in the *Kew Bulletin*.

I am, &c.
(Signed) JOHN BRAMSTON.

The Director,
Royal Gardens, Kew.

Sir A. SHEA to LORD KNUTSFORD.

Government House, Nassau, N.P.
November 22, 1888.

MY LORD,

I HAVE the honour to transmit to your Lordship six printed copies of a circular which I have caused to be addressed to the Resident and Assistant Resident Justices of the Bahama Islands on the subject of the present position and prospects of a fibre industry which is gradually being adopted by the people with a growing faith in its important bearing on their future welfare.

I am, however, anxious that the attention of capitalists should be directed to the solid attractions of this production, and I know of no investment so free from the speculative element and offering a fairer promise of remunerative results.

With a population so long in a stagnant and somewhat contented state, I feel some outside influence is required to urge this industry into vigorous activity, and your Lordship will confer a great good by enlisting the attention of some leading journal to the information in my letter, and thus attract those whose enterprise it would be so important to have engaged in developing this industry, and whose operations would be exemplary to the native population.

I have, &c.
(Signed) A. SHEA,
Governor.

The Right Hon. Lord Knutsford,
&c. &c. &c.

[Circular.]

Colonial Secretary's Office, Nassau, N.P.
November 22, 1888.

SIR,

I AM directed by his Excellency the Governor to call your attention to the important question of fibre cultivation, now so largely engaging the minds of the public, and on which it is essential that the fullest information should be disseminated.

During his Excellency's late absence from the Colony, he was enabled to gather some instructive particulars, which strengthens his faith in the part the fibre industry is to play in the speedy advancement of the Colony.

Through the good offices of the Crown Agents for the Colonies in London, the following statement was obtained from Mr. Thomas Briggs, a gentleman of great authority, to whom a sample of rough rope made from

Bahamas fibre was submitted for examination. Mr. Briggs states, under date September 3rd, 1888 :—"This material I consider equal to very "good Manila hemp, and worth in the unspun, raw state thirty-six to "thirty-eight pounds per ton, colour excepted, which is not of very great "importance. I consider it to be a very superior article for spinning "in yarns for rope-making, and unless in bulk some ingredient should "be found to counteract its apparent good qualities, it should find a "ready sale at the price I name."

This testimony is highly satisfactory, and in the United States the article is not less fully estimated. It is, moreover, a stable commodity of commerce in which serious variations of value are not to be looked for, and this goes to rid the work of production of uncertain and risky conditions.

With land and climate so adapted for the growth of the Sisal fibre, the plant being indigenous, it is remarkable that the industry had not acquired a practical existence until the Legislature gave it an impetus by the fostering Act of the Session of February last—so little was it generally regarded that the small farmers viewed the plant with despair as a noxious weed they were unable to eradicate. From every part of the Colony we now have gratifying proofs of an awakening and intelligent spirit and of the steady advance in the establishment of the industry, and public faith in its efficiency as an agent of general future prosperity increases as we proceed in the work of inquiry. There are some very interesting statements in a pamphlet recently published by Mr. Stoddart, of Jamaica, who spent some time in Yucatan, where the fibre industry has for some years been prosecuted with conspicuous success, under conditions of soil and climate not more favourable than we have in these Islands. We were aware that the plant is independent of drought, and this is Mr. Stoddart's experience. It was also believed in this Colony that it takes about three years after planting to bring the leaf to a productive state, and this is confimed by Mr. Stoddart, who also affirms that it will then yield annually for 15 to 20 years without any material outlay on its cultivation. The produce of an acre in full growth Mr. Stoddart sets down at from one thousand to twelve hundred pounds of fibre, and he corroborates the opinion held here that the plant thrives best on rocky and impoverished soil, and that it is shunned by cattle, and consequently free from injury on this account.

Mr. Stoddart's estimate of production, which it is not meant to impeach, admits of a large abatement and yet leaves the enterprise full of promise. At a fair price he makes the money value of an acre about eighty dollars annually, but His Exellency prefers a lower basis of calculation to cover all assumable adverse contingenies. The Governor in this view takes fifty dollars an acre annually, which gives a handsome margin of profit on the cultivation. The return of wheat farming is highly enough placed at 35 bushels an acre, or as many dollars at a reasonable computation of price, and we are thus brought in presence of the extraordinary conclusion that the barren lands of the Bahamas, through the fibre cultivation, are made to bear an economic value beyond the favoured wheat growing regions of the United States and Canada. We moreover find this difference enhanced by the fact that the fibre needs but one planting for 15 to 20 crops, while wheat must be planted annually, and is liable to many injurious contingencies from which the Sisal plant is exempt.

These islands should be the Paradise of the working man. The land is obtainable on very easy terms, and in lots to meet the circumstances of the labouring population. To create the largest possible

number of peasant proprietors is the great desire of the Government. But it is not their intention to lead the people away from their present pursuits, for the new industry can be combined with those existing, as it will involve little more than the use of the time now left on their hands. There are nearly 2,000,000 acres of ungranted lands in the Colony, and with the conditions of purchase, the facilities for prosecuting the fibre cultivation, and its value as a staple article of commerce, the countries are few that offer so fair a field for the reward of the capital and labour that may seek investment in this undertaking.

It is intended immediately to despatch a Commissioner from this Government to Yucatan to make further inquiries, as it is of the utmost importance to have the fullest information on the whole economy of the industry, in which the people of this Colony are now so vitally interested.

I am, &c.
(Signed) E. B. A. TAYLOR,
Colonial Secretary.

[It is desirable to add a few words to supplement the information given in the interesting circular issued by the Government of the Bahamas.

This information is very similar (with the exception of one or two points to be mentioned later) to that already published in the *Kew Bulletin* for March 1887, pp. 3–8.

Mr. Stoddart's report (published by the Governent of Jamaica) on which the estimates of profit in Mr. Taylor's memorandum are based, was communicated by Kew to the Colonial Office for transmission to the Government of the Bahamas in reply to a despatch from Governor (Sir Henry) Blake, date 24th January 1887.

It was pointed out at the time in par. 5 of the Kew letter, dated 15th February 1887, that "the statements contained in the pamphlet are not "necessarily endorsed, either by the government of Jamaica or by "Kew. It professes to be nothing more than an account given by a "Jamaican resident of the fibre industry in Yucatan in which he was "practically engaged for some time."

It is to the credit of Mr. Stoddart, however, that his account of the fibre industry of Yucatan is confirmed in most particulars by other writers, and there is no reason to believe that it requires correction in any essential point. It may at the same time be desirable to point out some of the conditions under which the industry is remunerative in Yucatan.

For instance the rates of wages in Yucatan are comparatively low (ranging from 9*d*. to 1*s*. per day for labourers), and under such circumstances, Mr. Stoddart estimates (at page 10) the net profit on current expenses at "between 4*l*. and 5*l*. per acre" (equal to between 20 and 30 dollars per acre), The plants, if 18 inches high when first put out, are said to be ready for a first cutting in three years. This period may, however, under unfavourable circumstances, be prolonged to five or six years. Another important point to bear in mind is that Mr. Stoddart speaks only of returns obtained by the use of machines driven by steam-power, and by working plantations of say 100 acres or more. The methods suited to one country are not necessarily suited to another. Possibly at the Bahamas it might be advantageous for small cultivators to clean the fibre in their leisure hours by hand, and sell it locally to merchants who would ultimately undertake the business of baling and shipping it. If the fibre is not properly baled, the cost of freight would

be so large as to greatly reduce the returns. Indeed the fibre in a loose state is so bulky that it would be almost impossible to ship it at such a rate as would enable it to compete successfully with fibres from other countries. It is usual to pack this class of fibre by means of hydraulic presses, in bales of about 400 lbs. each. If the small proprietors in the Bahamas take up a fibre industry, it is evident that some one possessing capital should be prepared to purchase the fibre in small quantities and pack it by means of suitable presses ready for shipment. There are no grounds, however, for supposing that a fibre industry based on *Agave* and *Furcraea* plants, and judiciously pursued, can be otherwise than satisfactory.

A collection of fibre plants was received at Kew about two years ago (from the Government of Bahamas), and it was stated in a letter dated the 16th May 1887, that among these specimens there was no species exactly answering to that yielding the Sisal Hemp of commerce. The fibres of No. 2 (*Furcraea cubensis*), and No. 3 (*Furcraea cubensis*, var. *inermis*), were the most valuable, and these are said to be used partly as a source of commercial fibres in Yucatau. The true Sisal Hemp plant is *Agave rigida*. This may be abundant in the Bahamas, but no specimens were received of it. Other fibre plants received at the time mentioned were *Agave lurida* and *Agave americana* var. *variegata*, the latter a variegated form of the common American Agave. These latter are of little value for fibre as compared with the true Sisal Hemp plant. Specimens of African Bow-string hemp (*Sansevieria guineensis* were also received, the fibre of which is of high value.

A fibre industry has been in existence in Mauritius for some years. The experience gained there might be of service in the Bahamas, especially in regard to the initial difficulties to be overcome in establishing a new industry.

The market value of this class of fibre, and the permanency of demand for it, has been fully investigated at Kew. A summary furnished by Messrs. Ide and Christie, gives the average price per ton for Sisal hemp in London for the years 1879-86 inclusive; these are:—1879, 27*l.*; 1880, 27*l.*; 1881, 28*l.*; 1882, 28*l.*; 1883, 27*l.*; 1884, 21*l.*; 1885, 19*l.*; 1886, 21*l.* The highest price paid was 32*l.* 10*s.* 0*d.* in December 1879 to February 1880, the lowest price was 17*l.* 15*s.* 0*d.* in January and February 1886. Recently there has been an increased demand for white fibres, with a corresponding rise in prices. In the United States, Messrs. Crocker's Statistics, dated the 1st December, gave the price at 8 to $8\frac{3}{8}$ cents per lb. (equal to about 37*l.* to 39*l.* per ton). A rough Agave fibre from Bombay (probably prepared by hand) was valued last December at 15*l.* to 17*l.* per ton. Mauritius hemp prepared by machinery from *Furcraea gigantea* (known as the green aloe or green Agave) was valued: good, 34*l.* to 35*l.* per ton; fair, 33*l.* per ton; common, 30*l.* per ton. D. M.]

XLIV.—FIBRE INDUSTRY AT THE BAHAMAS—(continued.)

(*Agave rigida*, var. *sisalana*.)

[K. B., 1889, p. 254.]

In the *Kew Bulletin* for March last, p. 57, information was given respecting a new fibre industry at the Bahamas. Since that time

specimens of the leaves of the plant have been received at Kew, and it has now been possible to determine the species, as shown in the following letter addressed to the Colonial Office :—

ROYAL GARDENS, KEW, to the COLONIAL OFFICE,

SIR, Royal Gardens, Kew, July 18, 1889.

WITH reference to your letter of the 14th February 1887, and subsequent correspondence on the subject of the "Pita" fibre plant of the Bahamas, I am desired by Mr. Thiselton-Dyer to inform you that he has lately received from Sir Ambrose Shea specimens of leaves of this plant, which have now enabled us to identify it.

2. When specimens of various fibre plants growing at the Bahamas were forwarded to Kew two years ago, a description of which was forwarded with my letter of the 16th May 1887, the present plant was not among them. The various species of Agave are extremely difficult to distinguish, and it is quite possible that the plant described as No. 1 *Agave lurida* was sent to this country under the impression that it was identical with what is known locally as the "Pita plant."

3. The "Pita" of the Bahamas, which it is hoped will give rise to a successful local industry, from the specimens of leaves that have now reached Kew, is a most interesting and valuable plant. There can be little doubt it is *Agave sisalana* of Perrine, now generally recognised as a variety of *Agave rigida* of Miller.

4. A good description of the plant, by Engelmann, is quoted in the *Kew Bulletin* for March 1887, p. 5.

5. This plant has doubtless reached the Bahamas, where we understand it is perfectly naturalized, from Florida and Key West. It is the produce of the plants originally introduced to Florida by Perrine about 40 years ago. The absence of teeth on the leaves, their extreme length (often attaining 5–6 feet), and the robust and free growing habit of the plant are qualities which render it one of the best, if not the best, fibre plant amongst known species of Agaves and Furcræas.

6. The steps already taken by the Governor of the Bahamas to encourage the utilisation of this plant and establish a local fibre industry are fully justified by the intrinsic merits of this Agave, and by the reports which have been obtained in this country on the quality and value of the fibre.

* * * * *

I have, &c.
(Signed) D. MORRIS.

Edward Wingfield, Esq., C.B.,
Colonial Office.

XLV.—FIBRE INDUSTRY AT THE BAHAMAS—(continued).

(*Agave rigida*, var. *sisalana*.)

[K. B., 1890, pp. 158–161.]

The development of an important fibre industry at the Bahamas has already been the subject of notes in the *Kew Bulletin* (*see* March 1889, p. 57, and October 1889, p. 254).

As indicating the character of the industry from an American point of view the following Report, prepared by the United States Consul at

Nassau at the beginning of this year, will be read with interest. This Report is reproduced exactly as it appears in the *Reports from the Consuls of the United States*, No. 114, March 1890 :—

Conditions of the Sisal Industry in the Bahamas.

Report by Consul McLain, of Nassau.

One year ago I made a report to the Department upon the culture of Sisal hemp in this colony, calling attention to it as a new industry just being introduced, and which promised to bring substantial prosperity to these islands in the near future.

During the year, and especially within the last few months, so many letters have been received at this Consulate from various parts of the United States making enquiries upon the subject, that I am satisfied a statement touching the present condition of the industry would interest many of our people, and I therefore submit the following :—

The progress made in the development of Sisal culture in the Bahamas during the past twelve months is marvellous. One year ago there was scarcely a dollar of foreign capital, and very little local, invested in this business in the colony, while to-day parties from Great Britain, Canada, and Newfoundland, representing large resources, are interested in the Sisal, have bought tens of thousands of acres of Government land, and are industriously engaged in clearing and planting the same to the full measure of their ability to procure the material. A local stock company, styled the Bahama Hemp Company, organised and managed by Nassau capitalists exclusively, has also purchased a large tract of land and is developing the same, whilst thousands of acres are being planted in every direction by individual owners of smaller pieces. American capital up to this date, I regret to say, for it is to its own disadvantage, has been conspicuous by its absence. One company, however, styled the Inagua Hemp Company, organised under the laws of the State of New Jersey, with D. D. Sargent, United States Consular Agent at Inagua, as manager, has lately procured about 1,200 acres at Inagua, and has begun operations.

Messrs. Munro & Co., of St. John's, Newfoundland, have obtained a grant of 18,000 acres of Crown land at Abaco, and are planting the same. Another tract of 20,000 acres has been allotted to a London company on the same island. Mr. Alex. Keith, of Edinburgh, Scotland, has taken 2,000 acres on Andros Island, and is working upon it. But the largest demand has been made lately by two London companies, who are said to be applying for not less than 200,000 acres between them.

Many applications for land have not been reached at all as yet on the files, the Surveyor-General's Department being hard pushed in the matter of surveys and locations, whilst new applications are being constantly received, and have to wait their turn for consideration. So much land has been taken up that the Governor, a short time ago, advanced the price of Crown land from $1·25 per acre, the ordinary price, to $4 per acre, withholding also the benefit of the bounty. And lately it has been decided to sell no more large allotments of Crown land at present, the quantity already allotted with a view to cultivation being as great as the condition of labour in the colony will justify. The number of acres of Crown land already disposed of is about 120,000 acres, whilst pending applications on file, and not yet reached, will amount to at least 200,000 more.

This substantial withdrawal of Crown lands is creating some movement in real estate—as is natural under the circumstances—between private parties, some old properties changing hands at prices double and treble their supposed values two years ago. Persons buying private lands and cultivating them will share in the bounty of 1 per cent. per pound provided by law on all fibre raised and exported. Private lands in New Providence can be bought, unimproved, for from $8 to $12 per acre, and for less on the out-islands.

The employment given to labourers in clearing land and in setting out plants has already put considerable money into circulation, the beneficial effects of which are being felt in various quarters. There has been no special advance in the price of labour, field hands commanding from 40 to 60 cents per day, and finding themselves. Each month, however, witnesses a large increase in the number of those who find remunerative employment, and pleasant relations obtain between employers and employed. The labour question has been and is one that here, as elsewhere, requires delicate treatment; but it has been skilfully met by Sir Ambrose Shea, the Governor, who, long ago perceiving that to permit investors to locate upon adjoining lands would induce sharp competition in wages in thinly settled districts, adopted the plan of scattering the allotments about the different islands, or in localities remote from each other on the same island, so that each settlement should have its share of the benefits of the new industry, by obtaining, at fair wages, employment for its local labour. In this way, also, a surplus of labour at one point and a scarcity at some other has been avoided. When the entire labouring population becomes employed, as will happen before long at the present rate of development, a new phase of the labour question will arise; but that time is yet in the future, and the remedy can be applied when the situation demands it.

Small shipments of fibre continue to be made by nearly every steamer, a few old plantings furnishing the materials. It is not likely that shipments in any quantity will be possible under two years, but after that time an enormous increase may begin to be looked for, increasing steadily as new fields come into bearing, until the annual exports of the colony, which now average about $600,000, will leap well up into the millions, as a moment's reflection will show.

It is a very low estimate to expect half a ton of fibre per acre, and a very low estimate to call it worth $100 per ton, for it is worth over $200 per ton in the world's markets to-day. When even the present quantity of land sold and applied for, to wit, 300,000 acres, is bearing, which ought to happen within five or six years, it will produce 150,000 tons a year, worth $15,000,000, an increase of prosperity that sounds more like a fairy tale than a strong probability deduced from reasonable figures. And yet 300,000 acres is but a small portion of the uncultivated lands within the limits of the Bahamas.

It is estimated that about 6,000 acres of land have already been planted in Sisal (a plantation once started needs no replanting for many years), and that many additional ones have been cleared and made ready for the plants, the obtaining of which has been almost impossible, the industry being seriously retarded thereby. The prices paid for plants have risen from 6 cents per dozen to 36 cents, so great has been the demand; but the price will now decline rapidly, since the supply of plants is developing enormously, about 2,000,000 being now available for planting, and others coming on speedily. The Pita plant is being found on all the islands growing wild, and the stock of old plants is very great. From the centre of the old plant rises a pole

about 16 feet in length, on the branches of which small plants grow, averaging a thousand to each pole, and from these poles a vast supply is coming into market, creating a profitable business; for what were two years ago only noxious weeds have all at once become worth $20 apiece for pole plants alone. Quantities of old plants have lately been discovered growing on the cays along the Florida coast, and small schooners are already buying these up and bringing them here for sale.

This fact suggests the question whether this new hemp industry, which is about to revolutionise the condition of the Bahamas, may not also be developed in the southern portions of Florida. The plants are found there growing wild just as they are in these islands, and they flourish best in dry sandy soils, fit for little else. I would earnestly call the attention of the Department of Agriculture to this matter, and suggest the propriety of looking into it, and of calling the notice of the people of Florida to this possible source of wealth and prosperity. The conditions of soil, climate, &c., which make its culture a success here may not obtain there, but the simple fact that the plant is found growing wild in Florida is of itself a consideration that should warrant an investigation at the hands of the Department.

The unexampled success of the Sisal industry, in so brief a period, in this colony is entirely attributable to the business-like, systematic manner in which it has been managed by the present Governor, Sir Ambrose Shea, who has all along taken a most earnest interest in the matter. He is a man of large experience in affairs, and has practical knowledge of the proper way to manage industrial enterprises. From the start he realised that this industry would be the salvation of the Bahamas, and, setting his heart upon it, he pushed it forward with great energy and prudence, overcoming numerous difficulties, surmounting obstacles, encouraging the faint-hearted, until now the people are touched with his own enthusiasm, and the industry is fairly afloat. He visited England, and by personal effort enlisted capitalists and procured large investments. To Sir Ambrose Shea the colonists owe a large debt of gratitude, and when the signal prosperity which is already hanging over the islands shall have been developed to its full measure they will more perfectly realise how not only their individual interests, but those of outside investors, have been wisely and prudently promoted and guarded from the very inception of the industry by the practical, discreet, and conservative action of their Governor.

There can be no doubt or question as to the success of Sisal culture in this colony. It has passed far beyond the experimental stage, and is giving daily evidence that it will become a source of wealth to all concerned. The combined conditions of soil and climate, especially adapted to the growth of first-class fibre, give this colony a marked advantage over other West Indian Islands, where the plant may grow luxuriantly enough, but will be found deficient in good strong fibre. The poorer and more sterile the soil the better the result, and here the plant flourishes where ordinary vegetation seems almost impossible. It is a plant of unfailing growth, it will live without rain to moisten the soil, you can scarcely exterminate it if you try, it requires but little cultivation, and at an expense below that of almost any other agricultural product, and its value is substantial.

As two thirds of the trade of the Bahamas is now with the United States; as their only steam communication with the outside world is by a subsidised line of American steamships running between Nassau and New York; as their increased wealth and prosperity means a larger and more profitable commercial intercourse with our own country,

we should view this coming development of their material interests with pleasure, and with the warmest wishes for its complete success.

In conclusion, I would add that I have sent by this mail four samples of the Bahama fibre for the information and satisfaction of the State Department, believing that the same would be of sufficient interest to justify me in so doing. These specimens were not specially selected, but are only fair samples of the average fibre which is now being grown and shipped from the colony. Two of them have still attached a stub, or portion of the butt end of the leaf, which was purposely not passed through the machine, showing the character of the Sisal plant when extracted.

THOS. J. MCLAIN, jr.
Consul.

United States Consulate, Nassau,
January 20, 1890.

XLVI.—FIBRE PRODUCTIONS IN THE CAICOS ISLANDS.

[K. B., 1890, pp. 273–278.]

The Turks and Caicos Islands lie between 21° and 22° N. lat. and 71° and 72° 37′ W. long. Their area is 169 square miles. The most important island, Grand Turk, is $2\frac{1}{2}$ miles long and two miles broad. It contains 2,500 inhabitants, being half the total population.

These islands were originally settled from Bermuda in the 18th century, and formed at first a portion of that colony. In 1799 they were transferred, for purposes of government, to the colony of the Bahamas, to which group they geographically belong. In 1848 they were made independent of the Bahamas, and were placed under the Governor of Jamaica, an arrangement which still continues.

Salt-making is the only industry of any importance, the quantity annually gathered exceeding $1\frac{1}{2}$ million bushels. Sponges are found in some quantities on the Caicos bank, but are chiefly collected by Bahamas schooners and carried to Nassau. There is one sponge-curing establishment on the Caicos Islands. The cultivation of the Manila fibre (or Pita plant) is being extensively introduced, with every prospect of success.

An agricultural settlement was started under Government auspices at Kew, North Caicos, in 1882, to grow fruit for export, but has proved a failure, owing to the absence of a remunerative market for the produce. The soil elsewhere is totally unfit for agricultural purposes. Practically the whole of the food and household necessaries are imported. The commercial intercourse is almost wholly with the United States.

The inhabitants are of mixed European and African extraction, the proportion of whites to coloured people being larger than in most of the West Indies.

The following correspondence relates to the attempt which is being made to develop the cultivation of fibre plants.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, February 21, 1890.

I am desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 17th inst., forwarding a copy of a despatch from the Governor of Jamaica together with a letter from the Commissioner of Turks and Caicos Islands on the subject of fibre plants.

2. The specimens of leaves mentioned by Captain Jackson have duly arrived at Kew and they have been carefully examined. The leaves marked A. and called "Pita" taken in conjunction with the specimen of fibre enclosed belong to the true Pita or Henequen of Yucatan (*Agave rigida* var. *sisalana*), and are identical with the plants yielding the valuable fibre which has lately attracted so much attention at the Bahamas. The leaves marked D. are derived from the same species, but the leaves in this instance are furnished with a few teeth, a circumstance which often occurs in this and other species of Agave. The original wild plants of *Agave rigida* were plentifully supplied with teeth. The present unarmed varieties have been selected for cultivation as being more readily handled. The three small living plants included with the leaves A. and D. were also apparently true "Pita" plants.

3. The plant known locally as "Manila," marked B., but supposed by Captain Jackson, as expressed in his letter of the 22nd July, "to be "the Sacqui or Henequen of Yucatan, of lighter colour and having "thorns on the edge of the leaf and growing freely wild," is *Furcraea cubensis*. This is well distributed nearly everywhere in the West Indies, and is known in Jamaica, Tobago, and elsewhere as "Silk Grass." It is closely allied to the plant yielding Mauritius hemp. It yields a good fibre, but it cannot be regarded as so valuable a plant as the "Pita." Where this latter is plentiful already, or easily obtainable in large quantities, it would not be desirable to devote attention entirely to the "Silk Grass."

4. It will be noticed than an examination of these specimens from the Turks Islands has proved very interesting. Captain Jackson has rendered valuable service by drawing attention to the existence of the true "Pita" in these islands, and there is no reason why a very important fibre industry should not be established here. The identity of the Turks Islands "Pita" with that of the Bahamas is a fact that should alone suggest some steps being taken to improve the condition of the people in these Settlements.

I am, &c.

Sir R. G. W. Herbert, K.C.B. (Signed) D. Morris.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, February 25, 1890.

I am directed by Lord Knutsford to acknowledge the receipt of your letter of the 21st instant, reporting on the specimens of fibre plants sent home by the Commissioner of Turks Islands, and to inform you that a copy of it has been transmitted to the Governor of Jamaica for communication to the Commissioner.

I am, &c.

The Director, (Signed) Robert G. W. Herbert.
Royal Gardens, Kew.

SIR, Downing Street, October 8, 1890.

I AM directed by the Secretary of State for the Colonies to transmit to you, for your information, papers relating to botanical subjects in several West Indian Colonies.

I am, &c.

The Director, (Signed) ROBERT G. W. HERBERT.
Royal Gardens, Kew.

The COMMISSIONER, TURKS ISLANDS, to the COLONIAL SECRETARY, JAMAICA.

(Turks Islands, No. 76.)

SIR, Grand Turk, August 19, 1890.

HAVING just returned from a tour of inspection round the whole of the Caicos Islands, during which I was able to visit all the lands lately taken up for fibre cultivation, I have the honour to submit to his Excellency the Governor a short report on the present prospects of this industry.

2. Leaving Grand Turk in a small schooner on the evening of the 5th instant, in company with Mr. Hance, the American Consul, we arrived early on the following day at the west point of East Caicos, better known as "Breezy Point." The island includes upwards of 25,000 acres, and is held on a lease, without rent, of 99 years, of which about 10 years only have expired. The original lessee died in March last, and his heirs have sub-let the property to Mr. J. D. Murphy, who represents a syndicate who are merely waiting for the passing of a Companies Act to register as a limited liability company.

3. At present, about two-thirds of the island is held as a cattle ranch, there being about 1,000 head on the island, and there is a considerable quantity of cave earth (guano), about 200 tons of which has been stored, and was awaiting shipment at the time of my visit. The island contains from 15 to 20,000 acres suitable for the Pita (or Sisal) cultivation, and some 200 acres have already been cleared. The land, so far as I was able to judge from the written descriptions, of which I have a considerable number, is fully equal to the best land in Abaco, where such large Sisal plantations are being established in the Bahamas, and it is far superior for this purpose to any land which I have seen in any other part of the Caicos. It is chiefly reddish-brown earth, freely interspersed with limestone rock, rich in phosphates, the fertilising power of which is amply attested by the luxuriant growth with which it is covered. The anchorage is safe and good for vessels up to 300 tons, and could easily be made available for larger craft by the removal of a few isolated coral patches.

4. The only obstacle to the assured and early success of the company working this property is the difficulty of obtaining sufficient plants of the right variety (*Agave rigida* var. *sisalana*), but it is one which I hope may be shortly overcome. At present, the company has the promise of sufficient plants to stock about 200 acres, but they are ready to clear 2,000 acres a year if plants can be had. The labour for this land is drawn from Grand Caicos, where, as reported in my letter No. 67 of the 22nd July 1889, there is no Government land available for the people, and they have hitherto been forced to hire land at exorbitant rents.

5. We were joined at Breezy Point by Mr. Leslie, the magistrate of the Caicos District, and, leaving there on the 7th instant, we proceeded to Lorimers, on Grand Caicos, to the fibre plantation leased by Mr.

Hance. This property comprises about 1,000 acres, of which nearly one third has been planted out for some years in Pita. Unfortunately, no system was pursued in setting out the land, and the plants are in irregular lots among thick bush, and in the six months he has held the land Mr. Hance has made no effort to clear or arrange his plantation, but has confined himself to gathering the mature leaves. He assures me, however, that he intends at once to clear and plant out regularly, and has also promised to dispose of his surplus suckers to the lessees of Breezy Point.

6. Mr. Hance has erected a stone store and dwelling combined, and has put up a 10 horse-power vertical engine, capable of working 5 or 6 "Raspadores." At present he is only working one "Kennedy" machine, and the result is not satisfactory, though I have little doubt that this is greatly owing to the entirely unskilled labour at his command. During my visit, which extended over two days, he was extracting fibre from small and damaged leaves, for export as "paper fibre," but even these it was considered necessary to divide before passing them through the wheel, and there was a loss of not less than 30 per cent. of fibre, the land on which the bagasse was put to dry being thickly covered to a depth of several inches with tangled fibre. Mr. Hance assures me that, in spite of this loss, he obtains an average amount of fibre of upwards of 4 per cent. of the weight of the leaves, which is all that is done by the Death and Ellwood wheels in Yucatan and the Bahamas. If this be so, then either the waste from the best machines at present in use must be equally extravagant, or else the peculiar soil of these islands must produce a leaf richer in fibre than has yet been grown. I am inclined to think that the latter is the case, to some extent at all events, as, at the next place visited, I found numbers of plants of the Manila or "Silk Grass" (*Furcraea cubensis*) with strong, hard, healthy leaves, 8 to 9 feet long, which is, I believe, far beyond the average.

7. The labour for Mr. Hance's lands is, like that for Breezy Point, drawn from Grand Caicos, including the villages of Lorimers, Bombarra, and Fergusons, but his plantation is so small that this will cause no difficulty. In fact it will require both these farms to find work for these people, whose position has hitherto been a very pitiable one.

8. I had intended visiting the extensive though thinly populated settlement of Bottle Creek on North Caicos, where I am told there are numbers of Pita plants on private lands not yet worked, but the state of the weather made it dangerous to risk the passages of the reef, so, leaving Mr. Hance to return to Grand Turk in the schooner which had brought us, I took my own open boat and, starting at 9 a.m. on the morning of the 9th instant, and sailing across the Caicos Bank, reached Kew Settlement on North Caicos at 11 p.m. the same day, a very hot day's work under an August sun, across such shallow water.

9. At Kew there are no Pita plantations, nor is it desirable that there should be, as the land is richer than in any other part of the Caicos, and is required for, and should be, the market garden of the other Settlements. This year has been one of such intense drought that the corn crops had failed, but the root crops are so plentiful that we found but little distress among the people. It is this land that I surveyed last year and placed the people in possession of 25 acre lots, and I was able to lay out some fresh lots during this visit, as well as to survey some of the roads to "tie" the previous surveys.

10. I found at Kew about a couple of hundred Pita plants growing in places choked up by bush, so I had a suitable spot cleared, and the

plants removed to this, and set out at regular intervals to form a Government nursery. It was here that I observed the large specimens of silk grass mentioned in paragraph 6 of this letter. These plants were introduced here from Jamaica in 1883–84 by Mr. Plummer, the Instructor in Agriculture, sent up by Mr. Morris at Mr. Llewelyn's request. They have certainly thriven marvellously, though, as far better results are obtained from the Pita, it is unlikely that we shall be able to put them to much practical use.

11. Our schooner having returned from Grand Turk, Mr. Leslie and I left on Thursday morning for West Caicos, the waste lands on which have been recently leased in accordance with the permission contained in your letter, No. 4269/6302, of the 28th ultimo. My visit was only for the purpose of forming an opinion as to the best means of surveying these lands at the least expense to the lessees, as I am most anxious to afford every possible encouragement to the new industry. Otherwise I should not undertake this work, as repeated absences from Grand Turk are very inconvenient where the whole of the executive work is centred on the Commissioner, as it is since the abolition of the office of Crown Surveyor (Colonial Engineer), just before my arrival in 1885. Besides, the work of surveying over such very rough country, through thick bush, is most trying at this season, but there is no officer whom I can send, and to obtain the services of a surveyor from abroad would entail an expenditure which the lessees of the land are not prepared to meet. As the work is necessary for the success of the new industry, I have promised to do it, and propose to return there early next month.

12. That this island of West Caicos is suitable for the fibre cultivation is proved by the fact that in cutting the bush from the small portion of land which the company has been able to clear, since they were allowed to go to work a fortnight ago, several Pita plants in good condition, and growing strongly, were found, which were before hidden in the bush, which is so thick as to be absolutely impassable. I found that the manager of the company had his house half built, and had some 30 acres of land in an advanced state of preparation, and he hopes to begin early in October to set out the plants, of which they have already upwards of 200,000. The labour for this property is drawn from Providence Caicos (Blue Hills), the poorest Settlement in these islands, and one in which it has hitherto been necessary to distribute provisions to the aged and infirm almost annually, a necessity which abundance of labour will entirely remove.

13. Having laid out the directions of the lines to be cleared for the survey, I left West Caicos in the night for Grand Turk, a beat dead to windward of 80 miles, much of it through very heavy seas. It took between three and four days to do, very weary and uncomfortable work in a small schooner, reeking of stale fruit and molasses, and swarming with cockroaches and other insects, and yet by far the best vessel obtainable here, and indeed the only safe one in heavy weather.

In conclusion, I may say that the result of my visit has been a conviction that the future of the fibre industry in the Caicos Islands is assured, if no useless obstacles or unnecessary restrictions be allowed to harass the companies now commencing operations. The land is in every way suitable, and the management of the companies possess energy, ability, and capital to direct them. The directors and shareholders are not speculators, but men whose fortunes are involved in the undertaking. Far beyond the success to individuals, however, is the improvement to the condition of the outlying Settlements, hitherto

the home of want and distress. With ample, steady, well paid, and congenial labour, always to be had for men, women, and children, for the nature of the industry provides occupation for all, a sufficient livelihood at least will be within reach of all who care to work, and it is not too much to hope that the near future may see a prosperous and contented community replace the half starved and not much more than half civilized "wreckers" whose names have been "a by-word and a fear" to many an unfortunate shipmaster whose vessel has been swept by the strong and uncertain currents on to the reefs surrounding these cays.

I have, &c.
(Signed) H. JACKSON,
Commissioner.

XLVII.—SISAL HEMP AT THE TURKS AND CAICOS ISLANDS.

[K. B., 1892, pp. 217-218.]

The progress made in a SISAL HEMP industry at the Turks and Caicos Islands is discussed as follows in the Blue Book Report (Jamaica) for 1891 :—The cultivation of the Pita (Sisal) plant has made fair progress, especially in the Caicos Islands, and the reports from the plantations, towards the close of the year, were satisfactory. Two companies, the West Caicos Fibre Company, Limited, at West Caicos, and the East Caicos Company, Limited, at Breezy Point, formed for the purpose of raising pita plants and extracting the fibre, registered under the companies ordinance, and there are several private plantations. A small shipment of fibre was made to New York within the year from one of the latter, and the first quality fetched a cent a pound more than the second quality—an equal price to the best from Yucatan. This speaks well for the quality of the fibre which can be produced in these islands, and promises a bright future for the local fibre industry.

XLVIII.—BAHAMAS INDUSTRIES.

[K. B., 1891, pp. 175-177.]

One of the most interesting circumstances connected with the economic development of the Bahamas Islands is the great attention devoted within the last few years to the planting of Sisal hemp (*Agave rigida* var. *sisalana*). In a recent report in the Blue Book for the year 1890, Sir Ambrose Shea, K.C.M.G., the Governor of the Bahamas, supplies the following particulars respecting this industry :—

Fibre Cultivation.

Steady progress continues to be made in this industry, with increasing faith in its value and permanence. A report of the cultivation to the present time has been prepared by order of the Government, which, though strictly accurate, would not convey true impressions to those at a distance.

The report speaks of 4,100 acres being already planted with 2,500,000 plants, but it states that there are also 1,300,000 plants in nurseries, which, being in course of growth, adds 50 per cent. to the active cultivation, making an aggregate of over 6,000 acres. Plants are now kept much longer in nurseries to lessen the cost of weeding, which is an expensive operation, and annually attended to after the plants are set out in the fields.

There has been some question as to the time to bring the plantings to maturity, but four years is now the accepted period, while plants retained in the nurseries, as above stated, will mature in three years. There is but little to add to former reports on this enterprise, which has passed out of the experimental stage and will not probably present any new features of interest until exports of fibre begin, which will be, on a moderate scale, in 1892, then developing annually into proportions of increasing importance.

The value of the fibre, like that of other products, will, of course, be subject to market conditions from time to time, but in the natural order of things it will ever be the main export, and, regarding all the surrounding circumstances, it is difficult to see how it can fail to pay present investors handsomely, and to be to them a source of income less liable to fluctuations than is the case with most commercial adventures. The time is now approaching when the machines for separating the fibre from the leaf will acquire practical importance; of those now in use none seem to meet all the requirements. Some of them clean the fibre well; but the process is wasteful, and the correction of this defect is the object to be accomplished. With so great an interest at stake, we must suppose inventive genius will be found equal to the occasion. Professor Edison has directed his attention to the matter and he hopes he has found an effective method which avoids waste. The treatment is by a solution of crude petroleum, and this Government are now in communication with the Professor. If the results meet our requirements, a most important end will be attained, which will have the further advantage of enabling small cultivators to dress their own leaves instead of being compelled to sell them at a loss to a large neighbouring planter, who is able to procure a machine.

The process is applicable to other and most valuable interests in this colony. Many thousands of tons of pine-apple leaves are now annually left to waste. The fibre commands a high price, from 60*l.* to 80*l.* a ton, for use in fine textiles. The small quantity now produced is roughly and expensively prepared for want of a machine sufficiently delicate to extract the tender fibre without injury. The proposed mode would seem to meet this difficulty, as all strain or friction is avoided, and the result of pending inquiries is looked for with great interest. The immediate effect of successful experiment would be to turn a wasted product into an article of much value, adding substantially to the returns of pine-apple cultivation, and this process may be applied to the growing crop. It is understood that the same solution may be used many times, and, if present hopes are realised, the petroleum will be admitted free of the duty now imposed.

XLIX.—SISAL HEMP INDUSTRIES.

(*Agave rigida*, Mill.)

[K. B., 1892, pp. 21–40.]

A remarkable development of the cultivation of Sisal hemp in the Bahamas has taken place during the last three years. The Governor, Sir Ambrose Shea, K.C.M.G., has enlisted such widespread interest, it might be termed enthusiasm, in the subject, that hemp-growing has become, for the moment, one of the most prominent of the new industries of the tropics. Frequent inquiry has been made at Kew in regard to the plant yielding the best qualities of Sisal hemp, and information has been sought by official and other bodies to enable them to judge of the suitability of the plant for cultivation in other countries. The position taken by Kew in this matter is a very simple one. The various varieties and forms of *Agave rigida*, Mill., the species from which the several sub-species and varieties yielding Sisal hemp are supposed to have sprung, have been carefully studied, and living specimens have been added to the collections in the Royal Gardens. In this respect, the collections of fibre plants at Kew, at the present time, are probably as complete as any in the world.

Further than this, an effort has been made to furnish from time to time in the *Kew Bulletin* such information as could be obtained respecting the methods of cultivation and the incidental conditions of the industry likely to be of general interest. The Bahamas are fortunate in possessing a soil and climate very favourable to the production of excellent fibre. They also have the great advantage of possessing, on the spot, immense quantities of plants of the best variety known to yield Sisal hemp. This variety (botanically known as *Agave rigida* var. *sisalana*) is of rapid growth, and is easily handled. It has no side teeth to obstruct or retard the process of harvesting, and the people generally appear to have supported the action of the Governor to such an extent that the establishment of the industry is now within measurable distance of being accomplished.

The only drawback, so far, is the want of a machine that will enable the planters to extract the fibre in an effective and economical manner. As a last resort there is the somewhat crude and clumsy machine long used in Yucatan, but it is probable that before any lengthened period has elapsed a machine of a more suitable character will be forthcoming.

In the meantime, efforts are being made to establish a fibre industry in Florida, where, more than 50 years ago, plants of Sisal hemp were introduced and partially established by Dr. Perrine. A special Report prepared by Mr. Charles Richards Dodge, of the Department of Agriculture at Washington [Fibre Investigations, *Report* No. 3, 1891], has lately been issued on the subject. In this Report an account is given of the distribution of Sisal hemp plants in Florida and the adjoining Keys, and it is recommended to utilise these as the starting point of a regular industry. Mr. Dodge says "what can be done in the Bahamas "I have reason to believe can be accomplished in this country [Florida] ". . . . We have the soil, the climate, and the plants. The com- "bination of capital and inventive genius with these conditions must "work out the problem, if, indeed, the question is not already practically "solved." A further account of the efforts made to establish Sisal hemp plantations in Florida is given later.

A small but promising effort is being made to grow fibre at some of the Turks and Caicos Islands, and plants obtained from this source and from Florida have been introduced into most of the West Indian Colonies.

A short account has been prepared mentioning most of the localities where plants of Sisal hemp are now found, and this account will afford useful material for enabling those who may wish to do so to decide as to the wisdom or otherwise of embarking in a fibre industry at the present time. At the close of the article, a statement is given of the average price per ton obtained for Sisal hemp in this country during the last 13 years.

YUCATAN.

Information respecting the Sisal Hemp industry in Yucatan has already been given in the *Kew Bulletin* for March 1887. Since that time an effort has been made to obtain direct from Yucatan a representative collection of the various Agaves cultivated in that country for fibre purposes.

Through the kind offices of the late Mr. Augustus Baker, Her Majesty's Consul at Vera Cruz, a large plant with a tall stem and flowering panicle was received at Kew in May 1890. The plant was dead on arrival, but it has since been prepared as a museum specimen, and is now deposited in Museum III. The dimensions of this plant are as follows: length of stem (below the leaves) 4 ft.; circumference of stem 36 in.; number of leaves on stem, 50; length of leaves about 4 ft.; breadth of leaves $3\frac{1}{2}$ in.; length of peduncle 14 ft. The branched panicle was received in an incomplete condition, but the total height of the plant as now existing is about 24 ft. The weight of the whole plant in a green state was probably not less than $2\frac{1}{2}$ to 3 cwt. The leaves have the characteristic black terminal spine, and they are furnished throughout with small black teeth about 1 inch apart. This plant belongs probably to the variety *elongata* (*Agave rigida*, var. *elongata*). It is evident that in Yucatan the plants cultivated for fibre are largely composed of this variety. We learn, for instance, that in harvesting the leaves the Indian who cuts off the leaves is followed by an Indian woman, "who with a knife cuts off the spike or thorn-" tipped end and the thorny side of the leaf ready for the machine." In the case of leaves without teeth, such as are borne by plants of the variety *sisalana*, it would be only necessary to cut off the terminal spine. Hence, while the latter variety yields fibre of equal if not better quality than the variety *elongata*, its leaves are more easily handled, and require less treatment during the process of harvesting.

In addition to the large plant received from Yucatan, there were received two lots of small plants. The first of these was received on the 31st May 1890, and represented apparently about five distinct kinds. The greater part consisted of plants of typical *A. rigida*, and a good number of *A. rigida* var. *sisalana*. The others represented forms not easily determinable in a small state. A set, with the exception of the above, has been retained at Kew, and the plants will be determined later. The others were all distributed to the Botanical Gardens at Singapore, and to the Botanical Stations at Fiji and Antigua. The second lot of small plants from Yucatan arrived at Kew on December 16, 1890. On arrival there were 30 plants dead and 11 alive. The latter were, however, so small and sickly that, weakened by the cold to which they had been exposed, it was impossible to save them. This attempt to introduce a representative collection of Agaves from Yucatan, in

spite of a considerable sum paid for expenses, was singularly unfortunate. It may be mentioned, however, that Merida, the headquarters of the hemp industry in Yucatan, possesses only an unpaid Vice-Consul, who is but partially under the control of Her Majesty's Consul at Vera Cruz. It is due to the latter to state that he endeavoured to the utmost of his power to assist this establishment; and if he had not been so remotely placed the result would have been far more satisfactory.

Very little additional information, not hitherto published, has been received respecting the Sisal Hemp (Henequen) industry in Yucatan. The subject has already been very fully treated in the *Kew Bulletin*, and it is only necessary to add a description (with woodcut) of the method adopted for harvesting the leaves quoted in the *Report* of the U. S. Department of Agriculture, p. 25.

"This is done by the Indians, who are almost nude, with a stroke of the knife, or *machete*, at the rate of, for one hand, 2,000 to 2,500 leaves per day. Following the Indian who cuts off the leaves is an Indian woman, who, with a knife, cuts off the spike or thorn-tipped end and the thorny side of the leaf, ready for the machine. One foreman was understood to say that it costs about 38 cents per 1,000 leaves to cut, prepare, and get the leaves to the cleaning machines. On all the large *haciendas* visited were little railways into the fields, upon which on cars, drawn by mules or oxen, the henequen was taken to the mill, and the waste was taken away."

A Sisal Hemp Plantation in Yucatan.

As will be seen from the above wood-cut, a Sisal Hemp plantation should be systematically laid out, and to work it economically it is desirable it should consist of a tolerably large area. It has been insisted in regard to fibre plantations in Florida that "small plantations . . . "." . will not pay. A large tract is necessary for the economical "production of fibre, so that the work of cutting the leaves and

" shipping the fibre may be systematically continued for the greater " part of the year."

As the weight of the green leaves is so large in proportion to the yield of fibre, their conveyance from distant parts of the plantation to the factory must involve considerable labour and expense. For instance, if every 100 tons of green leaves will yield only about $2\frac{1}{2}$ to $3\frac{1}{2}$ tons of dry marketable fibre, it is evident that an immense quantity of useless pulp has to be conveyed to the factory and disposed of as conveniently as the circumstances will admit.

Fibre estates should therefore be established on moderately level ground where light portable railways could be laid, or on moderately sloping ground converging on a single point where wire ropes could be used for sliding the leaves in portable bundles to the factory. The experience gained on sugar estates in cultivating large areas in the tropics and in conveying heavy perishable material to a central point would appear to be generally applicable also to Sisal Hemp estates. As in sugar, so in Sisal Hemp, the advantage will ultimately rest with such estates as are able to reduce their working expenses to the lowest point, and compete successfully with the produce of countries like Yucatan and the Philippines.

The *South American Journal* says that " the bulk of the henequen " grown in Yucatan is sent to New York, and that the export has " grown enormously. In 1878 the total value of the export from " Yucatan, as shown by the Custom House returns, did not exceed " 710,124 dols., since which period it began to attract greater attention, " and in 1878 the figure almost doubled. The following shows the " export of henequen in each year from 1878 to 1889 :—
" 1878, 1,166,504 dols.; 1879, 1,287,375 dols.; 1880, 7,495,467 dols.;
" 1881, 2,284,389 dols.; 1882, 2,672,107 dols.; 1883, 3,311,663 dols.;
" 1884, 4,165,020 dols.; 1885, 3,988,791 dols.; 1886, 2,929,116 dols.;
" 1887, 3,901,628 dols.; 1888, 6,229,460 dols.; 1889, 6,872,593 dols."

It is mentioned as a curious circumstance that the market price of the fibre in New York increased almost *pari passu* with the increase of exports.

From Messrs. Crocker's American Statistics quoted in Messrs. Ide and Christie's *Monthly Circular*, dated 15th January, 1892) we find that the total importations of Sisal Hemp into the United States during the years 1889–1891 were as follows :—1889, 237,736 bales; 1890, 230,800 bales; 1891, 286,700 bales. Of these latter we find 10,006 bales were re-shipped to the United Kingdom. The total importations into the United Kingdom (London and Liverpool), according to Messrs. Ide and Christie, were 20,296 bales. It is evident from this that the English market in regard to Sisal Hemp is comparatively small.

As regards Manila hemp, the result is very much the same, although in the first instance the bulk of the shipments are received in the United Kingdom. For instance, during the year 1891 there were received in the United Kingdom a total of 448,000 bales of Manila hemp. Of these there were re-shipped to the United States 175,919 bales, leaving 272,081 bales for consumption on this side. The total receipts of Manila hemp in the United States for 1891 (direct and *viâ* Europe) were 316,697 bales.

Taking the combined consumption of Sisal and Manila hemps (known generally as " white hemps ") we find the relative quantities taken on both sides of the Atlantic to be approximately as follows :— United States, 693,391 bales; United Kingdom, 292,377 bales.

Florida.

It is well known that plants of Sisal hemp were introduced to Florida from Yucatan by Dr. Perrine in the years 1836 and 1837. It is to this introduction that Florida and the adjoining Keys owe their present supply of this valuable fibre plant. In a recent Report on Fibre Investigations (No. 3, 1891) issued by the United States Department of Agriculture, Mr. Charles R. Dodge gives a detailed account of the distribution of Sisal Hemp plants in Florida, and he supplies some new and interesting facts respecting their original introduction. In illustration we quote the following paragraphs :—

"Mrs. Walker informs me that the first introduction of the plant from Yucatan occurred in the years 1836 and 1837, a few plants having been sent to the Royal Botanical Gardens of Cuba at the same time. Of the plants brought to Florida, part were taken to Indian Key and the others were planted upon 'the Indian hunting ground,' on the borders of Biscayne Bay. It is also stated that when these plants had multiplied to some extent the officers at Fort Dallas, at the mouth of the Miami River, 12 miles from this locality, were in the habit of gathering the young ones to send to greenhouses in the north, and also to other posts, where they were grown as ornamental plants. One of the results of this practice was to introduce the plant into many new localities in Florida, where it soon obtained a foothold. The plants set out on Indian Key multiplied very fast, and a few years after the destruction of the enterprise, and the death of Dr. Perrine at the time of the Indian massacre, a schooner load of the young plants were gathered and taken away, though it is not stated where they went. * * *

"From this first introduction of the *Agave rigida* var. *sisalana* into Florida the plants spread rapidly, especially on the mainland, being commonly transplanted to the gardens of the early settlers of south Florida, chiefly for the sake of ornament. * * *

"These facts are considered worthy of mention, as showing that while every other evidence of former cultivation has long since disappeared, the Sisal Hemp, regardless of forest fires, weeds, and neglect, still holds its own and spreads year by year. * * *

"In the remarks of Dr. Engelmann, in Appendix A., the 'Yaxci' form *Agave rigida,* var. *sisalana*, is so fully described that there can be no doubt as to the plant that is meant. The late Dr. Parry, at one time botanist of the Department of Agriculture, found it in full bloom in February 1871, at Key West, and on the adjacent islands, and describes the leaves as 'pale green but not glaucous, 4 to 6 feet long, and 4 to '6 inches wide, generally smooth-edged, but here and there having a 'few unequal, sometimes very stout and sharp teeth.' This is the plant introduced into Florida by Dr. Perrine, for fibre culture, and considered by Dr. Engelmann to be 'the most valuable of the fibre-producing Agaves.'

"This is the form that I found growing along the entire southern coast of Florida, on my recent survey, from Cape Canaveral on the east side, around to Charlotte Harbour on the west or Gulf coast, and including many of the Keys. * * *

"The most interesting tract visited along this portion of the coast was found on the point perhaps a mile below the railroad station and wharf at Jupiter. Here I found a thicket of these Agaves, both the smooth and spined varieties, many of the plants having shot up their 'poles' or flower stalks, which were covered with blossoms and young plants. * * * At Juno, about 10 miles farther south, at the head of Lake

Worth, I found another fine nursery of perhaps 100,000 plants, the property of Mr. A. M. Fields, who is quite enthusiastic on the subject. Fully 50 per cent. of his plants are not *Agave sisalana*, however, but a species which was subsequently met with at many points along the east and west coast, as well as on the Keys, doubtless *Agave mexicana* [since determined as *A. decipiens*]. At Addison's Landing, near Cutter, I found myself on the Perrine grant, though Mr. Addison informed me that the plants were chiefly growing on his own section. He estimates the number of old plants at about 15,000, growing without cultivation, and states that these have descended from the comparatively few plants which were on the place 25 years ago when he first occupied the land.

"The original planting, he states, was done by Mr. Charles Howe, who was associated with Dr. Perrine. He has both the spined and the smooth-leaved varieties, but makes the interesting statement that the latter 'spreads' much faster than the former. As a matter of fact, I found plants of the spined form at this place exceedingly few and far between. * * * From this point I sailed southward, but found nothing of particular interest until Upper Metecombe Key was reached where some of the most superb plants observed on the trip were seen. In one thicket, to which it was almost impossible to obtain access save at the expense of torn clothing and lacerated flesh, magnificent plants were seen, where the tips of the leaves were two feet above a man's head.

"Indian Key, where Dr. Perrine lost his life, lies just below, and beyond it is Lower Metecombe. Other Keys of the group are Lignum Vitæ, Shell Key, and some lesser ones, upon all of which the true Sisal Hemp plants are found in abundance. A very rough estimate of the old plants in this group of Keys would be a hundred thousand, though in making the estimate I have relied largely upon the statements of the intelligent Bahamians living upon them. * * * Superb plants were examined by me at Fort Myers, on the Caloosahatchie River, and at other points, though there were no such thickets as seen on the Keys."

Bahamas.

The progress made in extending the cultivation of Sisal Hemp in the Bahamas has been already duly noticed in the *Kew Bulletin*. In a recent report published by Mr. James M. Rae, and quoted in the *Bulletin* of the Botanical Department, Jamaica, No. 24, October 1891, it is stated that 12 months ago there were 4,199 acres of land in the Bahamas planted with Sisal Hemp, and the aggregate number of plants actually put out was over two millions and a half. In addition to this it was estimated that there were over one million and a quarter plants in nursery beds; and from root suckers and bulbils (called pole plants) there would be available during the ensuing six months about two million plants more. According to this estimate the total number of Sisal plants actually existing in the Bahamas at the close of the year 1891 would not be far short of six millions.

The distribution of the various Sisal Hemp plantations, and the methods of cultivation pursued in the Bahamas are described in the following extracts:—

"The people of Abaco, Harbour Island, Long Island, Rum Cay, Exuma, and Grand Bahama, where the largest number of Sisal plants are met with, have for many years past been in the habit of making a small quantity of rope for home use, from the fibre they extracted from

the leaf of the Sisal by the primitive method of bruising and maceration.

"In Abaco are the 'headquarters' of the Sisal industry; for it is on this island, and some of its adjacent cays, that the largest cultivations in the colony exist. Beginning at Hole-in-the-Wall, Mr. J. S. Johnson, * * * has 200 acres planted with 130,000 plants, some of which, planted two years ago, have leaves over 3 feet long. Mr. Johnson has also two other cultivations on Abaco, namely, one at East Creek, Little Harbour, of 25 acres, with 21,000 plants, and another at Witch Point of 60 acres, with 31,200 plants. Cotton is being planted between the rows of Sisal.

"The Bahama Fibre Co., Limited, of which Mr. Abbot is the manager, has a field of 150 acres at Broad Creek with 73,000 plants, and another field of 108 acres at Joe Creek, with 62,000 plants. These two fields also contain 264,000 nursery plants. In addition to these the company has purchased a cultivation at Sweeting's Village, and another at Great Guano Cay, both of which were planted some years ago, and are yielding thousands of pole plants (bulbils) as well as a large number of suckers.

"Cherokee Sound has confined itself mostly to nursery planting, and I saw several thousands of such plants growing about this settlement.

"The Munro Fibre Company, managed by Mr. T. Trumble, commenced planting in August 1889, and now have 1,100 acres planted at Cocoa Plum Creek, with 654,000 plants, and 10 acres at Black Sound, with 7,000 plants. In addition to the field plants, there are also about 300,000 plants in nurseries.

"The company intend to plant their fields with cotton between the Sisal, and I understood Mr. Trumble to say that seed for this purpose had already been received from one of the southern States of America. The company has also a factory at Black Sound, in which there are five of Death & Ellwood's machines worked by a 15-horse power steam engine. These have been employed in cleaning Sisal leaves purchased from persons who have full-grown plants. The yield of cleaned fibre was ascertained to be about 4 per cent., but I could not help being struck with the large proportion of fibre that was wasted in the process. There can be no doubt that, with the improved machinery which the demand must necessarily cause to be produced, the per-centage of cleaned fibre will be largely augmented.

"At Marsh Harbour * * * is the handsomest Sisal field I have seen. This was planted by Mr. Benjamin E. Roberts two years ago, and contains 140 acres, with 107,000 plants. * * * There were at least 25,000 suckers then in the field, and Mr. Roberts assured me that he had already removed 47,000 suckers. This field was being planted with dwarf cotton between the Sisal.

"At Hope Town, Mr. Thomas Russell * * * has about 20,000 plants, some of which have been growing half a dozen years, and from these he expects to gather 100,000 pole plants (bulbils) this year, in addition to a large number of suckers.

"Another gentleman of the same name, now residing in Nassau, has a very fine nursery at Black Sound, containing many thousands of young plants. * * *

"*Propagation.*—The plant is propagated in two ways, namely, from the young plants furnished by the pole (bulbils), and the suckers which are thrown out from the roots. On the plant reaching maturity, a pole 15 to 20 feet in height grows out from its centre, on which a number of blossoms appear borne on arms which extend laterally from the

upper part of the pole. In about six months after the appearance of the pole, bulbils that develop into young plants appear, varying in length from 2 to 4 inches, and in number from 1,000 to 2,500, and occasionally more. They are then gathered and set out 8 or 9 inches apart each way in nursery beds. In six months they will attain a growth of 8 to 12 inches, and they may then be transferred to the field.

"Suckers are plants which grow out from the roots of the parent plant, and in congenial soil are produced in 12 to 18 months. From this time, on to the third or fourth year, they appear in great numbers, many plants producing as many as 20 to 30 suckers during that period; after this they begin to decrease, until they finally cease to appear.

"With respect to the taking up and planting of suckers, I think it well, having regard to the speedy production of new plants, to call attention to a method which I have seen practised with very satisfactory results, viz., in removing a sucker from the parent plant, instead of cutting or breaking off the sucker only, to uproot entirely the white shoot at the end of which it is growing, and cut that off as near the parent trunk as possible. This shoot will be found to be jointed like a sugar cane. After the removal of the sucker, the shoot is cut up into lengths of two or three joints. These bits are then planted in nursery beds, and in a short time each bit will produce as many suckers as there are joints. This method has the two-fold advantage of speedily increasing the supply of the new stock, and relieving the parent plant of the support of the suckers.

"*Field Planting.*—The system adopted by those who have engaged largely in planting varies. Some have planted as near as 6 feet each way, others, 7×7, 7×8, 7×9, 8×8, and 9×9. The Munro Company at Abaco plant three rows 8 feet apart, with 7 feet interval between the plants, and leave a space of 12 feet between every fourth row. The Bahama Hemp Company, Limited, under * * * Mr. Abbot, plant four rows 8×8, leaving a distance of 12 feet between every fifth row.

"Many planters have planted the spaces between the Sisal plants with some other crop, either ground provisions such as pigeon-peas, corn, &c., or cotton. This plan appears to be attended with excellent results, and is one that I cannot too strongly recommend, provided always that such auxiliary crops be not too thickly planted. The slight shelter they afford seems to be beneficial to the Sisal plants in their early growth, and tends to suppress the growth of weeds, thereby lessening the cost of keeping clean the field, besides yielding a remunerative crop. Sweet potatoes should not be planted in a Sisal field, at least not until the plants have attained a growth of a foot and a half to two feet, as the vines very soon cover the field and completely envelop the young plants, and retard their growth.

"*Effect of different soils and aspect on growth.*—I have both read and heard it broadly asserted that Sisal will grow and flourish anywhere, no matter how sterile or impoverished the land may be. My observations, however, do not confirm this. I do not mean to convey the idea that *really good rich land* is necessary for its successful cultivation, but merely to remove the impression, if such there be, that the plant will thrive in dry arid sand, or on rocky land void of soil. Worn out 'provision' and pine-apple fields appear to be well suited to its cultivation, while on broken, rocky surfaces, containing innumerable 'potholes' and crevices, in which is deposited the ordinary black or red earth, the plant luxuriates.

"*Crop.*—The length of time required for the production of the first cutting of leaves may, I think, safely be regarded as four years from the time of planting. A great deal depends upon the size of the plants when transplanted, but if they be of a suitable size, say from 12 to 15 inches, without doubt the leaves will attain a length of 4 to 5 feet, and be fit to cut, well within the period named. I have seen thousands of plants with leaves from 2 to 3 feet long that had been growing only two years ; and I have also seen plants, that I was told were three years old, from which leaves had been already cut.

"For the present, the yield per acre with us can be only a matter of calculation, as the industry has been so recently begun ; but sufficient positive experience has been derived to determine this point with approximate accuracy. The number of leaves cut from many plants of four years growth and upwards, has given an average of 40 leaves per plant, with an average weight of 1½ lbs. per leaf, and a yield of 4 per cent. of clean fibre. With an average of 600 plants to the acre, and 40 leaves * * * to each plant, the yield would be 36,000 lbs. of leaf and 1,440 lbs. of cleaned fibre. If the estimate be reduced to 35 leaves, there will be 31,500 lbs. of leaf and 1,260 lbs. of fibre, and this is certainly a very modest estimate. To guard against all possible disappointment, however, the yield of fibre per acre can be safely placed at half a ton."

Considerable interest has lately been taken in endeavouring to trace the source from which the Bahamas have received their present supply of Sisal Hemp plants. The Bahamas Sisal (or Pita, as it is called locally) is identical with that existing in Florida and the adjacent Keys. We have trustworthy evidence that the Yaxci Sisal plant (the variety with pale green and smooth or unarmed leaves, known as *Agave rigida*, var. *sisalana*) was introduced to Florida direct from Yucatan by Dr. Perrine in 1836 and 1837, that is about 55 years ago. Full information on the subject is contained in Senate *Document*, 30, dated Washington, March 12th, 1838 ; and in the *Report* of the Agricultural Department at Washington for the year 1869. We gather further particulars from Mr. Charles R. Dodge's *Report* on Fibre Investigations, No. 3, 1891, recently issued by the same Department. Mrs. Walker, Dr. Perrine's surviving daughter, states that the general planting of the Perrine grant (in accordance with the conditions imposed by the Government) occurred in 1846. For this purpose 36 families of Bahamas people were to be brought over to Florida "to go upon "the land to fulfil the condition of a settler upon each section. The "men came over to build their houses and plant their gardens prepara- "tory to bringing over their families, when they were driven or "frightened away by the Indians, and could not be induced to return. "It was about this time that the Agave was planted upon each section." After the death of Dr. Perrine and the practical abandonment of the plantations, the Agave plants spread rapidly, and they were transplanted everywhere in gardens by the early settlers for the sake of ornament, and possibly also to make hedges. It is also mentioned by Mrs. Walker that a schooner load of young plants was gathered and taken away but it is not stated where they went. The natural inference is that they were taken somewhere to the south, as it was found that they would not grow much further north than the spot originally intended by Dr. Perrine.

In 1871, the late Dr. Parry found the Agaves in Florida, and he describes them as having "pale-green but not glaucous leaves, 4 to 6 feet "long, 4 to 6 inches wide, generally smooth-edged, but here and there

" having a few unequal, sometimes very stout and sharp teeth." This description exactly agrees with that of *Agave rigida*, var. *sisalana*, Perrine. The plants were then widely distributed at Key West and the adjacent coast. They have lately (1891) been carefully examined again by Mr. Charles Dodge, with the result already given.

As the islands of the Bahamas are adjacent to southern Florida, and there was regular intercourse between the two places about the time of the introduction of the *Agave* plants, it was only natural to assume that the Agave now so abundant in the Bahamas had been originally introduced from Florida. They had found in the southern islands a warmer and more equable climate and had spread rapidly throughout the Archipelago. This view has, however, been strongly contested by Sir William Robinson, K.C.M.G., formerly Governor of the Bahamas, in the *Agricultural Record* of Trinidad, January 1891, p. 6. According to his Excellency's view, the Sisal Hemp plant was introduced to the Bahamas by the late Mr. C. Nesbitt, a former Colonial Secretary, who " forty-five years ago, viz., in 1845, procured from Sisal, Yucatan, a " few hundred plants of this Agave and had them set out at his country " residence three miles from Nassau." Further " Mr. Nesbitt was " much struck with the vigour of the plants when grown in New " Providence . . . In 1851 he reduced a great number of the " leaves of this plant into fibre and placed samples of them in the " Nassau Museum. At the same time he sent specimens of them to " England, and received very favourable replies in regard to their value " from London."

Whether the whole of the Sisal plants now growing in the Bahamas have been derived from those first introduced by Mr. Nesbitt it is now impossible to say. It is evident, however, that this gentleman was fully aware of their economic value, and he deserves great credit for the steps he took to bring them into notice.

The date of Mr. Nesbitt's introduction of Sisal plants into the Bahamas is given by Sir William Robinson as 1845. This would be about eight years after their first introduction into Florida by Dr. Perrine and about the time the Bahamians were engaged upon the Perrine grant to establish regular plantations.

This latter fact may or may not have a bearing upon the question. There is, however, another point worthy of consideration, and it is this : the chief variety of *Agave rigida* cultivated for fibre in Yucatan is apparently not the Florida and Bahamas plant, but one with glaucous leaves and armed with teeth. This is the form nearly always described as growing on Sisal plantations in Yucatan, and plants of this are almost invariably brought from Yucatan as the true thing. The plant, with smooth leaves and of a pale green colour, was specially selected by Dr. Perrine from his personal acquaintance with it, while Consul for many years at Campeachy.

If Mr. Nesbitt also obtained this particular variety for the Bahamas direct from Yucatan without the special knowledge of its occurrence there, possessed by Dr. Perrine, the circumstance is a singular coincidence.

In the meantime, however, while we accept the claims so ably put forth by Sir William Robinson on behalf of Mr. Nesbitt, and trust that further investigation will confirm the fact that these islands owe to a Bahamas man the introduction of a plant which is calculated to produce so great an influence upon their future prosperity, the probability is that the plants now in the Bahamas were originally obtained both from Florida as well as through the intelligent efforts of Mr. Nesbitt.

Turks and Caicos Islands.

These islands were once included under the Bahamas, to which group they geographically belong. At present they are under the Government of Jamaica.

In the report of a visit made by the Commissioner of Turks Island to Lorimers on Middle or Grand Caicos in July 1889, he states :—

"Shortly after sunrise on the morning of the 10th instant I started to walk to *Bourbarra*, about four miles distant, and on the way there I visited the Pita plantations which have been established by Mr. Alfred Stubbs, of Cockburn Harbour. This gentleman, whose grandfather was the last slave-owner on the Caicos, whose house still stands, owns not less than seven to eight thousand acres on this Island (Grand Caicos) alone, and he is by slow degrees bringing portions of this under cultivation in fibre plants. His system has been to lease his land to the 'farmers' (or 'planters' as they call themselves) at the rate of about two dollars per acre per annum, under the condition of their planting so many Pita plants each year. As the land they hold gets gradually taken up by the plants, the planters move further afield.

"By these means he has succeeded in getting not less than 300 acres planted out, about half of which is now fit for cutting. His plants are placed too close to each other, and have not been kept clean, but they are strong and in good condition, and would furnish leaves from 3 to 4 feet long. Some plants that I saw in the village enclosures, which had received proper attention, were much finer, the leaves being stout and well-coloured and not less than 4½ feet long.

"The fibre plants planted out by Mr. Stubbs are, I believe, the true '*pita*.' [Specimens have since been received at Kew, and they are undoubtedly *Agave rigida*, var. *sisalana*.] They are exactly similar to those found in Florida and the Bahamas. They have but one thorn, and that at the end of the leaf. They have all been grown from imported plants. * * *

"The people are most anxious to start fibre cultivation on their own account, but I could not advise them to do so, until I can see my way to ensuring a sale for their leaves, as of course they could not buy machinery for themselves. Although the Government have but little land in that district fit for provision farms, they have about 2,000 acres fit for Pita, most of which is in excellent position for affording water carriage. This land I shall carefully preserve for the Lorimers' people, in case I am able to induce some persons here to form a company and import the necessary machinery."

The further development of a fibre industry at the Caicos Islands has been already fully described. It appears that at West Caicos Pita plants in good condition were found growing in the bush. The manager of a fibre company (lately formed) had land in an advanced state of preparation for planting purposes, and he hoped in October (1890) to set out plants of which upwards of 200,000 were already in hand. At East Caicos (Breezy Point) there were 15,000 to 20,000 acres suitable for Pita cultivation, and some 200 acres have been already cleared.

Jamaica.

As might be naturally expected, there has been considerable effort made to introduce plants of Sisal hemp for experimental trial in Jamaica. The Governor of Jamaica, Sir Henry Blake, has taken a deep interest in the matter, and land has been established with fibre plants adjoining the Hope Gardens. The plants, numbering over

20,000, have made good progress, and the Director of the Botanical Department is in a position to supply suckers on a large scale to those anxious to start a fibre industry. There are large tracts of level and accessible lands in the plains of Jamaica suitable for growing Sisal hemp, and if the people had taken note of these circumstances some 8 or 10 years ago, they would have been able to take advantage of the recent high prices for white rope fibres, and have realised some share of the fortunes which have fallen to the people of Yucatan. At the present time the circumstances have greatly altered, and the advice given by Mr. Fawcett in regard to caution being necessary before embarking, at this late hour, upon a Sisal hemp industry on a large scale is probably correct. In two or three years' time the extensive plantations in the Bahamas will be sending their produce to the market, and this, in conjunction with the expected increased returns from Yucatan, must tend to lower prices, unless something very unexpected occurs to create a greatly increased demand for Sisal Hemp.

The steps taken to obtain Sisal Hemp plants for Jamaica are detailed in the following extract from the Annual Report of the Botanical Department for the year 1889 :—

"*Sisal Hemp.*—There is considerable demand in the island for plants of Sisal Hemp. Three years ago I tried to obtain a supply of plants from Yucatan, but the planters there are so anxious to have a monopoly of a trade which brings them large fortunes that only through a special request from the Colonial Secretary to the British Vice-Consul at Progreso was I enabled to secure one dozen plants of the kind under ordinary cultivation (*Agave rigida*, var. *elongata*).

"Another variety (*Agave rigida*, var. *sisalana*), which is without the teeth on the edges of the leaves, has for some years been growing in the Bahamas, where it was probably introduced from Florida. A specimen of the fibre was shown at the Colonial and Indian Exhibition (1886) by his Excellency Sir Henry Blake, then Governor of the Bahamas. From a test that was made in the railway workshop by Mr. L. Mackinnon on this fibre extracted by Kennedy's machine, it appeared that it is at least as valuable as any fibre previously tested, and moreover, the leaves being without spines on the edges, are cheaper to work up. The Government of the Bahamas had forbidden the export of this plant (called 'Pita') for a period of three years, but fortunately it has been found possible to get more than 20,000 plants from Turks Island, and a plantation has been formed at Hope Garden. Mr. Stoddart has superintended the planting. It is expected that it will be found possible to import a considerable number of this variety of the plant, and several applications have been received from planters for supplies of suckers. Considering that the price of Sisal Hemp has (recently) fallen from 53*l.* per ton to 27*l.*, caution should be exercised in the investment of capital in the enterprise. I should hesitate to recommend its cultivation in any soil which is not suitable to it, and at the same time worthless for other cultivation."

A later account of the Sisal Hemp plants at Jamaica is given in the *Bulletin* of the Botanical Department for October 1891, p. 15 :—

"In order to encourage the planting of Sisal in Jamaica, the Government has imported lately from Florida 25,000 plants of the same variety as grows in the Bahamas. This is in addition to over 51,000 already supplied to planters, and to over 20,000 planted in the Hope Gardens. * * It is thus possible for anyone to obtain a few plants for experiment at a very small expense, or in large quantities for laying the foundation of future fibre farms. * * *"

British Honduras.

As might be expected from the close contiguity of this colony to Yucatan—the two countries, being, in fact, only separated from each other by the River Hondo—plants of the henequen, or Sisal Hemp, are fairly common in British Honduras. Some experimental plantations have already been established in the northern parts of the colony, in the neighbourhood of Corosal, where the climate very closely resembles that of Yucatan. Quite recently Sir Alfred Moloney, with that enterprising spirit which has always characterised him in dealing with the resources of any colony with which he is officially connected, has forwarded to Kew specimens of leaves of two sorts of henequen, and of the fibre locally prepared from them. The specimens were labelled respectively "Yaxci or Henequen verde (green henequen);" and "Sacci (Sacqui) or Henequen blanco (white henequen)." Both sorts were apparently varieties of *Agave rigida*, and referable to what is known at Kew as *Agave rigida*, var. *elongata*. The fibre prepared from these leaves arrived in a somewhat soiled and damp condition owing to the fact that it had been packed with the green leaves, which had fermented in transit. The report made on this fibre by Messrs. Ide and Christie, dated 17th December 1891, is nevertheless of a satisfactory character:—

"We have been favoured with your note of the 15th instant with regard to the specimens of henequen fibre from British Honduras. We do not make much difference, commercially, between the white and green sorts. Both are very good style of fibre, quite of the Sisal Hemp character, and they would be readily saleable to-day in London at 20*l.* to 21*l.* per ton. We think it should be possible to prepare them of a better colour, and with this accomplished a somewhat higher price might be obtainable. As we have mentioned in previous communications, colour is of importance in all so-called 'white hemps.' Although up to the present only small lots of Bahamas Sisal have come to this market, the colour and preparation have, as a rule, been excellent, and producers in British Honduras should likewise give them every attention."

Trinidad.

The following account of the introduction of Sisal Hemp plants to Trinidad is given in the Annual Report of the Superintendent of the Royal Botanic Gardens, Trinidad, for the year, 1891, p. 14.

"*Fibres.*—*Agave rigida*, var. *sisalana*.—During the year we obtained from Messrs. Reasoner Bros., of Manatee, Florida, 10,000 bulbils of this plant, and 2,000 from another source. Of this number, 7,700 have been distributed to various applicants. The remainder, deducting usual losses, are still at the gardens.

"One thousand plants requisitioned by Tobago, and two thousand sent to the Convict Depôt, are included in the above numbers.

"The plants arrived in splendid order in the form of small bulbils, *i.e.*, small plants without roots. They were placed in beds close together for convenience of culture, and as soon as properly rooted were transplanted at a wider distance, where they have thriven remarkably well. This is the plant which (it would appear from all accounts) is now being cultivated so largely in the Bahamas, and from which such 'great expectations' arise."

Windward Islands.

A good deal of interest has been shown by the Governor-in-Chief, Sir Walter Hely-Hutchinson, in the introduction of plants of Sisal Hemp to the Windward Islands.

At the Grenada Botanical Station, the Curator, in a *Bulletin* (No. 9 September 1891), states that "there are in cultivation about 2 acres of Sisal Hemp. These were planted out according to Stoddart's method, viz., 12 feet between rows, and 10 feet in the rows, on a rocky hill-side facing the west, and therefore fully exposed to the sun. For the sake of experiment, to half of this cultivation light shade has been given by planting a row of corn between the rows of Sisal Hemp, and it is worthy of notice that the plants so shaded have made far greater progress than those without shade. It would seem, therefore, that although the Sisal Hemp plant may be extremely hardy, and require no shade in its native habitat, or in those islands where it has fairly become naturalized, yet in introducing its cultivation to these islands it is rather an advantage to give the plant slight shade, at any rate during the first few months of its growth."

In the Report of the Curator of the Botanical Station at St. Vincent, dated the 1st August 1890, it is stated that "two thousand plants of "Sisal Hemp (presumably *Agave rigida*, var. *sisalana*) have been "received from Florida. One hundred and thirty of these were found "on arrival to be perfectly useless, and 1,600 were distributed. The "remaining 270 were retained for the Botanic Gardens, where the "largest plants were placed in the most suitable ground at my disposal, "the rest being planted in nursery beds, whence later on they will be "transplanted."

In connexion with introduction of plants of Sisal hemp to St. Vincent, it may be mentioned that in August 1890, Mr. J. H. Hart, F.L.S., Superintendent of the Botanical Gardens, Trinidad, drew attention to the existence of an *Agave* in St. Vincent, in the neighbourhood of Calliaqua, very similar to what may be regarded as the wild state of *Agave rigida*. It was furnished with teeth and it yielded very good fibre. Specimens of this plant are now under cultivation at Kew. It is evidently closely allied to the Sisal Hemp plants, but the leaves are short, and seldom exceed $1\frac{1}{2}$ to 2 feet in length. The habit of the plant closely resembles that of *A. excelsa*, Jacobi. On account of the shortness of the leaves, and the occurrence of teeth, this plant is not likely to be in large demand as a fibre plant in any locality where the very long leaved and unarmed *pita* of the Bahamas and Florida (*Agave rigida*, var. *sisalana*) is obtainable. The St. Vincent *Agave* has also been noticed at Barbados, and probably it will be found in others of the West Indian islands.

In the Report of the Curator of the Botanical Station at St. Lucia for the year 1890, it is stated that "with the view of forwarding the "establishment of a fibre industry in the island, the Government "undertook the importation of 5,000 plants of Sisal Hemp (*Agave* "*rigida*, var. *sisalana*) from Florida. They arrived in good condition, "and were at once planted in nursery beds to gain strength before the "final planting out. Of these plants about 700 have been already sold, "and orders have been booked for immediate execution; one for 1,000 "plants and the other for 600 plants."

South Europe.

Various varieties of *Agave rigida* are found in the South of Europe and especially in the gardens of the Riviera. They are grown chiefly as ornamental plants, but large quantities of suckers and bulbils would no doubt be available if they were required for distribution to other countries. These plants have recently been studied on the spot by Mr. J. G. Baker, F.R.S., keeper of the herbarium and library at Kew,

and a note upon them was given in the *Kew Bulletin* for January 1892 p. 4, which is reproduced below :—

"*Agave rigida*, Miller. This is the most valuable and most variable of all the Agaves. It is common and quite at home in the Riviera gardens and flowering freely. I had an opportunity of studying its character and range of variation far better than I had ever done before, and of seeing several forms with which I was not previously acquainted. The commonest forms on the Riviera show the characteristic small distant nearly black teeth, and agree very well with what have been described and figured as *A. Ixtli* and *A. ixtlioides* (Bot. Mag. t. 5893). In Dr. Hern's garden, situated just on the French side of the boundary gorge at St. Louis, I saw a form with leaves much thicker than usual (1½ in. thick at the base) and forming a less dense rosette. The plants called *A. Cantula* and *A. Rumphii* in the Riviera gardens are forms of *A. rigida*. Mr. Hanbury has just flowered a spineless form that agrees very well with the variety *sisalana* of Yucatan and Florida. I am quite satisfied now that *A. Houlletii*, Jacobi, is nothing more than undeveloped *sisalana*, and the same holds good with a plant called *A. lævis*. One panicle of this species at La Mortola was producing copious bulbils. The peduncle, including the rhomboid panicle, does not reach a greater height than 12–15 feet. The bract leaves, like those of *Agave americana*, are small and distant as compared with those of *A. atrovirens*."

Mr. Baker expresses the opinion that *Agave lævis*, Todaro (not *brevis* as given in the Handbook of *Amaryllideæ*), a plant of which he found under that name at La Mortola is probably typical *Agave rigida*, var. *sisalana*. A fine photograph of this was recently sent to Kew by Dr. Todaro which is now in the Kew Herbarium. *Agave Candelabrum*, Todaro, may on further acquaintance prove to be *Agave rigida* var. *elongata*.

West Africa.

In April 1890, there were received, through the Colonial Office, specimens of leaves of an *Agave* from Sherbro in the colony of Sierra Leone, West Africa, known locally by the rather singular name of "Wild Sarsaparilla." The leaves were evidently those of one of the numerous forms of *Agave rigida*. They had small, distant, black teeth, and the terminal spine so characteristic of the species. The leaves were thin and rigid in texture and of glaucous green colour. It is evident from this that Sisal Hemp plants have already been introduced into some parts of West Africa. The local name Wild Sarsaparilla cannot easily be accounted for. The thin long roots of some Aroideæ, somewhat resembling those of Smilax, have been exported from the West Indies as Sarsaparilla, but this is the first time that the name has been associated with any species of Agave. It is possible that introduced plants of *Agave rigida* may be found in other West African Colonies if they were specially looked for. Their presence so far is interesting as showing how widely diffused many new world plants have become even in the less accessible parts of the old.

East Indies.

The species of *Agave* hitherto yielding commercial fibre in the East Indies have proved to be either *A. americana* a *A. vivipara*. Investigations undertaken by Kew during the last three years have shown that the Bombay (Aloe)- fibre, of which an account is given later, is prepared from *Agave vivipara*, L. (A. Cantula, *Roxb.*) This fibre is almost unsaleable at the present time, and is quoted (January 15th, 1892) at 4*s*. to 11*s*. per ton. The stock at Liverpool is given at 5,136 bales.

Plants of the species above-mentioned, received through the India Office, are now growing in the Kew collections. Manila aloe fibre (to be distinguished from the well-known Manila hemp prepared from *Musa textilis*) is also apparently prepared from *Agave vivipara*. This is quoted (January 15th, 1892) at 14*s*. to 16*s*. per ton. Specimens of leaves of the plant yielding this fibre were lately received from Mr. Alexander Gollan, Her Majesty's Consul at Manila, and the above determination was confirmed. Fibre from *Agave americana* is pepared for local use both in India and elsewhere in the East Indies. It is probable that *Agave rigida* exists only here and there as garden specimens, and we are not aware of the occurrence of the unarmed Sisal plant *Agave rigida*, var. *sisalana* anywhere in the east. Plants of this have lately been distributed in small quantities from Kew to the Botanical Gardens at Calcutta, Madras, Singapore, Ceylon, and Mauritius.

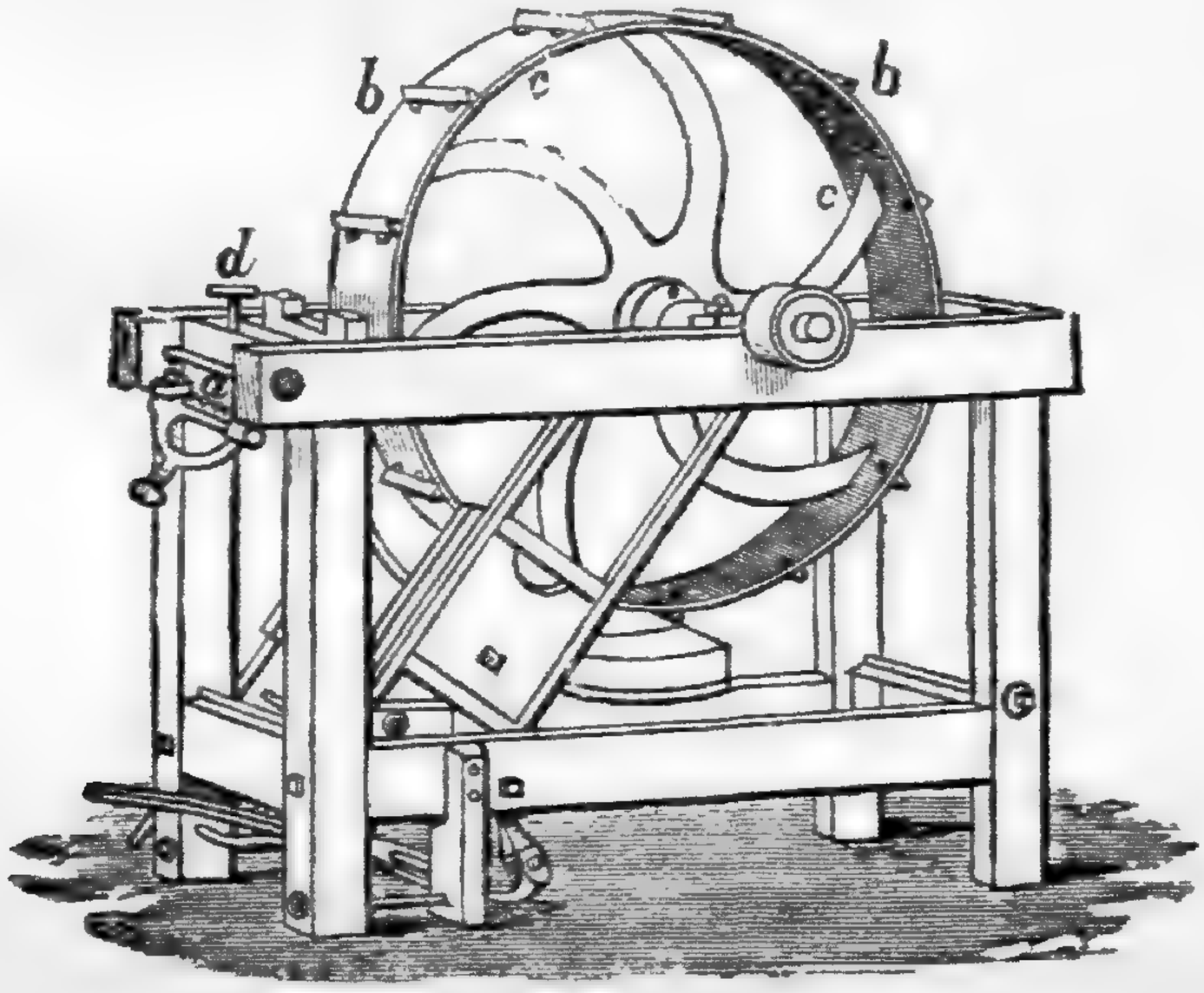
Recently about 1,000 plants were forwarded from Kew to the Botanical Gardens at Calcutta, and the Government of India has since taken steps to obtain a larger quantity for experimental trial in different parts of India.

Fiji.

At the request of the Governor, Sir John Thurston, who is keenly interested in the development of new industries in this remote British possession, plants of the various species of *Agave* yielding fibre have been forwarded for cultivation at the Botanical Station at Suva. In spite of the long time necessarily occupied in transit by way of Sydney, the plants have arrived in good order, and the reports received of their growth is very satisfactory

Fibre Machines.

Until very recently the only machine in use in Yucatan was a clumsy affair stated to be a native invention, called a "raspador." Rude as this piece of mechanism is, it is said that a native will clean 20 leaves a minute with it, though with a considerable per-centage of waste of fibre. Whilst the raspador is said to have been supersed on some plantations, it is more or less generally used at the present time for extracting the immense quantities of Sisal Hemp exported. The average work of one machine is claimed to be 7,000 leaves per day with two feeders or operatives.



Yucatan "Raspador" Fibre Machine.

The above is a representation of one of the Yucatan machines taken from the Report of the Department of Agriculture, U.S.A. [No. 3, 1891.] The following description of it is quoted by Mr. Charles Richard Dodge :—

"It is simply a wheel, like a 4-foot pulley, 6-inch face, with pieces of brass an inch square, and 6 inches long, running across the face about a foot apart. This wheel runs in a heavy wooden case. When working well it makes about 110 revolutions a minute. The leaf is put in through a small hole in the case, and being held by a strong clamp, is allowed to whip downward as the wheel moves around. A heavy block, like the brake of a car-wheel is, by lever, brought to bear on the leaf, pressing it against the revolving wheel. In a second the pulp is crushed and thrown into a pit under the wheel, and the fibre is drawn back, one half of the leaf being cleaned quicker than one can follow the motions. The leaf is reversed, and the other end cleaned in the same manner."

In the Bulletin of the Botanical Department, Jamaica, July 1891, a report is published of the results of experiments with the Weicher fibre machine at Jamaica. The machine was driven by steam power, and it required four persons to feed it and remove the fibre.

Amongst the leaves cleaned were those of the Sisal Hemp plants, *Agave rigida*, var. *elongata*, and *Agave rigida*, var. *sisalana*. The results may be briefly summarised as follows : 115 leaves (weighing 185 pounds) were cleaned in 17 minutes. These yielded wet fibre weighing $20\frac{3}{4}$ pounds, and dry fibre weighing $8\frac{1}{4}$ pounds. The out-turn of dry fibre per day of 10 hours would thus be about 291 pounds.

At the Bahamas an American machine known as the Albee Smith fibre-cleaning machine was lately tried. An account given by the United States Consul at Nassau, dated July 10th, 1891, states that :—

"Considerable difficulty was experienced in getting the machine to run properly, owing to the fact that the steam plant used was defective, and the pulley and belts were not of the proper size, width, &c. But, despite these drawbacks, the operation of the machine was said to be decidedly satisfactory, and nearly all present were of opinion that, under proper conditions, the machine would very easily do all that was claimed for it, and that it was a most valuable improvement over all other machines in use in the colony. The new machine is entirely automatic. It grips the leaves continuously as fast as the operators can supply them, holds them firmly during the operation of cleaning, and delivers the fibre completely and beautifully cleaned at the further side. No reversing of the leaves or any part of the machinery is required. The operator simply supplies the leaves, and the machine does the rest. It is said to be capable of cleaning 50,000 leaves a day, extracting therefrom 3,000 lbs. of fibre."

It will be noticed that the exact returns are not here given. Those claimed for the machine by the makers are evidently purely conjectural, and, having regard to the tested results of other fibre machines, it is impossible to attach any importance to them.

Numerous other fibre machines have been brought before the public during recent years. Some of these are of undoubted merit, but it is evident that the expectations of cultivators of Agave plants have not yet been fully met. The conditions existing in Yucatan, where clumsy and wasteful machines have hitherto been adopted with apparent success, are of a peculiar character. Labour there is so cheap that cultivators can afford to carry on the industry under circumstances entirely unsuited to other parts of the world. Numerous improvements have,

however, been lately made in English and American machines, and there are good grounds for believing that the problem will be ultimately solved. The point requiring special attention is to ensure continuous action in feeding the leaves to the machine, and so save the time and trouble of reversing the leaves before the whole length can be cleaned. The automatic feeding attached to some machines whereby the leaves are presented sideways may accomplish this, but so far such an arrangement has not been tested for a sufficient time to judge of its practicability. The urgent demand which will soon be felt in the Bahamas for a satisfactory means of utilising the extensive fibre plantations established in those islands will call forth strenuous efforts on the part of those interested in the subject. At Mauritius a machine for extracting the fibre of *Furcraea gigantea* has been in use for some years, and it appears to give satisfactory results. This is fully described later. The labour in Mauritius is chiefly supplied by Indian coolies.

Market Value of Sisal Hemp.

In view of the largely increased production of Sisal Hemp in Yucatan, and the extensive planting which is taking place in the Bahamas, Turks Islands, Florida, and other places, it may be useful to review the prices which have been realised by Sisal Hemp of good quality in this country during the last 10 or 15 years. By the courtesy of Messrs. Ide and Christie, fibre brokers, of 72, Mincing Lane, E.C., we are in a position to place on record the average prices per ton of Sisal Hemp in the London and Liverpool markets for every month during the last 13 years from 1879 to 1891, both inclusive. The table attached speaks for itself. It may, however, be useful to point out that the price per ton has been as low as 17*l.* 15*s.* (in January 1886), and in March 1891 it rose as high as 56*l.* 10*s.* These are the minimum and maximum prices respectively during a period of 13 years. The average prices for each of the 13 years, beginning with 1879, are as follows :—"24*l.*; 27*l.*; 28*l.*; 28*l.*; 27*l.*; 21*l.*; 19*l.*; 21*l.*; 33*l.*; 37*l.*; 50*l.*; 30*l.*; 26*l.* The average price for the whole period is 28*l.* 10*s.* nearly. Prices ruled highest during the year 1889, when the average price was 50*l.* per ton. During the year 1891 the average price was 26*l.* per ton, or nearly one half of what it was two years previously in 1889. The last return issued by Messrs. Ide and Christie, dated the 15th January 1892, quotes Sisal Hemp, spot value, at 23*l.* 15*s.* per ton. The market report is, "Sisal has again fluctuated, but closes at the "top, and 2*l.* per ton higher than when we last noticed." It is evident that the market value of Sisal Hemp has shown considerable fluctuation of late years.

It has already been shown that the bulk of the Sisal Hemp produced in Yucatan is shipped to the United States. The price paid for Sisal Hemp in the New York market during the last 13 years is therefore necessary before we can take a complete view of the Sisal Hemp industry for that period.

So far we can only give returns of prices in the United States, published on the 31st December 1891, for the last three years as follows :—

1889, $8\frac{5}{8}$ cents. per pound (40*l.* per ton) ; 1890, 6 cents. to $6\frac{1}{4}$ cents. (nominal) (28*l.* to 29*l.* per ton) ; 1891, $4\frac{1}{4}$ cents. to $4\frac{3}{8}$ cents. (20*l.* to 20*l.* 10*s.* per ton).

In the meantime the complete returns kindly placed at our disposal in regard to Sisal Hemp in this country cannot fail to be of service :—

AVERAGE PRICE per TON of fair quality SISAL HEMP in the LONDON and LIVERPOOL MARKETS for 13 years from 1879 to 1891 (inclusive).

Months.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
January - - -	23 0	32 10	28 0	27 10	28 0	22 10	19 0	17 15	27 10	36 0	50 0	40 10	28 10
February - - -	23 0	32 10	29 0	27 10	28 0	22 10	18 10	17 15	28 0	36 10	52 0	38 0	27 10
March - - - -	22 0	29 10	27 0	26 10	28 0	23 10	18 10	18 10	28 10	37 0	56 10	32 0	28 10
April - - - -	21 0	29 10	29 0	25 0	29 0	23 0	18 10	18 5	31 0	38 0	53 10	28 0	28 0
May - - - -	21 0	26 10	29 0	27 0	27 0	21 0	19 10	18 10	32 0	35 0	53 0	26 15	28 10
June - - - -	22 0	23 0	29 0	28 0	26 10	21 0	19 10	18 15	30 0	32 10	49 0	26 0	28 0
July - - - -	22 0	23 0	27 10	28 0	27 0	20 0	18 10	19 15	30 0	29 0	50 0	25 0	27 0
August - - -	24 0	24 0	26 10	27 10	25 10	21 0	18 10	24 10	33 0	32 10	50 0	25 0	23 10
September - - -	23 0	25 10	26 10	28 10	25 10	20 0	18 10	25 10	37 0	39 0	50 0	27 0	22 10
October - - -	25 0	25 0	27 10	30 0	25 10	19 10	18 10	24 0	40 0	39 0	50 0	26 10	22 0
November - - -	29 0	25 0	29 10	29 0	24 5	19 10	18 10	26 0	40 0	40 0	45 0	32 10	21 0
December - - -	32 10	25 10	28 10	28 10	24 0	19 10	18 5	26 0	39 0	45 0	45 0	29 10	22 0
Average - £	24	27	28	28	27	21	19	21	33	37	50	30	26

L.—SISAL HEMP IN THE BAHAMAS.

[K. B., 1892, pp. 141-143.]

The following interesting account of the fibre industry in the Bahamas has been recently communicated to Kew by his Excellency Sir Ambrose Shea, K.C.M.G., Governor of the Bahamas :—

Sir AMBROSE SHEA, K.C.M.G., to ROYAL GARDENS, KEW.

Government House, Bahamas,
April 11, 1892.

DEAR SIR,

I HAVE asked the Crown Agents to order in the meantime six copies of the *Kew Bulletin* for this Government, and I have notified parties wishing to become subscribers that I will have their orders forwarded.

I notice you give a good deal of attention to our fibre cultivation. It is really a most promising enterprise and I believe will financially realise all reasonable expectations.

It will not become what is called a boom, for the production is necessarily a gradual movement, but as far as the future of the industry can be inferred from experience and existing facts, the calculations of its progress and value may be made with an unusual degree of certainty, so stable are its general conditions.

The growth of the plant is unfailing, it being proof against drought and every known adverse influence. It matures fully in four years and then yields 10 or 12 annual crops without further cultivation. The fibre is of unsurpassed excellence, and a recent experiment shows that it takes a dye readily, and eminent fibre merchants in London have informed me that they only desire to be assured that they can depend on a supply.

Such a state of facts is full of promise for the future prosperity of the colony. The export is now beginning, and the whole for the year will be from 150 to 200 tons. There will be an increasing quantity in the succeeding years, and a careful estimate places the output at 14,000 tons in 1900. At the low price of 20*l.* a ton this would give an export of 280,000*l.* which, added to the normal export of the colony (130,000*l.*), makes 410,000*l.* eight years hence (to which the intervening years will be a steady approach), and we thus have in view a production more than three times of any in the experience of the colony.

But there is no reason why it should rest here, and it can be predicted with as much safety as can belong to any forecasts into the future than in ten years of the new century the industry will have reached a result of 50,000 tons, the value of which can be readily seen.

In these estimates I have taken due account of the competition which this colony has stimulated by its enterprise, and the price I have named will satisfy dealers in the article that I am under the influence of all necessary restraint in this respect. I do not think many of our imitators will be successful, for it requires special combined conditions of soil and climate to produce such a fibre as ours, and in a spirit of self defence, the Legislature has extended for five years an Act now three years in existence, which prohibits the export of fibre plants from the colony. This must affect the competition which has been spoken of, for some of the places in question had been relying on supplies of plants from our growers when the first prohibitory law should have expired.

The cultivation in Florida has been proposed, but this is not seriously considered by us. The plant is inferior, wages much more than double what is paid here, and there is a well-known liability to frost, which is

fatal to fibre growth. As far as the best informed judgment can at present be a guide, we have no grounds for apprehension that our position can be seriously disturbed, or that in any conceivable conditions in the future the fibre cultivation in this colony will be placed below the limits of profitable adventure. The Government have restricted for ten years the amount of Crown allotments to 100,000 acres, which embraces the maximum product of 50,000 tons I have referred to. These allotments have been widely distributed to secure for the largest possible number of the people the advantage of employment, and a disturbance of the labour market is also guarded against. One of the many attractions of this remarkable industry is in the fact that strikes are all but impossible, for they will have no plausible basis. The crop may remain unharvested for months without injury, and the good sense of the people may be safely relied on to recognise this fact, and also to make them feel, as they now do, that men of means coming to the colony to engage in its fortunes are its best benefactors, and this is being brought home to them by the improvement in their condition arising from the operations in which capitalists have already engaged.

I am, &c.
(Signed) A. SHEA.

LI.—SISAL CULTIVATION IN THE BAHAMAS.

[K. B., 1892, pp. 189-190.]

The following further information respecting the Sisal Hemp or Pita cultivation in the Bahamas is given in the Governor's Report on the Blue Book for the year 1891 (Colonial Reports, No. 44, 1892) :—

"Fibre cultivation makes very satisfactory progress, and there are now about 8,000 acres planted out. At least 6,000 acres will be added to this area in 1892. A larger addition would be made but that the supply of plants of the requisite growth is yet limited. It is now ascertained that it is not advisable to transplant from the nurseries until they are at least one year old, and have attained to a length of 12 or 15 inches. The nurseries, however, are in full operation, and I believe that after the present year the supply of plants will be equal to any supposable demand. The adoption of the limit which restricts Crown allotments for 10 years to 100,000 acres, assures present investors against risk of over-production in the near future at least. The export from early plantings has now begun, and will be about 150 to 200 tons in 1892, and this will thereafter be an increasing quantity, but a careful estimate shows that it will not reach beyond 14,000 to 15,000 tons up to the year 1900. The subsequent advance will be much more rapid, but in no reasonable view of the circumstances can the export from the colony have a marked effect on the market for many years to come. It is now ascertained that, with plants of fair growth, four years is the longest time for the maturing of the plant, and it then yields an annual crop, without further care, for 12 or 14 years. I do not approve of forcing the crop, and immature cuttings are to be specially deprecated. The fibre is at its best after due time has been given for its growth, and unwise methods will be carefully dealt with by the Government in the highest interests of the colony. There is much yet to be learned in connexion with this enterprise, but it is satisfactory to know that, with our present imperfect knowledge, no serious mistakes have been fallen

into. Experience will no doubt lead to a lessened expense of cultivation, especially in the matter of weeding, that has hitherto been a large item, but in which it now appears a reduction may be made. The highly important question of labour is well guarded, and the whole quantity of one hundred thousand acres may be brought into cultivation without strain on our present resources. The plant, being confessedly the best of any known growth, a demand from abroad has set in, and, though there are well considered doubts of its successful growth in some places where an attempt to cultivate the plant is being made, there seems no reason why any amount of competitive industry should be encouraged, and for this and other reasons the Act passed three years ago, to prohibit the export of plants, has now been extended for five years more. The available supply at present is not more than is required for the operations in the colony, which would be hampered by outside demand, and the progress of the colony be consequently retarded. It would be difficult to assign a limit to the future advance of the colony from the growth of this remarkable industry. Though the land provisionally assigned to fibre cultivation (one hundred thousand acres) will in time yield 50,000 tons, there seems no reason why even this great result should bar the extension of the area of production, if the markets of the time shall admit of its profitable disposal. It is generally thought that, from the excellence of the fibre, it will find its way into other fields for its use besides rope-making, and recent experiments prove that it takes a dye readily, indicating its adaptability to certain fabrics, and to some extension of demand on this account. There is the further ground for the probably strong place for Bahamas hemp in the future, that it can be produced more cheaply than any known fibre of equal value, and it may be inferred that it will hold its own at least against the influence of any probable competition with which it may have to contend."

LII.—SISAL HEMP INDUSTRY IN YUCATAN.

[K. B., 1892, pp. 272–277.]

A general review of the Sisal Hemp industry in various parts of the world is given in the preceding pages. A later account of the fibre industry in the Bahamas was communicated to Kew by his Excellency Sir Ambrose Shea, K.C.M.G., and reproduced in the two preceding articles. What seems to have been required to supplement and complete these accounts was some precise and detailed information respecting the various machines in use in Yucatan for extracting the fibre. It was felt that the success of the whole industry depended in a great measure upon this one point.

At the request of Sir Ambrose Shea, Captain E. Jerome Stuart, the Resident Justice of Long Island, was deputed to proceed to Yucatan with instructions to study the whole subject of fibre cultivation and production in that country, and draw a comparison between the circumstances of Yucatan and Bahamas as regards soil, climate, and the general healthiness of the plants. Captain Jerome Stuart gave particular attention to the character of the machinery used for extracting the fibre, and he gives the results obtained from each machine. This part of his report will be read with interest. There are apparently no insuperable difficulties met with in Yucatan in extracting the fibre from Agave leaves. The total exports of fibre from Yucatan are of the

annual value of more than a million and a half sterling, and if, as is shown by Captain Jerome Stuart, this large and valuable industry is capable of being continuously carried on by means of machines in regular use, there should be no difficulty in selecting one or more of these machines for use elsewhere. The only advantage possessed by Yucatan is apparently that of cheap labour. The rate of pay of the Indians on fibre estates is much below that of negroes in the West Indian islands; but if the higher value of the Bahamas fibre is maintained, Yucatan would appear to possess no advantages not shared by other countries.

REPORT on the FIBRE INDUSTRY of YUCATAN addressed to Sir AMBROSE SHEA, K.C.M.G., Governor of the Bahamas, by Captain E. JEROME STUART.

In accordance with instructions received from your Excellency on the 15th ultimo, I sailed on that date for Yucatan, for the purpose of comparing the soil of the Bahamas and its adaptability to the fibre industry, with the soil of that State: to find out the different species of Agaves planted, and their liability to disease: the character of the machinery used for extracting the Henequen fibre, and the cultivation and general management of the crops.

When in Yucatan I visited 28 Henequen estates, and after careful inquiry I have the honour to submit the following report:—

THE SOIL OF YUCATAN COMPARED WITH THAT OF THE BAHAMAS.

The soil in the "fibre producing district" of Yucatan is gravelly and stony, and varies in colour, being black, brown, and red. There are large tracts of land in the district, similar to that on most of our islands, and known as "mixed land." The soil has an average depth of 8 inches, and is underlaid by soft limestone rock, similar to that of our "Pine Barren" lands."

The largest fibre fields in the State are to be found on this shallow stony soil, and the yield of fibre is greater than on the deeper soil 30 miles further inland.

I could not, when looking at the fibre fields of Yucatan, doubt for a moment that the fibre fields of this colony are equally good; and if the growth of plants is any guarantee of the virtue contained in the soil in which they grow, I do not hesitate in saying that the soil of the Bahamas is equally as good as the soil of Yucatan.

Any one who will look over the grounds of Fort Charlotte will see the soil, trees, and weeds of the fibre fields of Yucatan, with this difference, that the soil there is more stony.

THE DIFFERENT SORTS OF AGAVES.

There are several species of Agaves to be found in Yucatan, but as two only are of chief commercial value, I confine my report to those two.

The Henequen.—The kind of fibre plant growing in Yucatan, and known as the Sacqui or Henequen, is a different and distinct Agave from that of the Bahama Hemp.

The plant is hardy, and has, when cultivated, an average life of 18 years; and propagates itself by sending out "suckers" from its roots.

This Henequen [*Agave rigida*, var. *elongata*] requires from five to eight years' growth to produce a marketable length (3 feet) of fibre,

The leaf from which the fibre is extracted has a thorn at the point, and spines on its edges, and averages 3¼ feet in length.

The fibre of the plant is white, but being inferior to that of the Bahama Hemp, is rated in the market at from 6*l.* to 8*l.* per ton lower.*

The Bahama Hemp.—The Bahama Hemp plant [*Agave rigida*, var. *sisalana*] differs from the Henequen inasmuch as the leaves are without spines on their edges; and the fibre is superior in texture. The plant matures from two to three years earlier than the Henequen, and has an average life of 12 years. Like the Henequen, it propagates itself from suckers, but is also capable of producing over 2,000 plants from the pole that grows from the centre of the plant.

The Bahama Hemp is found both in Yucatan, where it is known as the Yaxqui, and in Cuba, but it is not largely cultivated, as it requires a more congenial climate than these countries afford. In this colony the plant luxuriates, the length of leaf being 4½ feet to 5 feet, weighing 1½ to 2 lbs. In Yucatan a leaf of the Yaxqui from a plant of the same age would measure 3¼ feet, and weigh 11 ounces only.

The Plant's Tenacity of Life.

The Henequen and Bahama Hemp are the hardiest of all the Agaves. Their power to withstand drought is almost incredible. I have known plants of the Bahama Hemp to lie on the ground for three months, exposed to the rays of the sun, and when planted to grow with the greatest vigour.

It has never been known for these plants to be troubled with any disease. No fungus or insect can apparently damage or affect them; and in 1883, when the locust devastated the State of Yucatan, the cattle and birds died of starvation, and men were on the eve of despair, the only green living plants to be seen were the different species of Agaves, and they are now looked upon as the salvation of the State.

Although not apparently subjected to disease, and capable of resisting a drought of 11 months in 12, the plant is not altogether free from the effects of sudden changes of heat and cold, and is liable to be damaged by floods of rain immediately after a long drought, if accompanied by a *sudden fall of temperature.* This happened in Yucatan in 1888, when, after a severe drought, the rains came on suddenly, with hail and a heavy wind from the north-west, with a fall of temperature from 89 deg. to 57 deg., and within one night about 90 per cent. of the plants were damaged or blasted on the ends of the leaves, about an average of three leaves to the plant being affected, causing a loss of 3 per cent. to 5 per cent. of leaf. A similar change after a protracted drought happened in this colony in March last, when a few of our farms were affected; but after cutting off the ends of the injured leaves there was nothing more seen of the trouble, and the plants remained healthy and strong. I am told that this frequently happens in Florida, as the atmosphere is more changeable than in the Bahamas; but as this colony is protected by the Gulf stream, there is no probability of its happening here with frequency, and in Yucatan it has happened once only in 30 years. The blast is caused by a sudden atmospheric change over which we have, and can have, no control, and may happen at any time; but the loss of leaf, 3 per cent. to 4 per cent., even 5 per cent., would be so slight that it may be looked upon with unconcern.

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* At date of 20th June 1892, rated at 6*l.* lower.

I walked through hundreds of acres of the Henequen, but beyond noticing that a leaf here and there had a few inches dried on its end, similar to what is seen in this colony and Cuba, the plants were perfectly healthy and free from disease.

Kind of Machinery used.

There are several kinds of machinery used for extracting the fibre on the different estates.

Those cleaning less than 75,000 leaves per day use the large common wheels, Raspador and Barraclough; and those cleaning from 80,000 to 120,000 per day use the larger and more complicated machines, the Prieto, Villamore, Weicher, Death and Ellwood, &c.

The planters, if using one of the large machines, keep several of the Raspadors in reserve for use in case of accidents; for should the large machine break down or get out of order, leaving 70,000 or 80,000 leaves on hand, and there be no means of cleaning them, it would involve a loss of over 4,000 lbs. of fibre.

Cleaning Machines.—The *Raspador* is a 54-inch "wheel," said to be invented and manufactured in Mexico. It requires a two horse-power engine to run it at a steady rate of 200 revolutions per minute, at which speed the best results are obtained. Capacity 500 lbs. dry fibre per day of 10 hours; requires the services of two men.

The *Barraclough*, constructed by T. Barraclough & Co., Manchester, England, is similar to the Raspador, but of superior make, Capacity 500 to 600 lbs. dry fibre daily.

The *Prieto* machine is manufactured by Ping and Negre, Barcelona, Spain; requires a 16-horse power engine and the services of two men and a boy. Capacity 7,000 lbs. dry fibre per day of 10 hours. Cost 4,500 dollars.

The *Villamore* machine, made by Krajewski and Pesant, 35, Broadway, New York; requires a 15-horse power engine and the services of two men and a boy. Capacity 6,000 lbs. fibre per day of 10 hours. Frame made of wood. Cost 500 dollars.

The *Weicher* machine, constructed by J. J. Weicher, 108, Liberty Street, New York, is fitted with a service pipe for throwing a stream of water on the fibre as it is being cleaned, and is claimed by the inventor to lose but $1\frac{1}{2}$ per cent. only, as the leaves are fed into the machine endwise. Requires 12-horse power engine and services of three men. Capacity 2,500 lbs. dry fibre per day of 10 hours.

The *Death and Ellwood* machine, constructed by W. E. Death, of Brixton, England, requires a 3-horse power engine to drive it at a velocity of 400 revolutions per minute, and washes the fibre when cleaning. Like the "Weicher," the leaves are fed into the machine endwise. Capacity 250 lbs. of dry fibre per day of 10 hours.

With the exception of the Raspador and Barraclough, all the other machines are automatic; they rasp the pulp from the fibre on the same principle as the Raspador. Their wheels being smaller, require a velocity of 500 revolutions to the minute to give good results. Beyond cleaning a greater number of leaves, they do not appear to do better work, as the per-centage of loss is as great in the one as the other, and the fibre is equally as clean.

Engines and Boilers.—The engines used were from 6 to 80 horse power, manufactured by Marshal and Son, London; Appleby Bros., London; Fawcett and Preston, Liverpool; Watts, Campbell & Co., Newark, N.J.; H. M. Sciple, Corner 3rd and Arch Street, Philadelphia.

The estates running 60 to 80 horse-power engines have two boilers, using them alternately every 15 days.

Press.—Most of the small estates use small screw presses, baling from 3 to 8 bales daily. The large estates, baling 16 to 30 bales daily, use hydraulic presses, constructed by Appleby Bros., London, and Fawcett and Preston, Liverpool.

Locomotive, Tramway Rails, &c.—The locomotive cars are made of wood, 20 feet by 4 feet. The rails are of iron with gauge 3 feet, and sleepers of wood 2 feet apart.

Tramway trucks are of iron or wood; they are 12 feet by 3 feet. Rails and sleepers of iron with gauge 2 feet 4 inches, and sleepers 2 feet apart.

Locomotives and tram cars with rails are manufactured by Charles Wood, Trees Iron Works, Middlesbrough, England.

Cultivation of the Agaves.

The Estates.—There are 200 Henequen estates in Yucatan, varying from 500 to 28,000 acres in extent, having a total number of 105,000 acres under cultivation, employing 12,000 Indian labourers.

The largest and best estates are on the rocky gravelly lands, and they are valued from 100,000 dollars to 500,000 dollars each. Each estate is managed by three principal men—the attorney, the manager, and assistant manager. The largest of them employ locomotives for hauling in the crop from the fields, others using tramway trucks or carts drawn by mules or oxen.

Estates with less than 800 acres under cultivation erect one Raspador for every 100 acres. Those of 1,000 acres use the large automatic machines.

Preparing the Fields.—The size of the cultivations on the estates range from 250 to 3,500 acres. They are laid out in fields or sections of 50 to 200 acres, and contain from 600 to 900 plants to the acre.

When preparing the fields the land is cut during the dry season, is then allowed to spring up, after which it is "sprig weeded," and burnt after the first fall of rain. The stumps are cut close to the ground, so as to be out of the way of the leaves of the plants, and to facilitate the running of the line for planting and getting the rows straight.

Planting.—The plants are "set out" on the different estates at various distances, being 6 ft. by 11 ft., 5 ft. by 11 ft., 4 ft. by 11 ft., 6 ft. by 10 ft., 5 ft. by 10 ft., 4 ft. by 10 ft., 6 ft. by 9 ft., 5 ft. by 9 ft., 4 ft. by 9 ft., 6 ft. by 8 ft.

The rows are kept perfectly straight, for if they be otherwise there would be the greatest difficulty in getting through the fields.

When planting, the labourers have a small line with the distances at which the plants are to be "set out" knotted on it, and a pole cut to the length that the rows are to be apart. A man and a boy are employed at each line. The boy drops the plants along the rows at the distance marked on the line, and then removes the line to the next row, dropping the plants as before. The man does the planting, and is responsible for the rows being straight. When coming to a rock the planter does not turn aside, but goes on, and places the plant in the row a little beyond.

The row system facilitates weeding, admits a free current of air and sunlight, which is necessary to harden and give strength and texture to the fibre; allows the labourer to cut and bring out the leaf with despatch; and, what is of the greatest importance, gives room for replanting the

field when the life of the old plants is about to terminate, which cannot be done if the plants are growing over the field irregularly.

Plants of less than 15 inches are not planted.

Management of the Crop.

Cutting.—In Yucatan the Henequen matures in five to eight years. In the Bahamas the Bahama Hemp matures in three to five years.

To neglect cutting the leaves after the plant is matured retards its growth, which causes it to "pole," at the appearance of which the life of the plant is ended, and the planter, after reaping a few leaves only, must then plant his fields afresh. On the other hand, when the cutting is regularly attended to, the life of the plant is prolonged, the plant will produce a greater number of leaves, and fibre of a greater length and superior quality.

The plant is cut every three months, when seven to nine leaves are gathered. The leaf is taken from the plant with a "clean cut," making the cut down and inward at an angle of 45 deg.

Cleaning.—As soon as the leaves are cut they are taken to the machine for cleaning. The cleaning is so arranged that one-half of the leaves to be cleaned is taken from the cuttings of the day previous, and the other half from the cuttings of the same day, as in this manner the work can be commenced early in the morning, and steadily carried on without waiting for leaves to be brought in from the field. The leaves are not allowed to accumulate beyond half a day's cleaning, for if left to dry beyond the second day they become hard, and the fibre, when extracted, will be dark.

When the Raspador is used for extracting the fibre two operators are required; one stands to the left of the wheel and the other to the right. The operator on the left taking a leaf fastens the small end with a lever to prevent the whole of it being drawn into the machine; the larger end is inserted and cleaned; the other operator then hauls out and reverses the leaf, putting in the uncleaned end, at the same time taking a turn with the cleaned end of the leaf around a brass cleat which is fitted to the machine for the purpose, and managing a brake that regulates the pressure required for cleaning the leaf, finally drawing out the clean fibre. In this manner 14 leaves per minute, or 8,400 leaves, are cleaned for a day's work.

When cleaning with the Villamore, Prieto, or other automatic machines, all that is necessary is to lay the bundles of leaves on a platform fitted for the purpose, when an endless chain draws them into the machine, the mechanism of which is so arranged that one wheel cleans one-half of the leaf, the chain taking it along, where another wheel cleans the other half, and then throws out the clean fibre at the opposite end. Two men and a boy are employed at the machine, one man to see that the leaves enter the machine on their length, and that they do not ride one on the other; one to attend to and regulate the machine, and the boy to receive the fibre as it is brought out by the endless chain.

As soon as the fibre is extracted it is dried, for if allowed to remain without being exposed to the sun immediately after cleaning it becomes dark and spotted.

Yield per Acre.—The yield of fibre from an acre of Henequen is from 1,000 lbs. to 1,470 lbs. per annum. The number of plants usually set out in an acre is 650, giving an average of 33 leaves from each plant, and from 50 to 70 lbs. of clean fibre to the 1,000 leaves. Making an average calculation of 650 plants to the acre, 33 leaves from each

plant, yielding 60 lbs. of fibre to the 1,000 leaves, the return would be as follows :—$33 \times 650 = 21{,}450$ leaves yielding $60 \times 21\frac{450}{1000} = 1{,}287$ lbs. clean fibre per annum. The planters never speak doubtfully of their returns, as experience shows them that their crops can be relied on with almost complete certainty.

Cost of Working and Profits.—The planter estimates his crop to cost for cultivating, cutting, cleaning, baling and marketing from $2\frac{1}{2}$ cents to 3 cents per lb. At the present price of fibre, 5 cents per lb., taking 3 cents as the cost of production, an acre yielding 1,287 lbs. would give a net profit of 25 dollars.

After comparing the soil and plants of the Bahamas with that of Yucatan, I assure your Excellency that the one compares most favourably with the other ; and that we have in this colony every requirement for the development of the enterprise, and I am most sanguine as to the ultimate result of the Bahama Hemp industry.

(Signed) E. JEROME STUART.

LIII.—POLING IN AGAVE PLANTS.

[K. B., 1893, pp. 315–321.]

The progress of the fibre industry in the Bahamas has been fully noticed during the last four years in the pages of the *Kew Bulletin*. At the present time the earlier plantations are approaching maturity, and it is anticipated by those interested in the subject that the export of fibre on a commercial scale will probably begin next year.

In the meantime a question of some importance has arisen in regard to the duration of life of the particular sort of *Agave* cultivated for fibre purposes in the Bahamas.

This is botanically known as *Agave rigida*, var. *sisalana*. It is a dark green, smooth-leaved sort (with no marginal teeth) originally introduced, either directly or indirectly, from Yucatan. There it is known under the aboriginal name of Yaxci.

The plant more generally cultivated for fibre in Yucatan is a glaucous-leaved sort, armed with small, black, marginal teeth (*Agave rigida*, var. *elongata*), known locally as Sacqui. The Bahamas plant, the Yaxci, is still also found in Yucatan, but apparently it is not specially selected for general cultivation.

Of *Agave* plants, a familiar example, grown in green-houses in this country, and sometimes put out for decorative purposes during the summer months on lawns and terraces, is that commonly called the American aloe (*Agave americana*). Such plants produce nothing but leaves for the greater part of their life. In this state they may last for many years. In some species there are also occasionally produced root suckers, which afford a ready means of increasing the plant. This, however, is a purely vegetative reproduction. The exact life-period of Agaves in northern latitudes may vary from 10 to, possibly, 50 years or more. On account of this exceptional longevity amongst succulent plants they are sometimes called Century plants. In the tropics, grown under natural conditions, these plants seldom last longer than seven to 12 or 15 years. Sooner or later, however, within the periods above mentioned, and depending on the conditions under which they are placed, they throw up a "pole" or flowering stem. On this will successively appear the flowers, the capsules bearing seed, and possibly

also numerous bulbils. In some species there are produced abundant seeds, but no bulbils; in others there are produced bulbils only and no seed. The ripening of the seed or production of bulbils, whichever may be the normal habit, brings the life of the plant to a close. After that the whole plant withers and dies.

The question raised in the Bahamas, and respecting which the aid of Kew has been sought, has reference to the exact length of time the Yaxci (*Agave rigida*, var. *sisalana*) may be expected to last in the leaf state. In other words, how long can the plant be made available to the planter for the production of fibre? The matter is naturally one of great interest to the Bahamas people, for on it hangs the success of their plantations. The result of the inquiry at Kew is given in the following correspondence. It is so far satisfactory that, with care and judgment on the part of those directly in charge of the plantations, there need be no greater cause of anxiety in the Bahamas than has been felt during the last 30 years in Yucatan, for plants that have poled might easily be replaced from time to time by strong healthy "supplies" from nurseries, and the work of the plantations need not at any time be seriously interrupted.

Mr. NEVILLE CHAMBERLAIN to ROYAL GARDENS, KEW.

[Memorandum.]

July 26, 1893.

Information has been received from the Bahamas of a somewhat serious nature in reference to the Sisal industry. It will be remembered that in the wild state these plants pole when about seven years old, but it was supposed that the cutting of their leaves when cultivated would delay the poling and prolong the life of the plant, as is said to be the case with the Yucatan variety. It is said, however, from observation of old plants in the Bahamas, that cutting makes no difference to the life of the plants, which seldom exceeds seven years. As four years at least are needed for the growth of the plants before they are fit for cutting, this only leaves between two and three years of cropping, in which the planter must recover all the capital expended in their cultivation. Any suggestions by which the life of the plants might be prolonged and poling prevented are invited, as the early poling will gravely affect the success of the industry.

N. C.

THE MONRO FIBRE CO., LIMITED, to ROYAL GARDENS, KEW.

DEAR SIR, Abaco, Bahamas, July 20, 1893.

THE interest shown by your department in the fibre industry of this Colony, and the valuable information you have already afforded in connexion with the plant, have prompted me to submit the following questions, which deal with points of prime importance to those engaged in its cultivation. In fact I do not know to whom else to apply, for our plant is undoubtedly different from that commonly grown in Yucatan, and no one in the Bahamas seems able to speak with certainty upon the subject under review.

Our plant, or "Bahamas Hemp" as it is now termed, is an Agave with dark green leaves, which are spineless except for a thorn at the tip. From all accounts it is identical with the "Yaxci" of Mexico.

1. The life of the "Sacqui," which is that generally grown in Yucatan, is said to be from eight to 16 years after cutting has been begun. Can you tell me whether our variety enjoys as long a life or not?

2. Do Agaves put out during their life a certain fixed number of leaves, the normal quantity varying but little between plants of the same species, or is there no regular limitation in this respect?

3. If the output of leaves on a plant is variable, would cutting them as they mature be likely to increase it, and, judging from analogy or otherwise, ought the cutting to be made several times a year or at any particular seasons? Also, would cutting the leaves have the effect of prolonging the life of the plant by retarding its poling?

It may seem strange to ask for such information when we have the plant here growing under our eyes, but it is only now reaching the cutting stage on most of the plantations, and where it has been longer established there unfortunately does not seem to have been much observation bestowed upon its nature or the circumstances of its growth.

You can easily perceive the necessity we are under of obtaining a clear understanding on the points raised in this letter, as, for instance, when it will be advisable to reset the fields with young plants so as to be ready to take the place of the old ones as the latter die off, and also how to prolong the life and increase the yield as much as possible. I need not say how thankfully any assistance you may kindly give in this direction will be received.

Yours very obediently,
(Signed) J. GURDON.

The Director,
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to Mr. AUSTEN CHAMBERLAIN, M.P.

Royal Gardens, Kew,
August 18, 1893.

DEAR Mr. CHAMBERLAIN,

WHEN your brother was last at Kew he left with me a memorandum respecting the age at which plants of the Yaxci of Yucatan, now known as the "Bahamas Pita" or Sisal, reach their maturity. He also asked whether anything could be done by processes of cultivation to retard the poling or the appearance of the flowering panicle, which, it is well known, marks the duration of the life of the plant.

2. There is apparently very little reliable information obtainable in regard to the age at which these plants flower. In fact in the whole of the literature of the subject the references are very few and the language is vague and inconclusive. In the enclosed memorandum I have given a brief summary of what has been recently published, and it may be possible to draw some general conclusions from the facts therein stated.

3. The observations in regard to the Sacqui of Yucatan do not, it is true, bear directly upon the subject. But as the Yaxci or Bahamas Pita is only a variety of the same species it is improbable it should differ in any marked degree from that plant. The length of time that elapses previous to flowering in Agave plants may in some degree be affected by soil and climate, but as a general process of growth and with plants cultivated normally over a large area the experience in Yucatan may not be far from what will ultimately obtain in the Bahamas.

4. The latest information from Yucatan is furnished by Mr. Pierce, the Vice-Consul at Merida. He states that "a Hemp plantation in "Yucatan lasts for some 15 years." This is not conclusive as regards the age of the individual plants. It merely shows that while some of the original plants may pole at one age and some at another, their places are so filled up from time to time by new plants that the whole undertaking receives no serious check up to about the fifteenth year.

5. It appears to be recognised in Yucatan as the result of experience (without apparently any reference to the determining causes) that poling is encouraged amongst these plants if the leaves are left uncut for any length of time after they have arrived at maturity. There is little or no scientific basis for this opinion, and experience at the Bahamas should be carefully recorded if tending in that direction.

6. They also believe in Yucatan that if the root-suckers which are abundantly thrown out around the base are allowed to remain attached for a long period they tend to exhaust the parent plant and accelerate the period of poling. Such suckers no doubt divert the strength of the parent plant, and if allowed to remain too long either of two things must happen—the parent plant will produce fewer and smaller leaves or its period of maturity will be hastened. The practical outcome of this is the suggestion that such suckers as are necessary for supplying the plantation should be removed when large enough into nurseries and all others not required should be removed periodically and thrown away.

7. Mr. Stoddart, it is noticed, records that the Yucatan people are very particular when cutting the leaves to cut them as close as possible to the stem of the plant. In other words, they consider it undesirable to leave any portion of the base of the leaf to form what is called in tree-pruning a "snag" on the parent plant. A certain degree of "snag" is inevitable. This, however, afterwards falls off, when dry, leaving the central stem of the plant eventually quite clean. I am not prepared to attach much importance to this matter in relation to poling. It is undesirable as a matter of economy in fibre, and it may also have some effect on the general health of the plant. It certainly would produce an untidy appearance in the up-keep of the plantation, and altogether the practice of close cutting the leaves should be systematically carried out.

8. Coming now to the Sisal plant as known in Florida and the Bahamas, it is evident that an impression prevails both in Florida and the Bahamas that some of these plants have flowered at about the seventh year after planting. The instances recorded are given in the accompanying memorandum. They are, however, not conclusive. The exact history of the suckers before they were put out, and the treatment they afterwards received in regard to cutting the leaves and allowing the suckers to remain on indefinitely, are not given. All these are important factors to be considered before an opinion can be formed. The result of further and wider experience will probably show that some plants may pole at seven years, others at a later period. It is unlikely, if properly treated, that they will all pole over a large plantation at the same time. If the plantation is carefully watched, and fresh plants are put in immediately the fact is realised, or at the first sign of poling, there need be little interference with the work of the plantation.

9. It is essential that fresh plants in large numbers be grown on in nurseries with the view of supplying any vacancies caused by poling. Also the pole should be cut out as soon as it appears above the leaves in order that the leaves already formed should be ripened before the plant dies. This practically means that the plant should be kept available for yielding fibre for nearly a year later than it otherwise would be.

10. There is another point to be briefly noticed. While it is important that all the mature leaves be cut when they have attained full development, great care should be taken that the immature leaves are not also cut. The regular cutting of the fully matured leaves might possibly tend, as mentioned above, to prolong the vegetative life of the plant

and retard poling. Theoretically, however, there is no ground for such a supposition. On the other hand the cutting of immature leaves would certainly have a contrary effect. The plant would be likely to be weakened by the process, and the subsequent leaves borne by it would be smaller and weaker. The exact period when the leaves are to be cut should be carefully studied. As a general rule the leaves are ripening when they are gradually falling from the erect into the horizontal position on the plant. Also there may be some indication in the colour of the leaves. These are, however, matters to be decided on the spot by careful and skilful people. It is only necessary here to draw attention to them, and to state that both the life of the plants and the quality of the fibre, in other words, the success of the whole undertaking, may not improbably depend upon them.

I am, &c.
(Signed) D. MORRIS.

J. Austen Chamberlain, Esq., M.P.,
40, Prince's Gardens, S.W.

[Memorandum.]

THE LIFE OF SISAL HEMP PLANTS.

There are numerous species of Agave (popularly called Aloes) belonging to the natural order *Amaryllideæ*. They are almost all monocarpic perennials. That is, they grow on for a number of years producing leaves only; finally they flower, and this they do but once in their life, and that period is apparently determined by the nature of their environment. Usually Agaves under cultivation in this country live to a great age. On this account they are sometimes called century plants. In their native country they live for seven to 15 years. When once the monocarpic species have flowered and produced seeds or bulbils (pole plants) they die. The following notes refer to the Sacqui (*Agave rigida*, var. *elongata*) and to the Yaxci or Bahamas Pita (*Agave rigida* var. *sisalana*) :—

(*a.*) Mr. Stoddart says, "the plant (the Sacqui of Yucatan) lasts " . . . for at least 25 years in a cutting state, depending on the soil " and treatment." To renew a plantation after the original plants have become exhausted, "it is usual to plant at proper distances, by the sides " of the old plants or between them, young shoots which three years " afterwards (and upon the failure of old ones) will be fit for cutting." A new field will thus "be kept up without any loss of time or suspension of work." (*Sisal Hemp, its adaptation to Jamaica*, p. 4.)

(*b.*) Mr. Stoddart describes the poling as follows: "This happens when the plant has arrived at cutting age *and the plants are not cut.*" . . . "When the pole begins to come out and gains a length of about " three or four feet, it is customary to cut it off close without injuring " the leaves. These leaves will then mature and be fit to be taken off " before the plant dies." (l.c. p. 7.)

(*c.*) Poling appears to be accelerated (1) by the leaves not being cut " when they have arrived at maturity, (2) by the plants being exhausted by numerous suckers allowed to remain around their base, (3) by careless cutting of the leaves. Stoddart, on this latter point, says: "If the " stump (or base) of the leaf be left of any length on the trunk it

"seriously injures the plant, spoils its vigour, and *makes its existence a* "*short one.*" (l.c. p. 7.)

(*d.*) Mr. Pierce says: "A hemp plantation in Yucatan lasts for some "15 years . . . on good land the crop commences in four years "or earlier, whilst on rocky ground from six years or more." (F. O. Report, 1892, p. 2.)

(*e.*) Mr. Dodge, discussing the Pita or Yaxci plant of Florida and Bahamas, remarks that in one instance, on very poor soil, he noticed that "a long row of plants set out 10 years ago to form a boundary "line had hardly made any growth." (Report of C. R. Dodge on "Fibre Investigation in the United States." Washington, 1893, p. 21.)

Mr. C. T. McCarty of Ankona, Florida, says: "With us *Agave sisa-* "*lana* sends up its pole at seven years on our best lands. . . . So "far as the plant is concerned the 'poor land' theory has no foundation "in this locality. Our strongest and finest plants are on our best land." (Dodge, l.c. p. 15.)

(*f.*) Mr. Merrick Shaw, Polk County, Florida, describes a Sisal Hemp plant under his observation as follows: "The original plant growing on "the soil, of which a sample was sent, poled at seven years old. Twenty "layers of leaves had been cut from this plant, and the lowest of those "remaining measured 5 feet 9 inches in length by 5 inches in width at "the broadest part. About 100 suckers had been removed from (the "base of) this plant and planted elsewhere." (Dodge, l.c. p. 17.)

(*g.*) Mr. Dodge figures and describes a plant with leaves barely a foot long, which had thrown up a slender pole to a height of 8 feet or more. He adds: "I was informed by residents on Indian Key "that this premature blossoming of a young plant or sucker *while* "*yet attached to the parent root* is not of uncommon occurrence." (Dodge, l.c. p. 18.)

Kew, August 16, 1893. D. M.

[*Note added.*—The plant cultivated in Mauritius, and yielding what is known as Mauritius Hemp is the Green or Fœtid Aloe (*Furcraea gigantea*). The value of the exports is about 50,000*l.* annually. This plant is similar to an *Agave*, both in appearance and habit, and it also produces numerous bulbils or pole-plants after flowering. The experience in Mauritius with regard to poling of the *Furcraea* has a striking resemblance to what has been observed in regard to the Agave in Yucatan. M. de Chazal, who has written an account of "*Le fibre d' Aloës*" (Mauritius, 1882) states (p. 21) "that "the plants generally pole at the age of seven or eight years; they can, "therefore, be cut four or five times before poling and before it is "necessary to replace them." On the same subject Mr. John Horne, F.L.S., late Director of Gardens and Forests in Mauritius, writes under date of 4th September, 1893, as follows: "The life of *Furcraea gigantea* "in Mauritius is from seven to 10 years . . . as many of the plants "flower three to four years earlier than others, the leaves of the seedlings "(or pole-plants) from these are fit for cutting when the late flowering "plants are dying out, so cutting once begun on a plantation may be said "to be continuous. . . . Supplying amongst old plants should be "done in time so that as the old ones die out cutting from the young ones "should begin. Over-cutting the leaves is common in Mauritius. This "is generally held to be injurious to the plants, weakening their growth "and causing them to flower and die prematurely. People in Mauritius

"say that by cutting only the mature leaves the growth of the plants is "not weakened, and thus large fine leaves are obtained, yielding long fibre "of the finest quality. But I have never heard the idea expressed that "such a manner of cutting prolonged the life of the plant beyond what "I might call the natural limits. It is said in Mauritius that over-cutting "weakens the plants and causes them to flower and die prematurely, so "it may also be said in Yucatan that cutting only the mature leaves pro- "longs the life of the plants to its natural limits. It comes to this, that "what is said not to shorten the life of the plants in Mauritius is said to "lengthen it in Yucatan—a case of arriving at the same place from "opposite directions."]

LIV.—WEICHER'S FIBRE EXTRACTING MACHINE.

[K. B., 1893, pp. 141–144.]

This fibre-extracting machine is constructed by J. J. Weicher, 108, Liberty Street, New York. It is now on trial in this country under Mr. Weicher's supervision at the Carlton Works, Printing House Yard, Hackney Road, London, N.E. The chief interest at the present moment attached to fibre machines is based on their capability to clean leaves of the Sisal Hemp plant, so largely planted at the Bahamas and elsewhere. This brief report is therefore almost entirely confined to the treatment of leaves of this sort.

Recently, accompanied by Sir Alfred Moloney, Governor of British Honduras, I accepted an invitation to see the Weicher machine at work on Agave leaves obtained from the Riviera. The leaves were those of *Agave americana*. They had been cut about a fortnight, and hence they were not in the best possible condition for being experimented upon.

The Machine.—The machine consists of a drum fitted with beaters, and a feeding table mounted on an iron frame about $14\frac{1}{2}$ feet long and $2\frac{1}{2}$ feet wide. The whole structure is of iron, fitted with beaters composed of a mixture of copper, aluminium and iron attached to the drum where it comes in contact with the juice of the leaves. The general principle of the machine is similar to the "Gratte" in use in Mauritius, and the "Raspador" of Yucatan. The leaves, as in these machines, are presented endwise, and are cleaned by the beaters attached to the drum. About one half of each leaf is cleaned at one time. It is necessary to change the position of the leaf before the other half can be cleaned. There is, however, no reverse action, and in this respect the Weicher machine possesses an advantage over other machines of the same type.

The Feed Table.—The feed table consists of an endless band composed of flat iron laths fastened across two iron chains. The band is fitted with iron clamps for holding the leaves in position and presenting them to the beaters in such a position that at first about one half of their length is cleaned. After this the leaf is carried continuously back on the underside of the band, and brought out so that it can be seized by the operator and its position changed. When it is next presented to the beaters, the uncleaned part is treated and the whole of the fibre is then carried out and removed from the machine. The feed table is therefore automatic, and it will carry at one time about

four or five leaves. These may be any length up to about eight feet, and the quickness of the cleaning depends very much upon the activity and aptness of the operators.

Serving the Machine.—For regular working a man and two boys are required. The man and one boy attend to the feeding and the changing of the leaves, while the other boy takes out the cleaned fibre and hangs it up to dry.

The Trial.—The machine was worked recently at intervals for about an hour. It readily cleaned Agave leaves of various sizes, some only half an inch thick and others between two and three inches thick. There is an arrangement of levers to allow for yielding in case of very thick leaves, and the machine was not clogged or stopped during any portion of the trial. This is an important consideration. The quality of the fibre produced was on the whole good. There was but little waste, and none of the strands was damaged or broken. The samples cleaned are now at Kew. Nothing has been done to them since they left the machine.

Washing the Fibre.—Where there is an abundant supply of fresh water, an arrangement could be made whereby the fibre might be washed while passing under the beaters. This, however, is not an essential part of the cleaning. It may be adopted or not according to local circumstances.

Particulars of the Machine.—The following particulars were obtained from Mr. Weicher. The total weight is 3,100 pounds (avoirdupois). The space occupied by the machine with feed table extended is $14\frac{1}{2}$ feet long by $2\frac{1}{2}$ feet wide. The power required is 10 horse-power, giving 500 revolutions per minute. The inventor has worked the machine in Yucatan for a period extending over nearly three months. One machine is still in Yucatan.

Yield of Fibre.—Mr. Weicher claims the machine will treat 10 to 12 tons of green leaves in a day of 10 hours. Allowing the leaves to yield 3 per cent. of fibre (in a prepared dry condition), this would be at the rate of 672 pounds per day as the lowest return, with a possible return (at 4 per cent.) of 896 pounds per day. As far as could be judged from the recent trial these returns are not improbable. It is, however, impossible to offer a definite opinion on the subject. The actual capacity of the machine can only be determined by continuous working on a Sisal Hemp plantation, and with operators who have become thoroughly accustomed to it. In a Report on the Sisal Hemp industry of Yucatan, prepared for the Government of the Bahamas by Captain E. Jerome Stuart [*Kew Bulletin*, 1892, p. 275], it is stated that the Weicher machine "requires 12 horse-power engine and the services of "three men. Capacity, 2,500 lbs. dry fibre per day of 10 hours." Mr. Weicher judiciously disclaims all responsibility for the capacity here given. He prefers to indicate it by saying that the machine will treat at the rate of 10 to 12 tons of green leaves per day. The actual yield in dry fibre will therefore depend upon the quality of the leaves. Mr. Weicher hopes to obtain as high as 5 per cent. of dry fibre from good leaves, and he thus estimates the out-turn per day of 10 hours at 1,120 to 1,340 lbs. These figures, it is needless to add, are given entirely on his authority. For comparison from actual working it may be mentioned that the Yucatan Raspador (with two men) acting on leaves of Sisal Hemp will clean about 400 pounds of dry fibre per day. On the other hand, the Mauritius machine (also with two men) acting on leaves of the Green Aloe (*Furcraea gigantea*) will turn out only about 214 pounds of dry

fibre per day. The difference in these returns may be due to the different qualities of the leaves, but it is evident that, so far, neither of these machines working on a commercial scale is able to turn out more than 400 pounds of dry fibre per day.

The conjectural figures given by Mr. Weicher require therefore to be received with due reserve until the performances of the machine have been fully tested.

Summary.—I may add that I have seen most fibre machines that have been brought forward and tested during the last 12 years. I am not yet in a position to say that any machine has fulfilled all the conditions necessary in cleaning Sisal Hemp fibre. The whole of the Mauritius hemp (from *Furcraea gigantea*) exported from that island is cleaned by the Gratte, locally made and costing about 30*l*. [*Kew Bulletin*, 1890, p. 98]. This has to be fed with one or two leaves at a time, and there is considerable waste. There is also some risk to the workpeople, who have to hold the leaves in their hands while they are being cleaned. The Yucatan fibre is chiefly, if not entirely, cleaned by the rough contrivance known as the Raspador, also a local machine [*Kew Bulletin*, 1892, p. 37, with woodcut]. The working of this is slow and wasteful, but with very cheap labour the industry is apparently very remunerative when prices are high. There is probably little or no inducement, owing to cheap labour, to introduce improvements in fibre cleaning in Yucatan. In the Bahamas the circumstances are entirely different, and a satisfactory machine is indispensable. The various machines that have hitherto sought to supplant the Gratte and Raspador, such as the "Death machine," the "Barraclough machine," and others, have all turned out better qualities of fibre, it is true, but the total yield has been small and disappointing. In fact, taking into account the great efforts made to introduce and popularise these machines, their extended use on a commercial scale has made little or no progress of late years. The Weicher machine possesses distinct merit, and it is more promising than any (so far as I have observed) with an automatic feed table. It may be said against it that it is somewhat heavy and intricate, and its price (not yet fixed) must be higher than either the Gratte or Raspador. It deserves, however, to be tried under suitable circumstances, and those interested in the fibre industry of the Bahamas, for instance, cannot do better than carefully test it on the spot. The inventor would then have an opportunity of showing its capabilities in the presence of an unlimited supply of leaves. It is impossible to do more in this country than form an approximate idea of its merits. It may be added that it is claimed for the machine that it will clean the leaves of Bow-string hemp (*Sansevieria*), Banana (*Musa sapientum*), and possibly also pine-apple and Ramie. None of these, unfortunately, were available at the recent trial.

D. M.

LV.—THE PRIETO FIBRE EXTRACTING MACHINE.

[K. B., 1893, pp. 329–330.]

In Captain Jerome Stuart's report on the fibre industry of Yucatan, already reproduced, mention was made of certain machines that were being tried for the purpose of extracting fibre from the leaves of

the Sisal Hemp plant or Henequen. An account of one of these machines, known as the Weicher Fibre Extracting Machine, now on trial in this country, is given in the last article. Another machine mentioned was the Prieto machine. Of this Captain Jerome Stuart gave the following brief particulars :—"The Prieto machine is manu-"factured by Puig and Negre, Barcelona, Spain. It requires 16 horse-"power engine and the services of two men and a boy. Capacity, "7,000 lbs. of dry fibre per day of 10 hours. Cost, 4,500 dollars." As the value of a machine depends so entirely on its capacity, it was desirable to obtain more precise information on this point. In the following letter received from the makers of this machine, it will be noticed that they claim that the machine will clean 100,000 leaves, and turn out from 5,833 to 5,960 pounds of dry fibre per day. These estimates of capacity prove how untrustworthy any figures must be that are not based on actual trial. In fact, it is impossible to attach any value whatever to such figures unless they are checked by some one having a thorough knowledge of the subject and perfectly unbiassed in his judgment :—

[Translation.]

Señor ROMAN ROMANO to ROYAL GARDENS, KEW.

Calle Fontanella 10, Barcelona,
November 12, 1892.

DEAR SIR,

Messrs. PUIG AND NEGRE have sent us the printed report by Captain E. Jerome Stuart, of the Bahamas, as well as your favour of the 2nd instant.

These gentlemen were the first makers of our machines for extracting fibre of Sisal and Henequen, but afterwards we set up in this city our works for making them, having already sent about 40 machines, "Prieto Hermanos" system, to the State of Merida de Yucatan (Mexico), where they are working perfectly with favourable results for the farmers who purchased them.

We have no photographs or drawings to send to you, but we forward an account of the work it does compared to the old grating wheels, power required, and price of the machine here for cash.

Hoping that this information will be useful to you for the Henequen plantations in the Bahamas,

I remain, &c.
(for ROMANO NORIEGA Y PRETO)
ROMAN ROMANO.

D. Morris, Esq., F.L.S.

COMPARATIVE STATEMENT of the difference between 12 of the present SCRAPING WHEELS (RASPADORAS) and the LA VENCEDORA MACHINE, system "PRIETO HERMANOS."

People employed in 10 hours' work.

La Vencedora.		12 *Raspadoras.*	
1	for the feeder.	20	scrapers (men).
2	„ carrying leaves.	7	carriers of leaves.
1	„ receiving the fibre.		
2	„ carrying it to drying room.	4	people to carry to drying room.
2	„ collecting the waste.	7	„ to collect waste.
8	total people employed.	38	total people employed.

The difference in favour of the La Vencedora machine is therefore 30 men.

Production of Fibre.

La Vencedora.	12 *Raspadoras.*
100,000 leaves scraped in the machine give from 230 to 235 arrobas (5,833 to 5,960 lbs.).	100,000 leaves scraped in 12 raspadoras give from 165 to 170 arrobas (4,185 to 4,311 lbs.).

Difference in favour of the La Vencedora machine equals 65 arrobas (1,648 lbs.) increase per day. Cash price for machine in Barcelona, 4,500 Spanish dollars (928*l.* 2*s.* 6*d.*) Power, 12 to 16 horse-power (steam). Water is not required to wash the leaves. Total weight of the machine, 9,500 kilogrammes (9 tons 7 cwts.).

(Signed) ROMAN ROMANO,
Barcelona.

LVI.—SISAL HEMP IN THE BAHAMAS

[K. B., 1894, pp. 189–190.]

The following information respecting a machine for extracting the fibre from leaves of *Agave rigida*, var. *sisalana*, grown in the Bahamas, will prove of considerable interest. The machines hitherto tried to extract this fibre have not realised expectations, and some anxiety has in consequence been felt in regard to the future of this important fibre industry. The plantations established in the Bahamas are now arriving at such a stage that a successful machine to extract the fibre is a matter of the greatest importance. The information supplied to the Colonial Office by His Excellency the Governor, would appear to show that the "Todd" machine has, so far, proved so satisfactory that it is likely to be universally adopted in the Colony :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

Downing Street, May 19, 1894.

SIR,

WITH reference to your letter of the 7th July 1893, I am directed by the Marquis of Ripon to transmit to you a copy of a despatch from the Governor of the Bahamas reporting upon a fibre-extracting machine which is now in successful operation in that Colony.

Lord Ripon proposes to forward a copy of Sir Ambrose Shea's despatch to the Governor of Fiji, and his Lordship would be glad if you would be good enough to add any observations which would be likely to be of assistance to Sir John Thurston.

I am, &c.
(Signed) EDWARD WINGFIELD.

The Director,
Royal Gardens, Kew.

GOVERNOR OF THE BAHAMAS to COLONIAL OFFICE.

Government House, Nassau, N.P.,
24th April 1894.

MY LORD,

WITH reference to communications, verbal and otherwise, that I have received from the Colonial Office during the past three years, on the subject of machines for the extraction of fibre, on which information was desired for the Fiji Government, I have now the honour to acquaint

your Lordship that I am at length in a position to speak definitely of a machine that is now in successful operation in this Colony.

2. The machine in question is one manufactured by a Mr. Todd, of New York (address, Mr. J. C. Todd, Patterson, New Jersey, U.S.A.), and during my late visit to the Munro plantation in Albaco, I witnessed its performance, and have no doubt it will be universally adopted here. It dresses the fibre perfectly and with a minimum amount of waste, and though half a ton is all that a single machine will yield in a day's work, the principle is so sound that all that is necessary is to increase the number to meet any required need.

3. I may observe, however, it does not necessarily follow that the "Todd" machine will be suitable where the conditions of the plant are not similar to ours. I am not informed of the nature of the plant at Fiji, but it may be instructive to know that the leaves of the Bahama plant which hold the fibre are from four to six feet long, that they are free from gum, and the threads separate without combing. Little washing is needed, and the whole process of extracting, washing, and drying is the work of one day.

I have, &c.
(Signed) A. SHEA,
Governor.

The Most Honourable
The Marquess of Ripon, K.G..,
&c., &c., &c.

An account, with an illustration of the "Todd" fibre extracting machine, is given by Mr. Charles Richards Dodge in Report No. 5, "On the Leaf Fibres of the United States," issued by the Department of Agriculture in 1893, pp. 25–26. Mr. Dodge states :—

"The only new machine for cleaning Sisal hemp leaves that has been brought to my attention, since the publication of my previous report, is the device patented in 1892 by J. L. Acosta, and manufactured by Joseph C. Todd, Patterson, N.J.

"The claims of the inventor are set forth as follows :—

"'In Fig. 3 is shown clearly the arrangement of the machine for cleaning henequen leaves without the use of crushing cylinders. The operator seats himself before the table and lays the leaves on the feeding chains. Care should be taken to lay the thick ends of the leaves to the right side, with something more than half of the length of the leaf hanging down. The chains will then carry the leaves to the holding belts, by which they will be presented to the first scraping wheel. The leaves having been cleaned for the greater part of their length by the first wheel, a device placed between the two scraping wheels transfers the clean portion of the fibre to the second holding belt, and the remainder is cleaned by the second wheel, leaving no uncleaned or partially cleaned portions in the middle, as is usual in other machines. The leaves of the Pita plant need to be crushed by finely corrugated cylinders in order to separate the fine fibres of the back of a leaf. They should be crushed and scraped while still green and fresh, so that the cleaning may be assisted by the juices of the leaves. Knives or scrapers and brushes in alternation around the wheels are indispensable. It is also desirable to have a pump to furnish water to two small tanks fixed above the upper belts of both wheels. The water flows from these tanks to spread the leaves on the surface of the shoes and to clean and wash the fibres. Otherwise the fibres may be cleaned and washed after being scraped, if it is desirable to avoid the expense of the pump and tanks. With a single man to put the leaves on the feeding chain, and a

boy to take away the clean fibre from the end of the machine, it is capable of cleaning thoroughly 50,000 to 60,000 leaves in a day.'"

Mr. Dodge adds :—

"I have not seen this machine running on Sisal hemp leaves, but witnessed its work on the leaves of bear-grass (*Yucca filamentosa*) furnished by the Department, the cleaning being accomplished in a thorough manner."

LVII.—SISAL HEMP IN THE BAHAMAS.

[K. B., 1894, pp. 412–414.]

The gradual development of the Sisal hemp industry in the Bahamas continues to be watched with a good deal of interest. It is now in a position when exports of prepared fibre have begun to be made and its value quoted as a regular article of commerce. An important statement on the subject (in continuation of that in *Kew Bulletin*, 1894, p. 189) is contained in the following extract from the Annual Report on the Bahamas for 1893, submitted by the Governor, Sir Ambrose Shea, to the Secretary of State for the Colonies [*Colonial Reports*, Annual, No. 110, 1894].

The export of Bahama hemp amounted in 1893 to 1,200*l.* as against 692*l.* in 1892. The area of Crown land now disposed of is 85,000 acres, while about 15,000 acres of private land are also in course of cultivation. The quantity planted at the end of 1893 was 17,000 acres and an annual increase of about 6,000 acres will be the rate of progress. The history of the origin and growth of this industry has so often been written that but little remains to be said in that regard. It will, hereafter, be a record of increasing development and social advancement which results now appear to be as assured as is possible in the course of human events. As far as the welfare of the Colony is concerned there seems to be the minimum of uncertainty, for it is not conceivable that the value of the fibre can go below the cost of production, though the profit, as in the case of all commercial enterprises, must ever be an uncertain and varying quantity. The export of 1893 was far below the expectations, though not from want of an ample supply of the raw material.

The shortcoming was due to several causes. In the first place the most advanced plantation, in which an American syndicate is interested, was almost entirely neglected owing to the financial troubles in the United States, and the low price of the fibre, consequent in a great degree on the money stringency which lessened the desire to prepare the product for market. The business was also much delayed by disappointment in the matter of the scutching machines, which in many cases proved useless. It is highly satisfactory to know that this difficulty is now over, for a machine manufactured by the Todd Company of New York has been at length found to work admirably, the fibre being cleaned perfectly, at the smallest possible amount of waste (*Kew Bulletin*, 1894, p. 189). There can be but little doubt that this machine will be universally adopted, as, besides its efficiency, it is cheaply operated—a woman to feed the machine with leaves, another to remove the finished fibre, being all the labour attendant on this process. It has been for some time a subject of much thought as to how the small cultivators were to utilise their labour where, as in the great majority of

cases, they were too poor and their plantings too limited to admit of the cost of a machine. A satisfactory solution, however, has now been found which will be a great boon to this class and will bring the blessings of the industry home to the humblest peasant in the Colony. The process is as simple as it is available to all, and consists of a slit being made in the thick end of the leaf, when it is torn asunder, leaving the inner part exposed, and by then soaking it in salt water, which is never far to reach, in about a week the pulp may be removed by hand and the fibre preserved. No waste whatever is found in this method; and it is understood that a man or woman, or grown boys or girls, may turn out from 50 to 60 pounds of fibre as the result of a day's work. The plan is being adopted throughout the Colony, and what was for some time deemed a missing link is thus effectively supplied.

There has always been a certain amount of speculation as to the effects of hurricanes on the fibre fields, and though the plants are so hardy, the idea was in some degree a disturbing one. The question has now been satisfactorily tested. In August last, as well as in October, the Bahama Islands were visited with hurricanes which did considerable damage to various kinds of property. In one or two cases fibre fields, by unusual rising of the tides, were laid under water, and it was supposed that in these instances much injury had been done to the plants. In all other fields, though exposed to the force of the storm, the plants escaped without any injury, and their power of resistance was thus established. But even in the submerged fields, the damage proved eventually to be trifling. The leaves were much knocked about, but they finally recovered to a great extent, and they are now being dressed, producing a fibre not much inferior to the best, but classed as No. 2, because of some small spots being discoloured which detracts from the appearance, though not, it is believed, from the strength of the article.

Labour continues in good supply and is not likely to be a cause of difficulty for many years. Railways are being laid down in the principal estates, and this will be found a most profitable investment in saving labour on the carriage of the leaves to the dressing establishment, 100 pounds of leaf yielding not more than four or five pounds of fibre. Of the large plantations one has over 5,000 acres under cultivation, one about 3,000, one 2,000, and two others 1,000 acres each. The smaller farms are from 200 to about 700 acres. Now that a standard scutching machine has been accepted exports should go forward moderately in 1894, but on a large and increasing scale in the following and future years.

The generally accepted standard of 600 plants to the acre is now in many cases being changed to 800 and in some instances to 1,000. If this increased number be not found to impede harvesting by the inconvenient crowding of the plants, the yield per acre should, of course, be largely augmented. The estimated annual yield of a single plant is two pounds of fibre, and thus, instead of a return of 1,200 lbs. from the earlier planting of 600 suckers, assuming that the results are not modified by want of room for the full development of the plants, 2,000 lbs. will be the expected yield where 1,000 plants are given to the acre.

(Signed) A. SHEA.

[NOTE ADDED, Aug. 31, 1898.—The latest information in regard to Sisal hemp in the Bahamas is contained in the Sisal industry, by D. Morris, C.M.G., D.Sc., 1896. *Colonial Reports, Miscellaneous*, No. 5. *Bahamas*. Since that time the price

of the fibre has steadily risen. During the present year it has reached 33*l*. per ton. It should be borne in mind by all interested in the industry that the market for this fibre is liable to considerable fluctuation. Hence the cost of production must be kept within the narrowest possible limits. It is believed that under very favourable instances and the exercise of great economy Sisal fibre could be produced in the Bahamas at a cost of about 6*l*. per ton. If this were accomplished there would always be a profit on the lowest prices yet reached.]

LVIII.—SISAL CULTIVATION IN THE TURKS AND CAICOS ISLANDS.

[K. B., 1896, p. 119.]

The steps taken to establish a fibre industry in these islands were described in the *Kew Bulletin*, 1890, pp. 273–278. The plants under cultivation were determined at Kew to be identical with those grown in the Bahamas (*Agave sisalana*). A further account of the industry was given in the *Kew Bulletin*, 1892, pp. 31 and 32. In the following extract from a letter addressed to the Commissioner, Turks Islands, the Assistant Commissioner reports that the plants are in excellent health, and the only difficulty is the want of sufficient machines to clean the leaves as they arrive at maturity. Since this report was written it is stated that machines have been introduced, and the export of fibre is likely to be greatly increased :—

EXTRACT from a letter from the Assistant Commissioner, Cockburn Harbour, to Commissioner, Turks Islands, dated 31st December, 1895 :—

"Of the Sisal industry I cannot say much. At West Caicos it would seem, if output be the criterion, much is not being done : what is, would appear to be directed to weeding, clearing and systematic cultivation, rather than to shipment of the clean baled products. A limited number of the Blue Hills or Providence Cays people here get employment.

"In my recent visit to the scene of the wreck of the steamship 'Dorian' I travelled day after day for a week through these great stretches under cultivation by the East Caicos Fibre Company, a succession of regular well-ordered tracts of some 1,200 acres in all. The growth and stages of maturity clearly enough mark the different yearly plantings with ample roads and plant space.

"The crop is far the finest I have ever seen in the Bahamas. I visited the cleaning sheds ; the machinery is not equal to a third of the work to be done. There are very many leaves fit for cutting that lie untouched, and there are more plants poling than one would wish to see. I suppose that the condition of the market governs the business, but certainly there are scores of acres that require cutting.

"The labour afforded at Jacksonville in this hard year helped very considerably to alleviate the prevailing distress of the out-islanders."

In the Colonial Office Reports, No. 174, of 1896, it is stated that :—

"The export of sisal or Bahama hemp from the Turks and Caicos Islands is gradually on the increase, the value declared for 1895 being 620*l*. With the additional and improved machinery recently put up by each of the two companies engaged in this business, the output will probably be much larger."

LIX.—FALSE SISAL OF FLORIDA.

(*Agave decipiens*, Baker.)

[K. B., 1892, pp. 183–184.]

In the preceding pages a general account is given of the Sisal Hemp industry, and particulars of the distribution of Sisal Hemp plants in nearly every part of the world. In the description of the plants found in Florida it was pointed out that the bulk of these consisted of the best sort for fibre (*Agave rigida*, var. *sisalana*), in every respect similar to the plants now so largely planted in the Bahamas, Turks Islands, Jamaica, and elsewhere. Amongst the Florida plants Mr. Charles Richards Dodge, of the United States Department of Agriculture, found here and there some plants which were evidently not true Sisal. For instance, "at Juno, about "ten miles further south (from Jupiter), at the head of Lake Worth, "I found another fine nursery of perhaps a hundred thousand plants, the "property of Mr. A. M. Fields, who is quite enthusiastic on the subject. "Fully fifty per cent. of his plants are not *Agave sisalana*, however, "but a species which was subsequently met with at many points along "the east and west coasts as well as on the Keys—doubtless *Agave* "*mexicana*."* At the time this was quoted in the *Kew Bulletin* it was stated that probably this determination would require to be verified. Since that time abundant material has been received at Kew from Florida from Mr. Richard Dodge, and there is no doubt that the plant which he had provisionally taken to be *Agave mexicana*, and mentioned in his report under the name of "False Sisal," was an entirely new species. In a letter dated April 27, 1892, forwarding specimens, Mr. Richards Dodge states :—

"Department of Agriculture, Washington,
April 27, 1892.

"I have just received from Biscayne Bay, Southern Florida, some blossoms of my so-called 'False Sisal,' accompanied by mature leaves taken from the same plant. One of these I send you by mail to-day, the others being in a semi-decayed condition and unfit to send. This is the normal length of the leaves found throughout the Biscayne Bay region and along the line of Keys. Those at Lake Worth, which is very near to Jupiter, I found with leaves at least a foot longer, in rare instances two feet longer, though preserving the same characteristics. I send you with this a few blossoms, together with a sample of true Sisal Hemp, and another of false Sisal for comparison with it. As you will see, one is a strong, good fibre, the other is not more than half as strong, and of different appearance."

These and other specimens have enabled Mr. J. G. Baker, F.R.S., the Keeper of the Herbarium at Kew, to draw up the following description of the plant :—

AGAVE (EUAGAVE) DECIPIENS, BAKER.

Caudice demum 3–4-pedali, foliis dense rosulatis ensiformibus rigidis demum 4-pedalibus utrinque levissimis viridibus infra medium ad apicem sensim angustatis, facie sæpissime concavis, spinâ terminali pungente breviter decurrente, aculeis marginalibus parvis atro-castaneis

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* Sisal Hemp Culture in the United States. Fibre Investigations. Report No. 3. 1891, p. 41.

deltoideo-cuspidatis, floribus in paniculam amplam thyrsoideam dispositis, ovario oblongo, perianthii tubo brevi late infundibulari, lobis tubo duplo longioribus, staminibus longe exsertis, stylo staminibus demum æquilongo.

Hab. Florida, Biscayne Bay, and Lake Worth. For all the material from which the plant is described we are indebted to C. R. Dodge, Esq., the special agent for fibre investigations of the United States Department of Agriculture. It is the plant "supposed to be *A. mexicana*," figured on plates 7 and 8 of his report, No. 3, issued May 1891.

Caudex reaching a length of 3–4 feet, whilst *A. sisalana*, over the same area, remains nearly acaulescent. *Leaves* densely rosulate, very rigid, ensiform, reaching a length of 4 feet, broadest a little below the middle, where they reach $3\frac{1}{2}$–4 inches, narrowed very gradually to the horny brown pungent point, which is $\frac{1}{2}$–$\frac{3}{4}$ in. long, and decurrent as a narrow brown-black line along the edge of the leaf for 3–4 inches, narrowed also to a point above the dilated base, where they are $2\frac{1}{2}$ in. broad, very smooth and apple-green on both surfaces, not distinctly glaucous even when young, usually very concave all down the face and convex on the back, rarely flat; marginal prickles moderately close, deltoid, cuspidate, brown-black, not more than a line long.

Peduncle with panicle about five times as long as the leaves. *Panicle* 8–10 feet long, with a rather flexuose axis, and usually single dense clusters of flowers terminating the laxly-disposed simple arcuate branches.

Flowers arranged in dense clusters. Ovary oblong, finally 2 in. long, $\frac{3}{4}$ in. diam. *Perianth* greenish-yellow, an inch long; tube broadly funnel-shaped; lobes complicate lanceolate from a dilated base, twice as long as the tube. *Stamens* 18–21 lines long, inserted at the middle of the perianth tube; anthers linear, $\frac{1}{2}$ in. long. *Style* finally reaching to the top of the stamens.

Belongs to the section *Rigidæ* and nearly allied to *A. rigida* var. *elongata*, Jacobi, from which it differs by its longer caudex and concave-faced leaves, which are very smooth on both sides, and not at all glaucous even when young, broadest below the middle, and narrowed very gradually to the hard point, which is decurrent for a short distance as a narrow brown-black border. The fibre which it yields is very inferior in tenacity to that of *A. sisalana*. I cannot make out any material difference between the flowers of the two species. The name *decipiens* refers to the plant being confused so easily with the forms of *A. rigida*, of which the fibre is so much more valuable that it would lead to loss and disappointment if it were cultivated for economic use.

J. G. BAKER.

LX.—BOMBAY ALOE FIBRE.

(*Agave vivipara*, L.)

[K. B., 1890, pp. 50–54.]

The high prices lately obtained for white rope fibres have stimulated their production in nearly every part of the world. The chief supplies of these fibres have hitherto been obtained from the Philippines under the name of Manila hemp (yielded by *Musa textilis*, see page 95),

and from Yucatan under the name of Sisal hemp (yielded by one or more varieties of *Agave rigida*, see page 130). Quite recently a fibre of a somewhat similar character made its appearance in this country under the name of "Bombay Aloe fibre." This was very imperfectly prepared, and the price obtained for it was exceptionally low. In fact, had it not been for the relatively large demand for white rope fibres during the last two years this Bombay Aloe fibre would be unsaleable at a price that would hardly cover the cost of freight.

A specimen of Bombay Aloe fibre was presented to the Museums of Economic Botany at Kew by Messrs. Ide and Christie in 1888, and this led to an inquiry respecting the plant yielding it. Application was made to the India Office to obtain specimens of the growing plants and for information respecting the methods adopted for preparing the fibre. By the action of the Secretary of State for India in Council, the plants and full particulars respecting the preparation of the fibre have now been received at Kew. It appears that Bombay Aloe fibre is prepared from the leaves of *Agave vivipara*, L., in a crude manner by natives, and so far no attempt has been made to establish regular plantations.

Agave vivipara, L. (Wight Icones, t. 2024; *A. Cantula*, Roxburgh, Flora of India, vol. ii., p. 167), the "Bastard Aloe" of India, is a native of tropical America, but now found widely spread through various parts of the Old World. It is said to be commoner in Upper than in Lower India, and especially in the North-West Provinces. It is almost unknown in Bengal (Watt, Dict. vol. i., p. 143). Although resembling *A. americana* somewhat in habit, it is more closely allied to *A. lurida*. The dull green leaves are from 4 to 5 feet long, rather narrow and concave, thin but firm in texture, ending in a brown spine about half an inch long. The teeth are sub-distant, brown and hooked, $\frac{1}{2}$ to 1 inch long. The flowers, borne upon a tall branched flowering stem, about 20 feet or more in height, are greenish yellow. The specific name of the plant is derived from the fact that the flowers are often changed into bulbillæ; these grow into plants with leaves from 6 to 9 inches long before they fall and take root. "Royle states that on a rich soil the plant is vivi-
"parous, while on a poor stony soil, and under a dry climate, seeds
"alone are produced."

The utilisation of *Agave vivipara* as a fibre plant on a large scale is apparently of a very recent date. Dr. Watt, in a notice of the species, does not refer to it as the origin of Bombay Aloe fibre, and apparently he was unacquainted with the fact. The only reference to the fibre is as follows:—"The *Oudh Gazetteer* says it is chiefly grown as a hedge
"(plant) to keep back cattle, but in the jails good fibre is prepared
"from its leaves." *Dict. Econ. Prod. India*, vol. i., p. 143 (1887).

As already mentioned, the Bombay Aloe fibre received in this country is so badly prepared that it is practically unsaleable. About 200 tons were received in 1889, and we are informed by Messrs. Ide and Christie that the stocks of former shipments have now accumulated to the extent of 1,000 tons. The prices quoted are, good 12*l.*, common 5*l.* per ton. As the result of investigations detailed in the following correspondence, it appears that the fibre of *Agave vivipara*, though perhaps not so good in all respects as that derived from varieties of *Agave rigida*, is intrinsically of considerable merit. If properly cleaned it would command relatively high prices. A specimen of fibre from *Agave vivipara*, cleaned in this country by the Death machine, has been valued at 25*l.* to 30*l.* per ton. The difference between 12*l.* and 30*l.* per ton, due entirely to the mode of cleaning this fibre, is a fact that needs no comment.

ROYAL GARDENS, KEW, to INDIA OFFICE.

Royal Gardens, Kew,
February 21, 1889.

SIR,

I AM desired by Mr. Thiselton-Dyer to inform you that a specimen of white fibre, known in commerce as "Bombay Aloe fibre," has been lately presented to the Kew Museum of Economic Botany.

2. From the character of the fibre it would appear that this is obtained from *Agave americana* or an allied species, and rudely prepared by hand. The price of this fibre is from 15*s*. to 18*s*. per cwt., while Sisal hemp obtained from *Agave rigida* is selling at 52*s*. to 54*s*. per cwt.

3. It is very desirable to trace the source of this Bombay Aloe fibre. For this purpose it is necessary to obtain specimens of the plant yielding it.

4. Mr. Thiselton-Dyer is of opinion that as the Bombay fibre industry is apparently an established branch of trade, its value might be greatly increased by the introduction of plants yielding the true Sisal hemp, and by improvements in the preparation. The subject is of considerable importance at the present time, as white fibres are in great demand and sell at high prices.

5. I am therefore to suggest that the Government of India should b moved to procure and forward to Kew specimens of leaves or sm:" plants from which the present Bombay Aloe fibre is obtained, and full information as to the preparation and shipping of the fibre. On receipt of these Mr. Thiselton-Dyer will be happy to furnish a report on the subject, which may assist the Government of India in developing what may prove an important native industry.

I am, &c.
(Signed) D. MORRIS.

J. A. Godley, Esq., C.B.

INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.
March 23, 1889.

SIR,

I AM directed by the Secretary of State for India in Council to acknowledge, with thanks, the receipt of your interesting letter of the 21st ultimo, on the subject of the true source of the "Bombay Aloe fibre" of commerce, and to inform you in reply that a copy of the same has been forwarded to the Government of Bombay for their information and guidance.

The specimens and information for which you ask will at once be transmitted to you on receipt from Bombay.

I am, &c.
(Signed) J. A. GODLEY.

The Director,
Royal Gardens, Kew.

INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.,
January 21, 1890.

SIR,

IN continuation of my letter of the 23rd March last, I am directed by the Secretary of State for India in Council to forward herewith a copy of a letter dated 13th December 1889, with its enclosure, from the Government of Bombay on the subject of the "Bombay Aloe fibre" of commerce.

The box of specimens referred to has been forwarded separately to your address by carrier.

I am, &c.
(Signed) C. E. BERNARD,
Secretary,
Revenue and Statistics Department.

The Director,
Royal Gardens, Kew.

[Enclosure.]

ACCOMPANIMENT to the Bombay Government Despatch to Her Majesty's Secretary of State for India in Council, No. 52, dated 13th December 1889.

Report by the Officiating Director, Land Records and Agriculture, No. 2262, dated 23rd November 1889 :—

Undersigned has the honour to forward by rail a box containing six young shoots (useful for planting) and a full grown plant of *Agave vivipara*, the common species of Agave grown in the Bombay Presidency.

2. The Aloe fibre shipped under the name of "hemp" [or Aloe fibre] from Bombay comes chiefly from the Bombay Karnátak and the Central Provinces. It is not possible to ascertain from the trade returns details of the export trade in the Aloe fibre.

3. The Bombay Aloe fibre is prepared from *Agave vivipara*, *Agave americana* being rare. The plant grows wild, but nowhere in abundance. Nor is it anywhere cultivated specially for extracting fibre. It is chiefly used as a hedge plant in making live fences. As a hedge plant it is preferred to Cactus [*Opuntia*] and Milk-bush [*Euphorbia*]; and though it requires a greater breadth than other hedge plants, it is reported to be not injurious to plants in the vicinity. It grows well near watercourses, and this habit of the plant is put to profitable account by using it for live fences along boundaries of survey numbers which are subject to a rush of water. In such places it is planted close with a view to allow water only to pass through the fence and retain silt. When planted sufficiently close it serves as a dam and prevents entrance of rain-water of neighbouring fields. In the Bombay Karnátak it is the chief hedge plant along railway lines. For fencing it is planted 1 to 3 feet apart, according to the quality of the soil.

4. It is a plant of slow growth, and takes about two years before the leaf can be cut for fibre. Its slow growth is one of the drawbacks which prevent the plant from being cultivated for fibre. The leaves are cut from the stem and split lengthwise into thin shreds about half an inch wide, and bound in sheaves. In some places before they are bundled the shreds are dried in the sun for about four days. The sheaves are then kept soaking in a running brook, under a weight, for a week or ten days, and sometimes more, or buried in sand near the current of water in stream and river beds wherein water percolates. When sufficiently decomposed, the leaves are taken out and washed clean of the pulp by beating them in running water with wooden mallets, or against a stone. After washing, what remains is fibre. In Bijápur the fibre is sometimes separated by drying the leaves and beating them with wooden mallets.

5. Much of the fibre is made into ropes, which are chiefly used in agricultural operations. The manufacture is in the hands of Mángs and other depressed castes, who make ropes of hemp, coir, &c. Kimbis or cultivators seldom take to rope making. In the Karnátak, Advichinchers, a wandering tribe, have of late taken to rope-making.

Royal Gardens, Kew, to India Office.

Royal Gardens, Kew,
February 14, 1890.

Sir,

With reference to my letter of the 21st February 1889, and subsequent correspondence on the subject of Bombay Aloe fibre, I am desired by Mr. Thiselton-Dyer to inform you that the specimens of plants from India, advised in your letter of the 21st ultimo, have been duly received at Kew.

2. These specimens confirm the fact that the Bombay Aloe fibre of commerce is prepared from the leaves of *Agave vivipara*, L., an American species of Agave now widely distributed throughout subtropical and tropical parts of the Old World and some parts of India. From the interesting report of the Officiating Director of Land Records and Agriculture (Bombay), we gather that the fibre is extracted by certain depressed castes of natives by very crude and destructive methods, and that so far no attempt has been made to cultivate the plant for fibre. They are chiefly used as hedge plants, and are "nowhere at present in abundance."

3. It is evident, however, that the plants exist in Bombay in sufficient quantity to supply several hundred tons of fibre received in this country. After a consideration of the facts noted below, it might be found advisable to cultivate this species of Agave on waste lands in Bombay entirely for the sake of its fibre; or the Sisal hemp plant, *Agave rigida*, var. *sisalana* might be introduced on a large scale. This latter yields the most valuable fibre of any derived from species of Agave, and there is little doubt it would thrive equally well in India. The important fibre industry of Yucatan, created entirely within the last 20 years, is now of the annual value of about three-quarters of a million sterling. India has, therefore, good grounds for devoting attention to an industry which so far has established itself on a moderate scale in spite of adverse circumstances.

4. In order to test the quality of the fibre produced by *Agave vivipara* when cleaned by machines similar to those in use for the preparation of Sisal hemp in Yucatan and the West Indies, a few of the broken leaves about a foot to two feet in length, taken from the larger plant received at Kew, were forwarded to the Death's Fibre Machine Company, 147, Leadenhall Street, E.C. A sample of the fibre obtained by passing the leaves through the Death machine is forwarded herewith (marked A); while, for purposes of comparison, a sample of the ordinary Bombay Aloe fibre, as it comes into the London market direct from India, is also enclosed (marked B).

5. The great difference in quality and value between these two samples are well given in a report prepared by Messrs. Ide and Christie, a copy of which is herewith attached. The value of the machine-cleaned fibre ranges, according to length, from 25*l.* to 30*l.* per ton. The ordinary Bombay Aloe fibre, cleaned by hand, is worth only from 5*l.* to 12*l.* per ton. These figures fully bear out the opinion offered in my letter of the 21st February 1889, that the Bombay Aloe fibre industry was capable of being greatly improved. At the present time there are in stock in this country 1,000 tons of Bombay Aloe fibre, which, prepared roughly by hand, will only realise (if sold) about 8,000*l.*, a price that will probably hardly pay expenses. If this fibre had been cleaned by machinery, and presented in the condition of the sample marked A, it would realise about 27,000*l.*, or more than three times its present value. It appears possible, therefore, without any extension of the present Agave plants

in Bombay, to increase to a very appreciable extent the return on the shipment of Aloe fibre from the Presidency.

6. Mr. Thiselton-Dyer has little doubt that the facts herein stated will prove of considerable interest to the Government of India, and they deserve to be widely known amongst those concerned in the Bombay Aloe fibre industry.

I am, &c.

J. A. Godley, Esq., C.B. (Signed) D. Morris.

[Enclosure.]

Messrs. Ide and Christie to Royal Gardens, Kew.

72, Mark Lane, E.C.,
February 6, 1890.

Dear Sir,

We have your favour of the 4th inst, with samples of fibre extracted by Death's process from the leaves of *Agave vivipara*. This in an excellent fibre, of fair strength, fine colour (which, however, may change somewhat under continued exposure to the air), and were it *three* times as long would be worth 30*l*. per ton to-day in London; if *twice* as long 27*l*.; and, as it is, it may be valued at 25*l*.

The ordinary "Bombay Aloe" of commerce presents a very different appearance to your specimen, as, perhaps, samples in your Museum may show. Its value to day is *good* 12*l*., *common* 5*l*. per ton.

Yours, &c.

D. Morris, Esq., M.A., F.L.S. (Signed) Ide and Christie.

LXI.—BOMBAY ALOE FIBRE.—(continued.)

(*Agave vivipara*, L.)

[K. B., 1892, p. 283.]

In the previous article, an account is given of a fibre known in commerce as Bombay Aloe Fibre prepared from *Agave vivipara*. It appears that there is a variegated form of this plant in India, and recently through the kindness of Mr. G. Marshall Woodrow, Lecturer on Botany at the College of Science, Poona, several living specimens were obtained for the Kew collections. In forwarding the specimens Mr. Woodrow supplied the following interesting information :—

Mr. G. Marshall Woodrow to Royal Gardens, Kew.

College of Science, Poona,
May 19, 1892.

Dear Sir,

In reply to your letter of the 23rd April, I have the pleasure of intimating despatch by parcel post of a box containing nine *Agave vivipara variegata* plants, with a mature leaf, and a branch with flowers of the typical plant of this variety.

There are two distinct forms of *Agave vivipara*, one has leaves attaining $4\frac{1}{2}$ feet in length by $2\frac{1}{2}$ inches in breadth at the broadest part, which is near the centre; the other attains $2\frac{1}{4}$ feet in length, but is generally much shorter, it is of the same breadth as the other variety but somewhat thicker. The flowers are the same in both. The Marathee name is *Guial*.

The plant you refer to as having been received from the Bombay Government in 1890 is of the long-leaved variety; the one I send now is a variegated form of the short-leaved variety, it is a very ornamental plant.

I will be glad to send you a large number if you can make use of them, and can give a small plant of the Sisal Hemp in exchange; such plants thrive in this climate. I have lately received two very small offsets of a plant said to be Sisal Hemp, but I am doubtful of their identification.

The two varieties of *Agave vivipara* are grown as fences occasionally throughout South India, but are not found in forest lands or grown as field crops. I made experiments in growing the long-leaved variety as a field crop some years ago, but found that at the then price of the fibre it would be very unprofitable to grow this crop where Sunn (*Crotalaria juncea*) or Ambadee (*Hibiscus cannabinus*) would thrive.

I am much interested in your statement that *Agave vivipara* is the Bombay Hemp. That name is not known here, I presume it is the London market name. I had not learned it, as the *Kew Bulletin* does not reach me, except the part that gives the list of seeds available for distribution.

Yours, &c.

The Director,
Royal Gardens, Kew.

(Signed) G. MARSHALL WOODROW.

LXII.—MANILA ALOE FIBRE.

(*Agave vivipara*, L.)

[K. B., 1893, pp. 78–80.]

This is the commercial name given to a fibre exported from Manila in moderate quantities, but quite distinct in its character and origin from the Manila hemp of commerce. This latter is, as is well known, obtained from a wild banana of the Philippines *Musa textilis*. The origin of the Aloe fibre was apparently unknown. It was, however, regularly met with in commerce, although the price realised for it was always much below that paid for various sorts of Manila hemp.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
October 8, 1890.

SIR,

I AM desired by Mr. Thiselton-Dyer to inform you that a sample of "Manila Aloe Fibre" has recently been presented to the Museums of Economic Botany at Kew, and a portion of this sample is enclosed herewith. This Aloe fibre comes regularly into the London market, and is quoted as worth about 14*l*. to 16*l*. per ton.

2. The plant yielding this fibre does not appear to be known in this country. It is evidently quite distinct from *Musa textilis*, yielding ordinary Manila hemp. Probably it is a species of *Agave*, allied to that yielding the Sisal hemp of commerce.

3. In order to determine the plant exactly, Mr. Thiselton-Dyer would be glad if the Secretary of State would approve of a reference being made on the subject to Her Majesty's Consul at Manila, with a request that one

or two moderately large leaves of the plant be forwarded in a dry box to this establishment. In the case of Agave leaves, it may be mentioned that they travel very well if packed in a perfectly dry state without soil or any other material. If the box is pierced with holes to afford ventilation all the better. It would add to the interest of the specimens if the Consul could add a few words in regard to the methods employed in preparing the fibre.

I have, &c.
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.,
Foreign Office.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

Foreign Office, July 7, 1891.

SIR,

WITH reference to your letter of the 8th of October last, I am directed by the Marquis of Salisbury to request you to inform Mr. Thiselton-Dyer that Her Majesty's Consul at Manila reports that he has forwarded to Kew Gardens, under the charge of Captain Wilson, of the ss. "Barden Tower," a small box containing a few leaves of the Manila Aloe plant (Maguay).

I am, &c.
(Signed) JAMES FERGUSON.

The Assistant Director,
Royal Gardens, Kew.

Mr. Consul GOLLAN to ROYAL GARDENS, KEW.

British Consulate, Manila,
May 20, 1891.

SIR,

I BEG to inform you that, under directions from the Foreign Office, I, this day, forward to you a small box containing four leaves of the Manila Aloe (Maguay), which I trust may arrive in good condition and answer the purpose you have in view. I enclose a few notes from Mr. Osmond, a gentleman who is a considerable expert in such matters, as to the preparation of the fibre.

I send, in the same box, a small specimen of rope of great strength and durability made from another fibre called "Cabo Negro."*

I am, &c.
(Signed) ALEX. GOLLAN,
Her Majesty's Consul.

W. T. Thiselton-Dyer, Esq., C.M.G., F.R.S.,
Director, Royal Gardens, Kew.

[Enclosure.]

PREPARATION OF MAGUAY FIBRE.

The leaf is first soaked in water until it becomes quite soft and pulpy, which takes place in about a fortnight. It is then drawn between the thumb and fingers, which easily presses off the pulp, leaving a clean fibre. This is afterwards dried in the sun.

If required for immediate use, the leaf is first pared down on each of its flat sides, and afterwards drawn between two pieces of cane lightly

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* The fibre sent as "Cabo Negro" was the produce of the sugar palm of the East Indies, *Arenga saccharifera*.

pressed together, nothing but the fibres passing through. But this method is a very wasteful one, as many fibres are broken.

Amongst the many uses to which maguay is applied may be mentioned that of violin strings, for which it is much appreciated by the natives.

(Signed) J. H. OSMOND.

Manila, May 1891.

The specimens kindly obtained for Kew through the good offices of Mr. Alexander Gollan, Her Majesty's Consul at Manila, were received in good order. They consisted of fresh leaves of an *Agave* in different stages of growth, and there was little difficulty in recognising them as belonging to *Agave vivipara*, L. (*A. Cantula*, Roxb.), the plant which (according to *Kew Bulletin*, 1890, p. 50) yields also Bombay Aloe fibre. The distribution of this plant so far eastward as the Philippine Islands does not appear to have been specially noticed before. It is originally an American plant, and it owes its spread in India, at least, to its use as a hedge plant to keep back cattle. The local name *Maguay*, given to it at Manila, is a generic term applied by Spanish-speaking people to numerous species of Agaves. For instance, in the south of Europe it is often applied to *Agave americana*, although this plant in South America is distinguished as *Maguay de cerayza*. In some parts of Mexico *Agave vivipara* is known as *Theo-metl*.

The method of preparing the fibre at Manila, described by Mr. Osmond, is very crude, and the result is necessarily unsatisfactory. The process of maceration is not at all well adapted for extracting the fibres from leaves of monocotyledonous plants. The fibres are discoloured by long immersion in water, and during the process of fermentation, extending over a fortnight, the strength of the ultimate fibres is greatly weakened. It may, therefore, be readily understood that the value of Manila Aloe fibre is comparatively small, and it can only be profitable to produce it when the price of white-rope fibres is exceptionally high. In the last *Monthly Circular* (dated the 16th March 1893), issued by Messrs. Ide and Christie, of Mark Lane, Manila Aloe Fibre is dismissed with a few words,—"nothing doing, 17*s*." [per cwt.]. In the same circular Bombay Aloe Fibre is described as "dull at 8*s*. to 13*s*." [per cwt.].

LXIII.—MEXICAN FIBRE OR ISTLE.

(*Agave heteracantha*, Zucc.)

[K. B., 1887, December, pp. 5–7.]

Under the name of Mexican fibre or Istle, a short and somewhat harsh and stiff fibre comes into the London market, which is used in the manufacture of cheap nail and scrubbing brushes, and for various purposes where a substitute for animal bristles is desired. Messrs. Ide and Christie mention "that this fibre is pretty largely imported for "brush-making purposes, and its value in London [15th October 1887] "is 26*l*. per ton. The range of value of late years has been from 22*l*. "per ton to 50*l*. per ton. The fibre is quite unique as a vegetable "substitute for animal bristles, and is used in the manufacture of cheap "brushes of all sorts."

The origin of this Mexican fibre or Istle has been involved in a good deal of doubt, but we believe that we have been able to trace its origin

by means of material collected many years ago, and now available at this establishment. Some specimens of a stiff fibre and brushes in the Kew museums were received from Dr. Parry in 1879, and said to be derived from *Agave Lechuguilla*. Dr. Parry wrote the introduction to Torrey's *Botany of the Mexican Boundary*, which was published in 1858, and he states on page 11, speaking of the vegetation of the cretaceous formation, "Upon the rocky ledges a small species of Agave "grows in abundance. The low leaves, which are pointed with sharp "spines, are very troublesome to the foot traveller; they are, however, "of some use to the Mexicans, who employ the strong fibres they "contain in making coarse ropes. The plant is known to the people "of the country as 'Lechaguia.'"

According to Torrey, in *Botany of Mexican Boundary Survey*, p. 213, it appears there is a distinct species of Agave of this name [*Agave Lechuguilla*, Torrey], and "the fibres of the leaves are used "for making coarse rope, bagging, &c." This species, by Baker, in *Gardeners' Chronicle*, Vol. VII. (new series), p. 527, is placed under *Agave Poselgerii*, Salmdyck. Engelmann, on the other hand, looked upon *A. Poselgerii* and *A. Lechuguilla* as identical with *Agave heteracantha*, Zucc., and described them under that name. Hence we may look upon *Agave Lechuguilla*, Torrey, *A. Poselgerii*, Salmdyck, and *A. heteracantha*, Zucc., as synonymous names representing one and the same plant; and of these *Agave heteracantha*, Zucc., has priority as regards date, being published nearly fifty years ago.*

It would appear, therefore, that Parry's specimens of fibre and samples of brushes made from it were derived from *Agave heteracantha*, Zucc., the local name of which is Lechuguilla. This name is, however, by no means restricted to this species. Sereno Watson (*Proceedings of the American Academy*, Vol. XI., p. 16) mentions "Lechuguilla" or "Lechigilla" as the native name of *Agave guttata* and *A. variegata*. These latter are species belonging to quite another group, and as different as possible from *A. heteracantha*. It is very probable, therefore, that the name Lechuguilla, like Kerrato in the West Indies, has a wide stretch of usage in certain parts of Mexico and the United States, and that it is applied indiscriminately to various species of Agave.

There is at Kew a very large collection of living Agaves in which are represented most of the species here concerned.

By the courtesy of Messrs. Death and Ellwood, Engineers, Leicester, we have been enabled to extract fibre from the leaves of *Agave heteracantha*, Zucc.; *A. xylacantha*, Salmdyck; *A. horrida*, Lemaire; *A. Kerchovei*, Lemaire; *A. lophantha*, Schiede; *A. univittata*, Haworth; and *A. multilineata*, Baker. All these yield a coarse and somewhat rigid fibre, but the fibre of *A. heteracantha*, allowing for the age of the plant, comes nearest to the commercial fibre known in London as Mexican fibre of Istle.

All these species, it may be mentioned, belong to a distinct set of Agaves, the leaves of which are charaterized by a continuous horny margin, and hence placed together by Baker under the group Marginatae, of which the distinctive characters are,—"edge of the leaf "furnished all the way down from the top to the bottom with a "distinct horny boarder, of the same texture as the teeth."

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* It may be mentioned here that what Baker described as *Agave heteracantha*, Zucc. (?), in *Gardener's Chronicle*, Vol. VII. (new series), p. 369, has been proved to be a new species, and it is proposed by him to describe it under the name of *Agave multilineata*.

The species of *Agave* which yield Sisal hemp and fibres suitable for rope making and weaving, are discussed fully in the previous pages. Such fibres are ordinarily 3 feet, and often 5 and 6 feet in length. They are soft and pliable, not so stout as the Mexican fibre or Istle, and would scarcely answer the same purpose. This latter is generally, only about a foot or a foot and a half in length, and is stout and rigid.

There is little doubt, therefore, that Mexican fibre or Istle is derived from a group of Agaves with short leaves, and from the material available at Kew, the evidence is strongly in favour of *Agave heteracantha*, Zucc., being the species chiefly concerned. Indeed the specimens contributed by Dr. Parry to Kew in 1879, afford direct proof on this point. Since the above remarks were written we have been favoured by Dr. Newberry with a reprint of an article of his in the *Popular Science Monthly* for November 1887, entitled "Food and Fibre Plants of the "North American Indians." At page 10 we find he identifies the "lechuguilla" of the Indians with *Agave heteracantha*, and attention is particularly drawn to the size of the leaves, about a foot to 18 inches in length, and to the very strong character of the fibre contained in them. Dr. Newberry's observations are :—

"Another less known but scarcely less valuable plant belonging to the same genus (*Agave*) is the 'lechuguilla' (*Agave heteracantha*) of Chihuahua and the surrounding country. Of this, the leaves are from a foot to 18 inches in length, and grow in a tuft like those of the century plant (*Agave americana*). Though separated with some difficulty from the parenchyma in which they are enveloped, the fibres that traverse the leaves are numerous and very strong, and are largely used by the Mexicans for the manufacture of ropes, sacking, &c."

In the Kew museums there are specimens of Mexican fibre as follows :—Prepared Mexican or Istle fibre, from Mr. A. Rowbottom ; fibre used by the Indians for making ropes and coarse sacking, from Dr. Parry, 1879 ; a piece of cordage and Mexican hair-brush, made from Mexican fibre, contributed also by Dr. Parry ; and Mexican fibre or Istle as sold in London (value 26*l.* per ton, received from Messrs. Ide and Christie, 15th October 1887.

LXIV.—MEXICAN FIBRE OR ISTLE—(continued).

[K. B., 1890, pp. 220–224.]

The source of Mexican Fibre or Istle is discussed in the last article. The fibre is prepared from one or more species of Agave, but, as already stated, it is probable that the plant known as Lechuguilla (*Agave heteracantha*, Zucc., Agave Lechuguilla, *Torrey*) yields the best qualities of Mexican Fibre or Istle used in the United States and in Europe.

We are indebted to Mr. W. S. Booth, Belle Vue House, Gloucester, for the following further account of this fibre, prepared from his own observations while travelling in Mexico, a few months ago :—

Mexican Fibre or Istle.

This fibre is classed in England not according to the plant from which it is extracted, but in reference solely to the district from which

it is supposed to come. Thus the district of Jaumave is understood to send long, clean, fine fibre, and gives its name to what is considered to be the best quality; Tula, a shorter and coarser fibre; and lastly, Matamoras, a short and soft fibre, somewhat "woolly" and "off colour" (*i.e.*, brownish). Each of these three qualities varies considerably within its own limit.

Until lately little has been definitely known about the plants from which this fibre is extracted. According to the Kew authorities the fibre is yielded by *Agave heteracantha* and closely allied species.

The fibre known in England as Jaumave is doubtless extracted from the Lechuguilla (*Agave heteracantha*). That known as Tula may be either from the Lechuguilla or the Palma loca (*Agave striata*), the inferior qualities coming from the latter plant. That known as Matamoras fibre may be either from the Palma loca or from various forms of the Espadillo, or again from varieties of *Yucca*, known to the natives as palma baréta or palma real. These palmas and espadillos are often picked and decorticated indiscriminately and mixed as they come to hand.

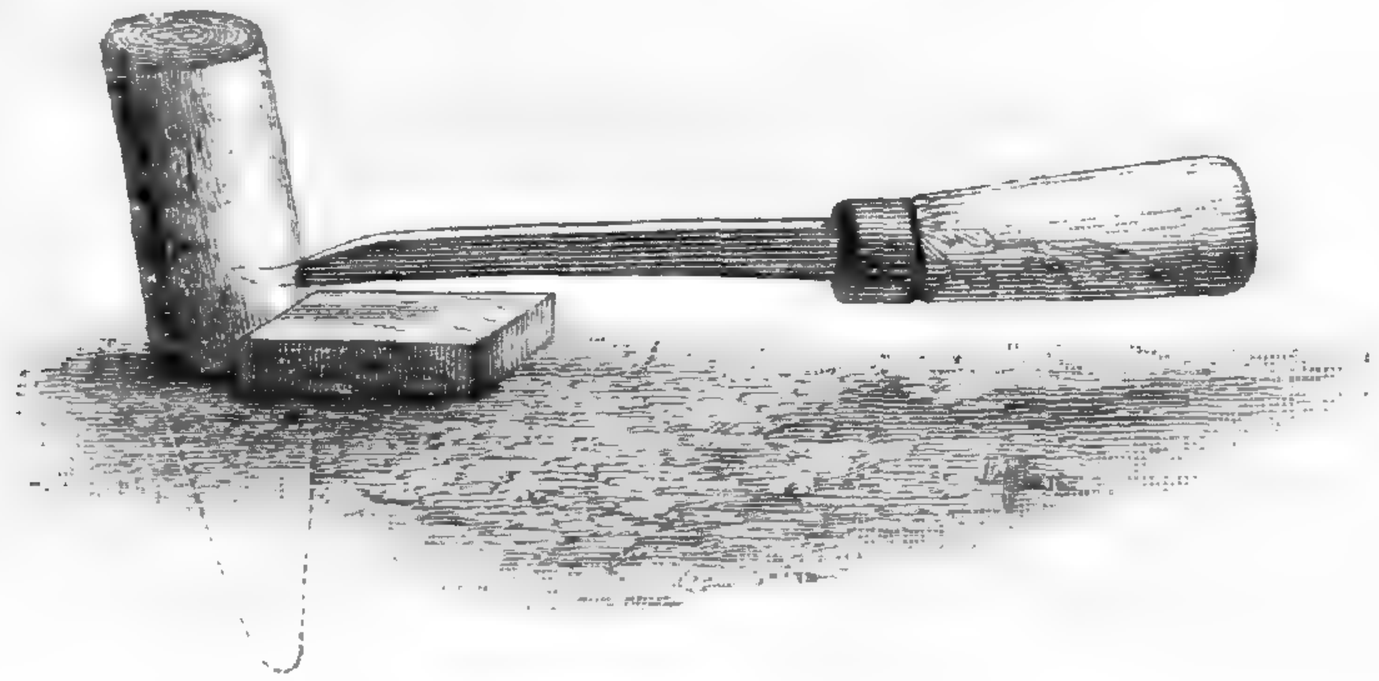
The various plants from which Istle is extracted are found at present chiefly on the plains and rugged mountain slopes of the States of Coahuila, Tamaulipas, Nuevo Leon, and San Luis Potosi. The central towns for the trade in the several States are: Coahuila, Saltillo; Nuevo Leon, Monterey; Tamaulipas, Jaumave, Tula, Tampico and formerly Matamoras; for San Luis Potosi, San Luis Potosi.

The trade is carried on in these States owing to the exporting conveniences, but the plants exist all over the Republic. San Luis Potosi does by far the largest business in fibre, exporting by sea from Tampico, and also from the different points on the railroad *en route* to the United States. The heights at which these plants grow, lie approximately within the *tierras templadas* and the lower regions of the *terras frias*; the former comprising "all the higher terraces and the central plateaux "themselves between about 3,000 and 8,000 feet, with a mean tempera- "ture of from 62° to 70° Fahr., and oscillating between such moderate "extremes as 50° and 86°;" the latter "all the highlands from about "8,000 feet and upwards."

The soil of the mountain slopes and wide plains where the plants are found, is of the barest description, hardly covering in many cases, on the hillsides, the rocks beneath. Generally speaking it is a detritus of hard whitish limestone, and the traveller's smarting eyes will soon force on his notice the fact that the fine dust of many of the broad pan-shaped valleys is heavily impregnated with lime.

The Lechuguilla (*Agave heteracantha*) is found associated with five or six sorts of Cactus, Maquey (*Agave americana*), Huapilla, Zacate, Zamandogue, and palmas; forming a sparse vegetation about 6 feet high, with a long wiry grass so poor as to leave the grey dusty soil exposed underneath. Almost the only use to which this kind of land is put is that of corn raising, and that only in small patches where irrigation is possible. The grazing of goats, sheep, cattle, and horses is also attempted, these endeavouring to glean a meagre subsistence from the Nopal (Cactus), scrub, and grass. On the rugged barren mountain sides and slopes of naked stones and boulders, the same plants are found, only in a more stunted and dwarfed condition, and yielding a shorter and coarser fibre. Nearly all the accessible country is owned by Haciendados, most of whom live in the towns, leaving their estates in the hands of an agent. With the exception of a few native Indian tribes who live in the more inaccessible parts of the mountains, the rural population is composed of christianised Indians and half breeds, both called peons.

These build round the hacienda their villages of mud, sticks and palm-leaf thatch hovels fenced in with cactus and maquey hedges and mud walls, and are quiet and docile, but lacking utterly any spark of intelligent ambition. The hands who are not regularly employed on the work of the hacienda wander out over the valleys and mountains with mules and donkeys to gather the raw leaves of fibre plants. The greatest quantity is gathered naturally at the end of the year when the harvest is taken in. The central mass of heart leaves (*cogolho*) in the plant is alone gathered, leaving the outside leaves (*penca*), or say about 70 per cent. to waste, as the flesh of these outer leaves is found to be too hard to work. Although a fresh crop of leaves springs up from the terminal bud which was previously protected, this process prevents the plant from flowering, thereby causing its decrease, as it dies after about four years of this treatment. Having got his load of cogolhos, the peon makes his way back to the hacienda, where he sets about extracting the fibre, for which when finished and dried he gets from 25 to 50 cents* per arroba (25 pounds) either in money, or as is almost universal, in credit at the ranch store. The price he receives depends largely on the distance from which the cogolhos have been brought. Under the rude shade of palm-leaf thatch or in the shade of the Mesquit trees the peons are to be seen preparing the fibre. With a bundle of raw Lechuguilla cogolhos at his left, the man sits with his legs stretched out on either side of a wooden peg, about 8 inches high and 3 inches in diameter, driven firmly into the ground with a slant to the left. Fixed to this is another piece of wood about 3 inches square, about an inch above and parallel with the ground. About half an inch above this table the peg has a hole in it to receive the point of the *tallador*, a blunt-edged ironscraper in a wooden handle which the man takes in his right hand. The simple implements used are shown in the wood-cut below.



Tearing a cogolho to pieces, taking a leaf and dexterously stripping the thorny margin from its sides, he places a corn-cob in the hollow of the base end of the leaf to make a handle, then with the simultaneous action of both hands the point of the *tallador* is placed in the peg hole and pressed on the leaf half way from its point. The leaf is then pulled through, once for one side, once for another, and a third time to give a finishing scrape. Then with a rapid motion the pulp is tapped from the *tallador* and the end of the prepared fibre is twisted round the cob (which the operator holds as if it were a spade handle), and the process is repeated for the other end (the base) of the leaf. When the pile of fibre has grown enough to warrant movement it is carefully spread out in the sun to dry. One cause of discoloration is a weak arm, which causes some of the pulp to remain on the fibre and give it a green tinge

* Mex. dollar worth 38½*d*.

owing to lack of pressure; another is leaving it too long in the sun or air, which gives it a brownish tinge.

When a Lechuguilla has been once pulled it is called *lechuguilla capona*, and all succeeding growths of heart leaves will have withered burnt-looking ends, owing to the delicate points of the young sprouting leaves being scorched by the sun. This accounts for the rusty ends seen on Istle fibre in this country. After each pulling, too, the fibre of succeeding leaves naturally becomes more stunted and coarse.

The Haciendados generally bale the fibre in rough Istle sacking in 200 lb. bales, and when sufficient quantity is on hand it is sent to the nearest central town or railroad depôt by trains of ox teams which carry about two tons apiece, or on mule trains which take a bale per pannier. These trains often travel 170 miles from point to point, and are frequently on the road from 15 to 20 days, allowing for breakages. Tula and Jaumave are about this distance from Tampico, San Luis Potosi, or Vanegas. The roads are rough tracks along the bottoms of valleys and over mountain passes. In the valleys a team can be seen at a great distance by the cloud of white dust rising lazily around it. This dust is so fine and light that it hides the mules from the occupants of a buggy running before the wind. The mountain tracks are of the roughest description. They are full of boulders and deep hollows torn out by the mountain torrents, and broken wagons are as common a sight as vultures whirling over a dead mule.

The fibre from plants gathered in the mountains is, as a rule, coarser and shorter than that of those gathered in the valleys. The greater average length of the Jaumave istle is possibly accounted for by the lower altitude and greater fertility of the district. The quantity of fibre obtained from the Lechuguillas and Palmas is about 5 per cent. of the green leaves handled. Little, if any, fibre is lost in the manual process. The maquey leaves (*Agave americana*), owing to their huge size, go through a much more laborious process, and yield only from 2 to 3 per cent. of a long, wavy, fine fibre, used largely for twine, saddle pads, and fine matting. The cogolhos of the palma loca, palma baréta, and palma real go through exactly the same process as the Lechuguilla, with the exception that, having much harder flesh, they have to be *boiled* before the fibre can be drawn. This boiling or steaming, which goes on until the leaves are completely soft, turns the fibre a brownish colour, and at the same time makes it very soft by dissolving the stiffening gum in the flesh. Many men have invented machines which were to have revolutionised this hand process, but all, up till now, have failed—not in the quality of the fibre produced, for the results have been good in this respect—but in the cost of working. In the treeless deserts of Mexico there is no fuel and no water. Machines have hitherto required both; water, especially, for washing the fibre—an operation that is not required in the hand process. Also with the best machine there is more effort and system required, to say nothing of the services of an intelligent mechanic. A fortune is no doubt awaiting the man who can bring a machine to bear successfully on the millions of acres of closely growing agaves and yuccas of Mexico, whose fibres, besides their use in brush-making, mats, and sacking, are available also for paper when properly treated. Paper is already made from the maquey fibre in works outside Saltillo (Coahuila). The stems of the palmas, too, are a spongy mass of fibre ready for crushing and pulping.

The bulk of the fibre exported from Mexico now goes to the United States, where it is used for brush-making and for twine for reapers and binders. A failure in the harvest in America will, therefore have an appreciable effect on its price. England and Germany take large

quantities for brush-making, but our imports come largely through New York. Such things as trade statistics are difficult to obtain in Mexico. The only figures I have are unreliable. There are no export duties, but as a rule it costs about $20 (Mexican) for every shipment crossing the borders. This is made up of fees to Customs authorities on both sides, passing entries, and commission to agent undertaking to see it through. There is a tax of ½ per cent. on all transactions in the Republic, but many large firms contract themselves out of this tax, which is called Renta Interior, and is payable by the buyers. The present (1890) price of the finest Lechuguilla fibre (Jaumave) is from 30*l.* to 35*l.* per ton; that of shorter and coarser Lechuguilla (Tula), 28*l.* to 28*l.* 10s.; and of inferior Lechuguillas and Palma (Matāmoras), about 22*l.* per ton.

Before closing I may perhaps say that the Agave and Yucca fibre industry is at present in its infancy. If intelligently followed it might become a very prosperous enterprise in many of our tropical possessions where cheap labour and poor soils prevail. It might become still more prosperous by the use of economical machinery and intelligently managed plantations. In the *Kew Bulletin* for March and October 1889 the interesting accounts of the development of the fibre industry in the Bahamas will show what can be done by intelligent and systematic action.

(Signed) W. S. Booth.

LXV.—MAURITIUS HEMP.

(*Furcraea gigantea*, Vent.)

[K. B., 1887, March, pp. 8–10.]

A hemp industry was started at the Mauritius to utilize the large number of plants of *Furcraea gigantea*, Vent., which had spontaneously established themselves on low-lying lands near the sea coast. This is one of the oldest and best known species of *Furcraea*, and is now universally spread throughout tropical America, and also in India, Ceylon, Mauritius, and St. Helena. The trunk below the rosette of leaves reaches a height of 2 to 4 feet. The leaves are 4 to 7 feet long, 4 to 6 inches broad at the middle, unarmed, bright green and channelled down the face. The scape or terminal flowering stem reaches a height of 22 to 30 feet. Like all the other Furcraeas this species produces copious oblong bulbillæ in place of or in addition to flowers, which falling, take root and reproduce the plant. It has often flowered under cultivation in England, the last time at Kew being the autumn of 1874.

A full account, with description, of the various species of *Furcraea* is given by Mr. J. G. Baker in *Gardeners' Chronicle* (1879, pp. 623, 624). *Furcraea gigantea* is figured in the Botanical Magazine, t. 2250 : Wight Ic., tab. 2025 : Decandolle, Plantes Grasses, t. 126.

Although *Furcraea gigantea*, known locally as *Aloës vert*, is the chief fibre plant in Mauritius, there is evidence that *Furcraea cubensis* is also found there, as well as species of Agaves such as *A. americana* and others.

Bojer (Hortus Mauritianus, p.353) mentions the *Aloës vert* (*Furcraea gigantea*) as common in 1837, and states "Croît sur la Montagne "Langue dans les endroits vides et les basilages des habitations dans

" tous les quartiers d'île." He does not mention *Furcraea cubensis* at all, so the latter must be a later importation. Plants of both species have been received at Kew from the Mauritius Botanic Gardens.

Furcraea gigantea is supposed to have been introduced from South America to Mauritius about 1790. It has evidently found a congenial home there, for without any effort on the part of man it has covered waste lands and abandoned sugar estates to such an extent as to lay the foundation of a considerable fibre industry. The leaves are often 8 feet in length and from 6 to 7 inches in breadth. The pulp of the leaves when crushed gives off a strong pungent odour, and hence this species is sometimes called the *fœtid aloe*. The juice is strongly corrosive and soon acts upon wrought iron; it is said to produce less effect on cast iron, while it is practically inoperative on brass and copper.

The plant grows in all soils and up to an elevation of 1,800 feet above the level of the sea. It has, however, more generally disseminated itself on the lowlands near the coast, and on a few of the abandoned sugar estates that have become too dry for cane cultivation.

A fibre industry was started at Mauritius about 12 years ago, when the wet or retting system was tried. The cut leaves were first passed through the rollers of a sugar mill and steeped in water for some days. The fibre was then washed and beaten out by hand in running water. This process was soon found unsuitable, as the fibre was discoloured and rendered weak; consequently it obtained comparatively low prices. Attention was then directed to extraction by means of a *grattoise* or scutching machine. Many machines have since been tried, and apparently the purely mechanical difficulties connected with cleaning the fibre have been for the most part overcome. The amount of fibre obtained from leaves of the *Aloës vert* was at the rate of 3 per cent. by weight of green leaves. The yield of fibre was at the rate of about $1\frac{1}{2}$ tons per acre. A set of six machines, driven by a steam engine of 8 horse-power (nominal), cleaned 1,155 pounds of fibre per day, which is at the rate of 197 pounds for each machine per day.

At one time there were eight fibre or hemp companies formed, with a total capital of Rs. 1,182,500. The total quantity of fibre exported in 1872 was 214 tons, of the value of 4,934*l.*, which would be at the rate of 21*l.* 13*s.* per ton. In 1880 it had increased to 662 tons, which sold in England at 28*l.* to 32*l.* per ton. Some samples in 1882 sold as high as 38*l.* per ton. Since that time low prices have ruled, and this added to the fact that the cost of production was considerably increased, tended to discourage the industry. It is evident the industry was first started to work off the leaves of self-grown plants which were ready at hand in great abundance. When these leaves were exhausted it remained either to wait until the plants were regrown or to procure supplies of leaves at increased cost from the surrounding country. This latter course being adopted at a time when the market value of fibre was low, rendered the enterprise, for a period at least, unremunerative. In the returns of 1885 we find that Mauritius hemp imported to this country amounted to 255 tons, of the value of 39*l.* per ton. In Messrs. Ide and Christie's monthly circular, Dec. 1886, Mauritius hemp is quoted "in good demand" at 28*l.* per ton.

The following extracts taken from Mr. Horne's Report on the Agricultural Resources of Mauritius will sufficiently explain the circumstances under which the fibre industry was started and the causes which have operated to produce the present depression, which in the interest of the island it is hoped will be only of a temporary character :—

"The industry of extracting fibres from the leaves of the *aloës vert* is "by no means exhausted. There is ground for believing that it has

" yet a future in Mauritius. The fall in the price of this fibre in the " European markets broke several local companies that were formed " for the working of the aloe estates. There was far too much money " invested in them to pay."

* * * * *

" On many of the estates self-sown plants abounded in great numbers. " It was from the leaves of these that the companies made money and " paid large dividends when the price of the fibre was good. The " plants had grown naturally on the land, and their presence on it had " not cost a cent. In such cases results materially differ from those of " reaping the crops of regularly laid out plantations with low prices for " the produce. The soil and climate of the localities referred to favour " the growth of the plants in such a degree that little expense need be " incurred in introducing it to new grounds. The plant produces " plantlets in great abundance in this colony. These plantlets grow " viviparously on the parent plant, and adhere to it till they have " developed into almost perfectly formed plants. When the young " plantlets drop from their parent they are perfectly fitted to stand by " themselves. Excepting the want of roots they are perfect. The " roots are emitted as soon as the plantlets come in contact with the " moist soil, even when they are lying on the surface of the ground. " It seems, therefore, that to increase this plant rapidly and cheaply " over a given area, due advantage should be taken of its peculiarities " and the facilities which it naturally affords for propagation and " increase."

At St. Helena *Furcraea gigantea* has been for some time under cultivation as an introduced plant. Experiments on a small scale have been carried on, and samples of fibre have appeared in the English market. (Report by Mr. D. Morris, F.L.S., on the Resources of the Island of St. Helena, Colonial Office, African No. 275, 1884.)

Messrs. Collyer and Co. reported in 1883 on fibre from St. Helena as follows :—

" Aloe fibre (*Furcraea gigantea*) St. Helena. Good length, full " strength, rather dull colour, generally well cleaned but with some " runners untouched, and barky. Value 28*l.* to 30*l.* per ton. This " sample is very different in appearance from the *Furcraea gigantea* " of Mauritius, owing probably to differences of both growth and treat- " ment."

Silk Grass (*Furcraea cubensis*, Haw.).

While on the subject of fibre from *Furcraea gigantea*, it may not be inappropriate to say a few words as regards the merits of another species, *Furcraea cubensis*. This, as already pointed out, is possibly one of the plants under the name of *Cajun* from which some of the Yucatan fibre is obtained.

It differs from *F. gigantea* in that it has no distinct trunk, or a very short one, below the rosette of leaves. The latter are 3 to 5 ft. long, about 5 inches broad at the middle, bright green, rigid in texture, and armed with regular, hooked, brown prickles.

It is a native of tropical America and cultivated in most tropical countries. A variety of this plant—*F. cubensis*, var. *inermis*—is figured and described in Bot. Mag., t. 6543.

In addition to flowers it produces bulbils on the flowering scape, from which the plant is readily increased. The plant is common in Jamaica, and it is said that there " would be no difficulty in establishing there a " large area under cultivation." The fibre is white, strong, and bright

looking. It yields at the rate of 2·05 to 3·15 per cent. by weight of green leaf. From experiments carried on at Jamaica under a committee appointed by Government, it was found that leaves of *Furcraea cubensis* weighing 366½ pounds yielded 28 pounds of green fibre, which when perfectly dry weighed 7½ pounds. This was at the rate of 2·05 per cent. by weight of green leaf. In the Report of the Committee this plant and its fibre are described as follows :—

"Silk grass (*Furcraea cubensis*). Leaves 5 to 6 feet long, generally "armed with strong prickles, but sometimes unarmed or with few "prickles. Common in Jamaica, and might be largely propagated at "once. Value of fibre—(*a*) 28*l*. good quality, but might be whiter; "(*b*) fairly clean, fair colour, value about 28*l*. per ton; (*c*) superior "to Sisal, and worth 27*l*. per ton. A good fibre, not quite sufficiently "white in the centre."

It may be mentioned here that many Agaves yield fibre, but the fibre may, as in the case of the Jamaica Keratto, prove unsuitable for industrial purposes. The Brokers' Report on Keratto fibre was—"little "strength; not an even (but a curly) fibre: towy: value 12*l*. to 14*l*. "per ton."

LXVI.—MAURITIUS HEMP MACHINES.

[K. B., 1890, pp. 98–104.]

The subject of Mauritius hemp has been already discussed. Considerable interest has been taken in India and the Colonies in the production of fibres suitable for rope and twine making, for which of late years there has been a considerable demand. In connexion with this interest numerous inquiries have been addressed to Kew respecting the best machines for cleaning the leaves and stems of plants yielding such fibres. The plants in most cases have been various species of *Agave*, *Furcraea*, *Sansevieria*, *Karatas*, *Bromelia*, and other monocotyledonous plants whose fibre bundles yield the particular kind of fibre in demand.

It is well known that certain fibre machines, more or less effective, are in use in Yucatan in the production of Sisal hemp, yielded by one or more varieties of *Agave rigida*. It is very probable that some of these machines could be successfully introduced into other countries where Agave plants are grown for fibre.

In the case of Mauritius hemp we learn that the fibre machines, locally known as *grattes* or scrapers, which have been generally in use in that island for many years, are manufactured in the Colony. These are exclusively engaged in extracting fibre from the leaves of the *Aloës vert* or fœtid Aloe (*Furcraea gigantea*). The leaves of this plant are very similar in size and character to those of *Agave rigida*, var. *sisalana*, lately received at Kew from the Bahamas. There is little doubt that the *grattes* or fibre machines as now used in Mauritius, or with some slight modifications, could also be used in the treatment of Agave leaves. In any case it was very desirable to obtain exact particulars of the construction and capabilities of the Mauritius machines. They appear, so far, to meet the requirements of the Mauritius planters, and, moreover, they have been adopted after careful trial with other machines which have been ultimately discarded. The particulars desired in regard to the machines in use have now been furnished in an exhaustive manner by the Government of Mauritius, and they are published in the

Kew Bulletin with the view of placing the information within reach of a large class of people interested in the subject.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew,
November 6, 1889.

I AM desired by Mr. Thiselton-Dyer to inform you that the high prices now ruling for white rope fibres have stimulated inquiries in regard to their origin and production, and numerous applications have been made to Kew on the subject.

2. As you are aware, a considerable industry has arisen in Mauritius during the last six or seven years in extracting fibre from the leaves of the Aloës vert (*Furcraea gigantea*). This fibre is known in commerce as Mauritius hemp, and it is regularly quoted in London prices current.

3. The success of the industry in Mauritius indicates that a tolerably successful machine has been found capable of preparing the fibre on a commercial scale. Information as regards the nature and working of such a machine is just now a matter of considerable interest.

4. Mr. Thiselton-Dyer would be glad if the Secretary of State would approve of an application being made to the Government of Mauritius for such information; and it would be convenient if the information, for a comparison of the results obtained in different countries, could be supplied in the form of replies to the questions given in the enclosed schedule.

I am, &c.
(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.

[Enclosure.]

MACHINES IN USE at MAURITIUS for EXTRACTING FIBRES from LEAVES of *Furcraea gigantea*.

1. Name and description of machine (with address of maker) ?
2. Weight and cost (not including power) ?
3. How long in use ?
4. Whether worked by hand, horse, or steam power ?
5. If by steam, what is the registered horse-power necessary to drive one machine ?
6. No. of men required to feed and remove fibre (not including carriers or other persons employed in bringing in leaves or in drying the fibre) ?
7. Average out-turn of wet fibre for each machine per hour ?
8. Average out-turn of dry fibre for each maehine per day of— hours ?
9. Average cost in labour, fuel, &c., in cleaning a ton of dry fibre ?
10. Please add any other information respecting the character and working of the machine not included in the above inquiries.

Sir C. C. LEES to LORD KNUTSFORD.

Government House, Mauritius,
February 20, 1890.

MY LORD,

I HAVE the honour to transmit to your Lordship a copy of a report by the Acting Surveyor-General, Mr. Vandermeersch, forwarding replies to the questions annexed to Mr. Morris' letter of the 6th

November 1889, which was enclosed in your Despatch No. 369 of the 8th November as well as four other documents regarding the extraction of fibre, and the machines now employed in the Mauritius.

I am, &c.
(Signed) C. C. LEES,
Governor.

The Right Hon. Lord Knutsford, G.C.M.G.

[Enclosure.]

REPORT by ACTING SURVEYOR-GENERAL, No. A/66, February 17, 1890.

I HAVE delayed reporting upon this subject because I had to procure reliable information. I now forward formal replies to the queries of Mr. Thiselton-Dyer. To these replies I have added the following documents, which I hope, will make the information as complete as possible :—

1st. A very detailed and interesting memorandum on the subject kindly supplied at my request by Mr. Regis de Chazal, C.E. (Engineer to the *Forges et Fonderies de Maurice*), to which I have appended some supplemental notes by myself.

2nd. A plan of an installation for two "grattes" and a tracing (full size) of the "servante" to accompany Mr. de Chazal's memorandum.*

3rd. A pamphlet on Aloe fibre by Mr. Evenor de Chazal.*

4th. A statement of the actual results obtained at St. Antoine Hemp Factory during 60 days' work.

(Signed) A. VANDERMEERSCH,
Acting Surveyor-General.

February 17, 1890.

[Enclosure No. 2.]

Answers to queries respecting machines in use at Mauritius for extracting fibres from leaves of *Furcraea gigantea*.

1. The machine in general use in this Colony is a drum of 2 feet in diameter by 1 foot in width, upon which are bolted blades in 2-inch L steel, and which revolves at a great speed, the blades passing close to a guide in brass ("servante"). The machine is called a ("gratte") scraper. It is manufactured in the Colony by all engineers' shops, but chiefly by the "Forges and Fonderies de Maurice."
2. The weight of the drum is about 4 cwt., the cost, including the driving pulley and bolts (exclusive of framework, masonry, and setting), is about Rs. 250 per "gratte."
3. This gratte has been in general use in Mauritius for the last six years.
4. The machine is worked by steam or by water power.
5. The registered horse-power to drive one gratte is 3 h.p.
6. One gratte is served by two men who stand on each side of the gratte, and who work alternately. One of them must be left-handed. One carrier will bring in sufficient leaves from the yard to the gratte, and another man will suffice to remove the wet fibre produced by two grattes and to carry this fibre to the weighing machine and thence to the cleaning pits.

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* Not reproduced.

7. The out-turn of wet fibre for each machine per hour is, on an average, 42½ kilog., that is taking eight hours' work per day, which is as much as the men can do, the work being very fatiguing.
8. The out-turn per day of eight hours is per machine (gratte) 340 kil. wet supplying on an average 97 kil. of dry fibre (or 28½ % of the wet fibre).
9. The average cost in labour, fuel, &c., in cleaning a ton of dry fibre, packing, and transporting to the place of shipment is - - - - - - - - - Rs. 150

If to the above we add other charges, viz., collecting leaves, carting, mill management, interest on capital, &c., say about - - - - - - - - - 75

The total average cost of one ton of fibre ready for shipment is - - - - - - - - - - Rs. 225

(Signed) A. VANDERMEERSCH,
February 17, 1890. Acting Surveyor-General.

SUMMARY OF A NOTE ON THE FIBRE MACHINES GENERALLY IN USE AT MAURITIUS FOR CLEANING ALOE FIBRE, BY M. REGIS DE CHAZAL.

1. *Description of Machine.*

The machine generally in use in Mauritius for extracting fibre from the leaves of the green Aloe (*Furcraea gigantea*) is known under the name of *gratte*. This gratte consists of a drum about 2 feet in diameter and 1 foot wide. On the circumference of this are bolted 2-inch L-shaped blades parallel to the axis. These blades are generally of iron, but steel is preferred. They are firmly fixed to the drum by means of bolts and nuts. The drum is mounted upon an axle and made to revolve with great rapidity close to and against the front or edge of a feed table (*servante*). The feed table is adjusted by means of screws so as to approach the revolving drum within a distance of quarter inch to an inch, as required. It is composed of a stout brass plate and lip fitted firmly to a piece of hard wood by means of a bolt. The plate and wood are themselves fixed to two wooden bars, 6 inches by 6 inches, which serve as guides in the movement of the feed table backwards and forwards.

The most difficult task in connection with working the gratte is the exact adjustment of this feed table. It is most necessary that the blades on the drum and the edge of the feed table are so adjusted that they work freely and evenly and at the same time bring every fibre in the leaf in contact with the beaters. The proper adjustment of the feed table in regard to the beaters is stated to be the secret of the success of the *gratte* as a fibre machine. This adjustment should be performed with the utmost care before the machine is started. When once adjusted it is important to maintain the feed table in its proper position and prevent any displacement during the process of working.

The drum should be turned at an average rate of 700 revolutions per minute; while a higher rate of speed may be maintained without injury, it is found not desirable under any circumstances to fall below 620 revolutions per minute. The best and most economical work is that done at 700 revolutions per minute.

Method of Working.

The Aloe leaf is presented tip first along the feed table, and is drawn down between the latter and the drum. It is thoroughly beaten by the grattes to about three-fourths of its length. By these means the pulp is removed and the fibre is left. The leaf is then withdrawn and the other end presented to the beaters until the whole is cleaned.

Two men usually work at each machine. They stand one on each side of the feed table and work alternately. It is desirable for rapid work that one of the men should be left-handed. Each man in turn presents his leaf to the machine and withdraws it as soon as possible. In a regular and efficient working of the machine it is arranged that one man or the other should always have a leaf in the machine in course of being cleaned. To avoid accidents the feed table is now provided with a wooden guard. This guard prevents the hands of the work-people from being caught by the beaters.

Mounting the Machines.

The machines are generally mounted in pairs, both working on the same axle, and driven by steam or water power. The driving wheel, fixed midway on the axle between the two machines, should have a minimum diameter of 18 inches, with a strap 6 inches wide. A single adjustment of the feed table should last from 8 to 15 days. At the end of that time it is generally found necessary to readjust the parts to ensure good results.

The framework of the machine is securely attached to substantial masonry work by large bolts about 5 feet long. The machines must be thus firmly secured or the vibration during the process of working would soon cause them to become detached. The arrangement of the machines in pairs on the same axle could be extended in the same line indefinitely, provided the necessary distance is preserved between the centre of each machine. One of the largest fibre factories in Mauritius contains 12 machines, that is, six pairs arranged as already described.

Out-turn of Fibre.

As already stated, each machine is served by two men standing on each side of the feed table. One carrier supplies them with fresh leaves while another is engaged in receiving and removing the wet fibre. The task of a man, which can be easily accomplished in six to eight hours, is 250 lbs. (or 125 kilos) of wet fibre. The wage paid for this is one rupee. Sometimes, however, by extra work (for which the workman is paid at the rate of 50 cents per 100 lbs.) as much as 800 to 900 lbs. of wet fibre have been produced in a single day. This amount, however, is quite exceptional.

The proportion of dry fibre to the wet fibre as it leaves the machine varies from 22 to 30 per cent.

The yield of dry fibre in relation to the weight of green leaves varies according to the age of leaves and the characteristics of the season. The riper the leaves the larger the yield of fibre; a wet season producing leaves charged with moisture will also affect the result. To produce a ton of dry fibre ready for shipment requires from 80,000 to 150,000 leaves, varying according to the size and age of the leaves and character of the season. The cutting of the leaves costs from 50 cents to one rupee the 100 bundles of 25 leaves each. The higher price is paid when labour is scarce, or when the ground is rough and difficult

to traverse. The baling of the dry fibre costs from 40 to 50 cents the bale of 150 kilos. It may be assumed that a set of 10 to 12 fibre machines properly installed and attended by men accustomed to the work will turn out on an average about 1,200 kilos (2,645 lbs. avoir.) of dry fibre per day.

Difficulty is sometimes experienced in obtaining pairs of right-handed and left-handed men for each machine. Right-handed men are, as may be expected, in excess. As already shown, it is necessary for economical working to have a right-handed and left-handed man to attend to each machine.

Treatment of the Fibre.

When the fibre first leaves the scraping machine it is covered with mucilage possessing corrosive properties which dries on exposure to the air. The tendency of this mucilage, if left on the fibre, is to turn it a yellow, and sometimes even a reddish colour. To prepare the fibre with a bright attractive appearance the best plan is to place it, as soon as it leaves the machine (or as soon as it has been weighed, to check the amount produced by each man), in warm water of a temperature of 60° to 80° Cent. (140° to 176° Fah.), and leave it there for about two hours. It should then be washed in two waters, and finally exposed to the sun to be dried.

A treatment recently employed consists in washing the fibre in cold water only. In the first washing soap is used at the rate of 2 to 3 per cent. of the wet fibre. After being thoroughly washed with soap the fibre is passed through pure water until all the soap has disappeared, then exposed to the sun and dried. By these means a beautifully white fibre is obtained. When thoroughly dried the fibre is afterwards scutched, to get rid of pith and dust. This process is usually performed by a machine constructed on the plan of an ordinary *gratte*, but fitted with four blades instead of 12. These also turn away from the feed table instead of towards it. The fibre is inserted at an opening about 6 inches higher than the centre of the axle. It is carried away by the movement of the beaters, and remains on the top of the drum, where, exposed to the repeated blows of the beaters, it is cleaned of all dust and impurities.

It may be mentioned that, owing to the corrosive nature of the juice of the Aloe leaves, the workpeople are compelled to wear strong leather gloves. The gloves are fastened to the wrist by leather bands. As the gloves are provided by the proprietor, and they wear out very quickly, they constitute quite an appreciable item in the cost of working a fibre factory.

(Signed) REGIS DE CHAZAL.

ADDENDA.

The upper half of the gratte is covered with a semicircular wooden cover, to prevent the "pulpe" from being splashed about the place: this "pulpe," which is semi-liquid, falls on an inclined plane standing about 1 foot below the gratte, and upon which it slides into troughs, wherefrom it is gradually removed and spread to dry.

There is a considerable quantity of this "pulpe" produced for one ton of dry fibre (about 20 tons), and large areas are required to stack it. The smell from the decomposing "pulpe" is anything but agreeable.

During the first years of Aloe fibre manufacture in Mauritius no use was made of the residue ("pulpe"), as it was found to burn the plantations when used as manure. Of late, however, it has been extensively

employed by mixing it with other manure, and it has given good results in the cane fields.

(Signed) A. VANDERMEERSCH,
February 17, 1890. Acting Surveyor-General.

STATEMENT of WORK executed at ST. ANTOINE HEMP FACTORY in District of RIVER DU REMPART, MAURITIUS.

Year 1889.

February - - -	15	days' work with	9 grattes
March - - -	18	„	11 „
May - - - -	20	„	11 „
June - - - -	7	„	11 „
	60	days.	

Equivalent to 630 days' work of one gratte.

The produce has been 213,371 kilos. of wet fibre, which have given—
401 bales of dry fibre, 1st quality.
6 „ coarse fibre, inferior quality.
407 bales, weighing 61,050 kilos.

Mean day's work=10,175 kilos.
Proportion of dry fibre to wet fibre=28·61 %

A true copy of note supplied by Manager.

(Signed) A. VANDERMEERSCH,
February 17, 1890. Acting Surveyor-General.

LXVII.—AGAVES AND ARBORESCENT LILIACEÆ ON THE RIVIERA.

[K. B., 1892, p. 1-10.]

At the close of November 1891, Mr. J. G. Baker, F.R.S., keeper of the herbarium and library, paid a short visit to the gardens of the Riviera for the purpose of studying the plants of Agave and allied genera, and the plants of such Arborescent Liliaceæ as had been successfully introduced into cultivation in that part of the world. The following notes, prepared by Mr. Baker, deal with the plants of a few groups only.

The principal object of a visit which I made in November-December 1891, at the instigation of the Director, to the gardens of the Riviera, was to see the Agaveæ and arborescent Liliaceæ growing there in quantities in the open air. I have for some time devoted special attention to these two groups of plants, and have written papers upon them in which I have endeavoured to work out and characterise the species and varieties. In these large plants very little help can be obtained from herbarium materials, and the species have been mostly described and their range of variation studied from a small number of specimens grown in the conservatories of England, France, Germany, and Belgium. It is quite obvious that the range of specific variation is often far

greater than was supposed when they were first named and characterised, and that often the descriptions have been made from plants in a state of very imperfect development. Very few botanists have attended much to these plants, so that it has often been very difficult for cultivators to obtain names for their specimens. I also wished to get any further light I could upon the differences in the climatic requirements of the species. I was kindly invited by Mr. Thomas Hanbury, F.L.S., of the Palazzo Orengo, La Mortola, who has the largest collection of these plants on the Riviera, to pay him a visit. I stayed at his house more than a week, and had therefore full opportunity of studying all the forms contained in his collection in a leisurely manner; and he kindly also took me to a number of other gardens at Mentone, Monte Carlo, Bordighera, and San Remo. I also went with him to Genoa to see the magnificent botanical institute which he has recently founded there, and had the opportunity of going with Professor Penzig through the Genoa botanic garden. I worked for a day making notes upon the collection in the Jardin d'Acclimatation at Hyères, which, next to that of Mr. Hanbury, contains the largest series of forms on the Riviera. In the following paper I propose to give a complete list of the species which I saw growing in the open air, which appeared to be fully adapted to the soil and climate of the Riviera, with a summary of the notes which I made upon any points about their characters and development which are not already known and placed on record. Besides studying the plants, I took note of all the names I saw, and these names were often wrongly applied. These corrections will be a great help to us at Kew in the interchange or purchase of further specimens for our collection, but it is needless, in the present paper, to enter into full details on this part of the subject. For the nomenclature and classification of the *Agaveæ* I follow my "Handbook of the *Amaryllideæ*," published in 1888, and for the *Aloineæ* and *Yuccoideæ*, my paper in the 18th volume of the "Journal of Linnean Society," published in 1880.

Order AMARYLLIDEÆ.

Genus, AGAVE, Linn.

Group FILIFERÆ.

A. filifera, Salmdyck. Grown abundantly all along the Riviera, from Hyères to Genoa, in a great variety of forms, flowering freely. It does not differ materially from the plant of English conservatories. It is quite clear that *A. filamentosa*, Salmdyck, is a mere form of the same species.

A. schidigera, Lemaire. La Mortola. This is just the plant of English conservatories. It is very doubtful whether this is more than a variety of the last.

Group MARGINATÆ.

A. lophantha, Schiede. Seen in various forms, both the type and *A. cærulescens*, Salmdyck, under a great variety of names, but not in flower. What is grown as "*stenophylla*" is not the plant described under that name by Jacobi, but a form of this species. I do not think *lophantha* is really distinct specifically from *A. univittata*, Haworth, which has long green leaves, with a pale band down the middle.

A. xylonacantha, Salmdyck. The true plant is grown at La Mortola, not differing materially from that of English conservatories; but I saw a great many others so called, which were wrongly determined.

A. Kerchovei, Lemaire. Grown sparingly both at La Mortola and Hyères, at the latter garden as "*A. Beaucarnei*, Lemaire," not differing materially from the plant of English conservatories. A very curious plant grown at La Mortola, under the name of "*A. Villæ*, Pirotti," is, I think, a very dwarf, spineless form of this species, identical with what has been called in England "*A. Kerchovei inermis.*"

A. Victoriæ-reginæ, Moore. Seen at La Mortola, not differing materially from the plant of English conservatories. Has not flowered.

A. Gheisbreghtii, Lemaire. Seen at La Mortola, not differing materially from the plant of the English conservatories.

A. Hanburii, Baker, n. sp. A new species allied to *A. Gheisbreghtii*, seen in the Mortola collection under the name of *A. heteracantha*. It has a sessile rosette, 8–9 inches in diameter, oblong rigid very glaucous leaves 4–5 inches long, $2\frac{1}{2}$ inches in diameter at the middle, with a very concave face, a pungent brown-black end-spine, a narrow continuous brown border, and close spreading colourless deltoid teeth, $\frac{1}{4}$ inch long. Flowers not seen.

A. horrida, Lemaire. Seen at La Mortola, not differing materially from the plant of English conservatories.

Group SUBMARGINATÆ.

A. Deserti, Engelm. Seen only in an undeveloped state at La Mortola.

A. Shawii, Engelm. Seen only in an undeveloped state at Hyères.

A. applanata, Lemaire. A most striking species, which I saw all along the Riviera, from Hyères to Genoa, reaching a much fuller state of development than we ever get in England. Leaves 30–40 in an acaulescent rosette, very rigid, oblong, very glaucous, reaching a length of 4–5 feet, and a breadth of 4–6 inches at the middle; base very convex, $1\frac{1}{2}$ inches thick; end-spine very large and pungent, decurrent along the margin a third or half way down; teeth distant, deltoid-cuspidate, dark brown, $\frac{1}{4}$–$\frac{1}{3}$ inch long. It flowers freely at La Mortola and elsewhere, with a peduncle 10 or 12 feet long. *A. spectabilis*, Todaro Hort. Bot. Panorm. II. t. 25, is probably the same species.

A. Hookeri, Jacobi. A fine plant from Mexico, without a name, which had just flowered at Hyères, I referred here. It had 30–40 very thick, rigid, bright green, oblong leaves, 3–4 feet long, 6–8 inches broad, at the middle, a decurrent large pungent end-spine, very broad deltoid-cuspidate teeth, and a stout peduncle, 20 feet long, with large crowded lanceolate bract-leaves, imbricating like those of *A. atrovirens*. It flowered at Kew in 1889, and was figured in the *Botanical Magazine*, tab. 6589.

A. Franzosini, Hort. Hanbury. This, which is one of the most striking plants in Mr. Hanbury's garden, was one of the things which I was desirous to see, and I find that it is an undescribed species of this affinity, which I have never seen in any English collection. It has an acaulescent rosette of 30–40 oblong-spathulate leaves, which are as thoroughly and persistently glaucous as those of *A. applanta*, reaching a length of 8–9 feet and a breadth of a foot at the middle, very rigid in texture, with a very pungent end-spine decurrent for about half a foot, and distant dull brown-black deltoid-cuspidate hooked or straight teeth, $\frac{1}{3}$–$\frac{1}{2}$ inch long. It was not in flower at the time of my visit, but its huge *Fuagave* panicle was produced a year ago, with a stout peduncle 40 feet long, and was described fully in a paper by Philip Sewell in Gard. Chron. 1889, Vol. II. p. 639. Mr. Hanbury tells me it was introduced to La Mortola in 1878, and probably named in honour of Francesco Franzosini, proprietor of the Villa Franzosini and a rich

garden at Intra on the Lago Maggiore, which was rented for some years by the late Sir G. Macleay.

[NOTE ADDED, 1894.—*Agave Franzosini* flowered again in the autumn of 1892, and it was fully described and figured in the *Gardeners' Chronicle*, 1892, vol. ii., p. 177, fig. 31.]

A. atrovirens, Karw. Next to *americana* and *rigida*, this is the most abundant Agave of the Riviera gardens, attaining a much greater development than it ever reaches at home. It may be recognised through all its wide range of variation by its large oblong-spathulate dull green leaves, large decurrent end-spine, large distant deltoid-cuspidate marginal teeth, stout peduncle with crowded ascending imbricating lanceolate bract-leaves, the lower a foot or a foot and a half long, and very stout comparatively short panicle branches. I saw it in flower at Hyères, La Mortola, and San Remo. The leaves reach a length of six or eight feet, and a breadth of 15–16 inches. On the Riviera it is usually called *A. salmiana*, but I believe that quite a dozen plants named or maintained as species by Jacobi must range here as forms.

Group AMERICANÆ.

A. seemanniana, Jacobi. This I saw at Hyères just coming into flower, not differing very materially from the plant of English conservatories.

A. ferox, K. Koch. This species, grown in the open air at La Mortola, is developed much better than any I have seen at home. It has slightly glaucous oblong-spathulate leaves, 3 feet long, 9–10 inches broad at the middle, a large pungent non-decurrent end-spine, and very large irregular deltoid-cuspidate marginal teeth, with the edge hollowed out between them. I did not see it in flower.

A. Scolymus, Karw. Not grown commonly in the Riviera gardens, but I saw it at Hyères, La Mortola, and Monte Carlo, in flower at the last locality. *A. Verschaffeltii*, Lemaire, and several other plants which have been described as species, must clearly be placed here.

A. potatorum, Zucc. What was called by this name at La Mortola, and it may be named correctly, was clearly conspecific with *A. atrovirens* (*salmiana*).

A. coccinea, Roezl. Grown at La Mortola, not differing materially from the plant of English conservatories.

A. mexicana, Lam. The plant grown under this name at Hyères is no doubt named correctly, but I do not think in any broad sense it is more than a variety of *americana*.

A. americana, L. Everywhere abundant along the Riviera, not in gardens only, but by roadsides, and along the sea margin, flowering very freely. Besides the type, two varieties, one of which is called *lætevirens* and *Milleri*, with very glaucous leaves, approximating towards *mexicana*, and another called *ornata* and *picta*, with green leaves with great stripes of yellow. I saw one plant of the latter with leaves 8–9 feet long and nearly a foot broad at the middle.

Group RIGIDÆ.

A. rigida, Miller. This, the most valuable and most variable of all the Agaves, is common and quite at home in the Riviera gardens, flowering freely; and I had an opportunity of studying its characters and range of variation far better than I had ever done before, and of seeing several forms with which I was not previously acquainted. The

commonest forms in the Riviera show the characteristic small distant, nearly black teeth, and agree very well with what has been described and figured as *Ixtli* and *ixtlioides* (Bot. Mag. t. 5,893). In Dr. Hern's garden, situated just on the French side of the boundary gorge at St. Louis, I saw a form with leaves much thicker than usual ($1\frac{1}{2}$ inches thick at the base) and forming a less dense rosette. The plants called *Cantula* and *Rumphii* in the Riviera gardens are forms of *rigida*. Mr. Hanbury has just flowered a spineless form that agrees very well with the *sisalana* of Yucatan and Florida. I am quite satisfied now that *A. Houlletii*, Jacobi, is nothing more than undeveloped *sisalana*, and the same holds good with a plant called *lævis*. One panicle of this species at La Mortola was producing copious bulbillæ. The peduncle, including the rhomboid panicle, does not reach a greater height than 12–15 feet. The bract-leaves, like those of *americana*, are small and distant as compared with those of *atrovirens*.

A. Davilloni, Baker, n. sp. This is a new species, intermediate between *rigida* and *polyacantha*, which I saw for the first time in the Jardin d'Acclimatation at Hyères. It is acaulescent, with a rosette of about 30 rigid ensiform leaves, which reach a length of 3–4 feet and a breath of 4 inches at the middle. They are moderately glaucous when mature, tinged with red when young, very concave on the face towards the tip, with a non-decurrent pungent point and close minute deltoid chestnut-brown marginal teeth. The peduncle was about 20 feet long, and the panicle 6 feet long and broad. The bract-leaves and flowers are like those of *A. rigida*.

A. lurida, Miller. Seen only at Hyères, not differing materially from the plant of English conservatories.

A. troubetskoyana, Hort Hyères. A very fine plant, allied to *A. lurida*, which I saw, under this name, in the Jardin d'Acclimatation at Hyères, is quite distinct from anything I have seen at home. It is acaulescent, with about 30 lanceolate very glaucous leaves, 9–10 feet long, 6–7 inches broad above the middle, very thick and rigid in texture, with a large pungent non-decurrent end-spine, and small distant nearly black deltoid marginal teeth. I was informed that it had been received from De Smet of Ghent, and named in honour of Prince Troubetskoy, who some years ago had a very fine garden on the Lago Maggiore near Pallanza.

A. miradorensis, Jacobi. A plant which I saw under this name at Hyères, differs considerably from what we have at home, but is probably a variety of the same species. It has very glaucous lanceolate rigid leaves, 2 feet long, 4–5 inches broad at the middle, a small pungent black non-decurrent end-spine, and indistinct very small marginal teeth.

A. polyacantha, Haworth. Seen both at La Mortola and Hyères under a great variety of forms and in different stages of growth. When fully developed it has an acaulescent rosette of about 40 lanceolate leaves of firm texture, measuring about 3 feet long by 4 inches broad at the middle, green with a slight glaucous tinge, a small non-decurrent pungent red-brown end-spine, and copious close minute red-brown deltoid marginal teeth. The peduncle is about 5 feet long, with many small scariose bract-leaves, which are linear from a broad base, and the dense spike is about as long as the peduncle. In a young state the red-brown horny border is quite continuous, so that it is probable that this may be *A. Keratto*, Miller, received by him from the island of St. Kitts. A curious form seen at Hyères has more ensiform leaves than in the type, curved forward in the plane of the face, like a sickle.

Plants which I saw labelled *xalapensis*, *chiapensis*, *densa*, and *cubensis* were all *polyacantha* forms.

A. densiflora, Hook. After seeing the wild range of *polyacantha* forms just described, I cannot now separate *densiflora* as a species.

Group STRIATÆ.

A. striata, Zucc. Frequent in the Riviera, with a range of variation similar to what we know already at home. Here belong the plants called *Bonapartea rigida*, *B. striata*, and *B. hystrix*; but what are called *Bonapartea gracilis* and *B. gracilis glauca* really belong to the genus *Dasylirion*.

A. dasylirioides, Jacobi. Had just flowered at La Mortola. *A. dealbata*, Lemaire, is substantially identical with Jacobi's plant.

Group INTEGRIFOLIÆ.

A. Houlletii, Jacobi. As already stated this cannot remain in this group, but is *A. rigida*, var. *sisalana*, in an imperfect state of development.

Group GEMINIFLORÆ.

A. geminiflora, Gawl. Is grown at La Mortola under the name of *Littæa geminiflora*. This does not differ materially from the plant of English conservatories.

Group ALOIDÆ.

A. celsiana, Hook. Seen at Hyères only, just like the form grown at Kew.

A. mitis, Salmdyck. Gets better developed at La Mortola than any I have seen in England. Shortly caulescent; leaves lanceolate, 2 feet long, 4 inches broad at the middle, green, with a slight glaucous tinge; tip small not pungent; teeth very minute, coloured brown in the sun, remaining green when in the shade.

A. albicans, Jacobi. Seen at La Mortola only. I do not think it can stand as more than a glaucous leaved variety of *A. micracantha*.

A. chlorocantha, Salmdyck. Seen at La Mortola in a young state.

Group ATTENUATÆ.

A. elemeetiana, Jacobi. A plant seen at La Mortola, agreeing well with what we have at Kew.

A. attenuata, Salmdyck. Has lately flowered at La Mortola, with a cernuous spike 8-9 feet long, and a peduncle about half as long.

Group YUCCÆFOLIÆ.

A. yuccæfolia, DC. Seen both at Hyères and La Mortola, flowering freely and better developed than we get it in England. Leaves linear, 3 feet long, $1\frac{1}{2}$ inches broad at the middle, tapering gradually to a long point not pungent at the apex, obscurely serrulate on the margin. Peduncle wand-like, 4–5 feet long, with only a few distant small scariose bract-leaves, linear from a broad base. Spike dense, 3 feet long. Capsules very small, turbinate.

A. spicata, Cav. One of the things that interested me most at La Mortola, was to find growing in full perfection an *Agave* which cannot be anything else than this species, which was described by Cavanilles

in 1802 from a plant from Cuba, which flowered in the Botanic Garden at Madrid, and has not been heard of since. It is a very distinct species, nearly allied to *A. yuccæfolia*, with about 20 oblong-lanceolate leaves in an acaulescent tuft, which are bright green, 2 feet long, nearly 3 inches broad at the middle, with a small non-pungent end-spine and very close minute greenish-white marginal teeth. In the La Mortola plant the peduncle and bracts were just like those of *yuccæfolia*, the spike 3–4 feet long, and the oblong capsule an inch long, dehiscing loculicidally to the base.

Genus FURCRAEA, Vent.

F. gigantea, Vent. The typical form is quite at home at La Mortola in the open air, with bright-green glossy rigid ensiform leaves 4–5 feet long, with all the inner leaves of the rosette entire, but the outer with a few irregular teeth about the middle of the blade. I did not see *F. cubensis* or any of its allies anywhere on the Riviera, except young plants just received at La Mortola from Kew.

F. pubescens, Todaro. Seen at La Mortola in a young state.

F. Bedinghausii, K. Koch. Frequent in the Riviera gardens from Hyères to Genoa. The caudex is always short, the leaves reach a length of 4 feet, and are persistently very glaucous and scabrous on the under surface. I saw it in flower in two gardens at Mentone, producing copious bulbillæ. At Hyères it was labelled *Roezlia regia*. I do not think *F. Roezlii*, André, can be a distinct species.

Genus DORYANTHES, Correa.

D. excelsa, Correa. Is grown at La Mortola and elsewhere in the open air, but I do not think it has ever flowered.

Genus BESCHORNERIA, Kunth.

B. viridiflora, Hort. Hanbury. Leaves oblong-lanceolate, 3 feet long, 3–4 inches broad at the middle, glaucous green, scabrous on the under surface. Peduncle about 2 feet long; panicle 3–4 feet long, central branches nearly a foot long, each branch bearing at its apex a few corymbose flowers; bracts large ovate; pedicels 1½–2 inches long. Capsule oblong-trigonous, 1½ inches long, dehiscing loculicidally to the base. This is probably *B. yuccoides* (Hook, in *Bot. Mag.* t. 5,203) in a state of full development.

Order LILIACEÆ.

Genus YUCCA, Linn.

Y. aloifolia, Linn. Common all along the Riviera, flowering and fruiting freely. The typical form has stems 6 or 8 feet long, green rigid ensiform leaves, 1½ feet long, 1½ inches broad at the middle, with a pungent point, a channelled face and a very scabrous margin, a short peduncle, a rhomboid panicle 1½–2 feet long, and glossy bright red-brown indehiscent oblong fleshy fruits, 2½–3 inches long, 1½ inches diameter.

Y. guatemalensis, Baker. This is one of the commonest species along the whole Riviera, in a great variety of forms, and I had the opportunity of studying it far more fully than I had been able to do before. It is usually called *Y. Draconis*, but is not the plant of Linnæus, which is founded upon a figure in the "Hortus Elthamensis" of Dillenius. It gets up to a height of 15 or 20 feet, sometimes branching from low

down. I saw a tall one at Genoa with 15–20 branches, each ending in a great tuft of leaves. The leaves are always bright green, and reach a length of 3–4 feet. *Y. Gheisbreghtii* recedes from the type in the direction of *aloifolia* by its rigid scabrous leaves. *Y. Hazelli* and *Y. lenneana*, on the other hand, have less firm recurving leaves, and the marginal toothing is sometimes very obscure, and there is a trace of a brown border. *Y. conspicua*, of the Riviera gardens, is also a form of this species, and I have very little doubt now that *Y. gigantea*, Lemaire, which I know from description only, must also range here. It produces flowers copiously on the Riviera, but never ripens its fruit.

Y. desmetiana, Baker. This is evidently a distinct species, which attains a greater size on the Riviera than with us at home, but has not been known to flower. The finest plant I saw was in the garden of the Baroness von Huttner at San Remo, 5–6 feet high, the branching stems 3 inches in diameter, the recurving leaves a foot and half long, $1\frac{1}{2}$ inch broad.

Y. Peacockii, Baker. Grown at La Mortola, but has not yet flowered.

Y. gloriosa, L. Not common in the Riviera, but I saw several forms at Hyères. *Y. pendula*, Siebold, is substantially the same as our *recurvifolia*. *Y. brasiliensis*, is a form with much recurved very glaucous leaves. *Y. glaucescens*, Carrière, is a form of *gloriosa*, and quite different from Haworth's plant so called.

Y. macrocarpa, Engelm. This I saw alive for the first time at La Mortola. It was acaulescent, with a great tuft of very rigid glaucous ensiform leaves, 2 feet long, 1 inch broad at the middle, with a very pungent apex and a narrow brown margin without any threads. It has not yet flowered.

Y. treculeana, Carrière. This is grown along the whole Riviera, reaching a development far beyond anything which we have at home. In a plant at Genoa, planted 37 years ago, branching into several heads, the stem was 30 feet long, 4 yards in circumference at the dilated base, and a foot and a half in diameter some distance above the base. I feel quite satisfied that *canaliculata* and *carnuta* are forms of the same species.

Y. filamentosa, L. This is represented at La Mortola and by a form which quite agrees with Haworth's *glaucescens*.

Y. albospica, Hort. Grown both at La Mortola and Hyères, in fine condition at the latter garden under the name of *Y. elata*. It is the plant described in my monograph under the name of *Y. constricta*.

Y. Hanburii, Baker, n. sp. A new species, allied to *albospica* and *fragilifolia*, the seeds of which were sent to La Mortola many years ago by Mr. Sampson Hanbury from the Rocky Mountains. It is acaulescent, with a dense tuft of about 100 very rigid glaucous green leaves $1\frac{1}{2}$ feet long, under half an inch broad at the middle, smooth on the face, subscabrous on the back, with a pungent point, and a margin edged with brown with a white streak beyond the brown, from which a very few slender threads split away. It was not in flower at the time of my visit.

Y. baccata, Torrey. What is commonly grown as *baccata* on the Riviera is *Y. filifera*, Chabaud, which forms a trunk and inhabits Mexico, whilst the true *baccata* is acaulescent and inhabits California. I saw nothing *in situ* to equal the grand trunk which has just been presented to Kew by M. de Falbe from his garden at Cannes, and is now in the Temperate House. I saw at Hyères a curious plant called

baccata glauca, acaulescent, with very glaucous rigid ensiform leaves with very copious stout spreading filæ.

Y. Whipplei, Torrey. A fine plant, which has been drawn by Mrs. Thiselton-Dyer, has just flowered and died at La Mortola. I saw another which had lately flowered at Hyères, where it is grown under Lemaire's name of *Yucca californica*. I now think this had better be kept as a genus distinct from *Yucca*, under Engelmann's name *Hesperoyucca*.

Genus DASYLIRION, Zucc.

All along the Riviera Dasylirions are a prominent feature in the gardens, and the soil and climate appear to suit them admirably.

D. acrotrichum, Zucc. Grown everywhere and flowers freely. Easily recognised by the leaves breaking into a tuft of threads at the top.

D. glaucophyllum, Hook. Like the last, grown all along the Riviera and flowers freely. *Bonapartea gracilis glauca* and *Dasylirion gracile glaucescens* both represent the typical form. *Bonapartea gracilis*, of the Hyères garden, differs by its bright green leaves. It may be a distinct species, but I did not see it in flower. A plant grown at La Mortola as *Dasylirion hybridum* may be the same. What I saw called *D. quadrangulatum* was all *glaucophyllum*. In a plant seen in flower at Genoa the peduncle with the panicle reached a length of 20 feet.

D. juncifolium, Hort. Hanbury. This I was very pleased to see in flower in a state of full perfection at Monte Carlo and again at Genoa. It has a great tuft of 200–300 recurving rigid linear leaves, 3–6 feet long, not more than a quarter of an inch broad at the middle, vertically striated, slightly glaucous and convex on both faces, scabrous on the margin, not splitting up into threads at the top. The peduncle is 15–20 feet long, bearing, in its upper half, dense spikes of minute whitish flowers in the axils of great scariose serrated lanceolate white bracts. Mr. Watson sent home specimens in fruit of the same plant two years ago from Hyères. It may be *D. quadrangulatum*, S. Wats., in a state of full development.

Genus NOLINA, Michx.

N. longifolia, Hemsley. Grown commonly all along the Riviera under the name of *Dasylirion longifolium*. I saw it in flower at Genoa.

N. recurvata, Hemsley. Not unfrequent in the Riviera gardens; under the names *Pincenictitia glauca* and *P. tuberculata*. The finest plant I saw was in the garden of the Baroness von Huttner at San Remo, with a trunk 6 feet in circumference at the base.

Genus DRACÆNA, L.

The only true Dracæna grown is *D. Draco*. I did not see any old trunks.

Genus CORDYLINE, Com.

The universal *Cordyline* of the Riviera gardens is the New Zealand *C. australis*, Hook. fil., with leaves varying greatly in breadth and rigidity. I did not see any trunks taller than those which we have in

the Temperate house at Kew. All the plants I saw labelled *indivisa* were forms of *australis*. At La Mortola I saw also plants of the Australian *C. stricta*, Endlich.

Tribe ALOINEÆ.

The Aloes were not in flower at the time of my visit, with the exception of *A. ciliaris*, Haw., which grows luxuriantly in the open air. The commoner large caulescent Aloes of the gardens at La Mortola, Mentone, and Monte Carlo were not, as I expected, the Mediterranean *A. vera*, Linn., but the Cape *A. africana*, *A. supralævis*, and *A. arborescens* and its variety *frutescens*. *A. striata*, Haw. (*A. albocincta*, Haw.), and its variety *A. hanburyana*, Naudin, are also frequent. I saw also at La Mortola *A. purpurascens*, the typical *A. ferox*, *A. Bainesii* (young stems only), and *A. plicatilis*. Of the smaller species *A. aristata* is much finer than we get it in England, and this is also the case with *A. heteracantha*, Baker, which is not yet known in flower. A caulescent species, grown at Mortola, allied to *A. arborescens*, with a dense tuft of lanceolate leaves 7–9 inches long, margined with minute teeth, at the top of a long slender erect stem, is probably new and undescribed. [This has since been described in *Gardeners' Chronicle*, 1892, vol. i., p. 780, under the name of *Aloe aurantiaca*, Baker]. Dr. Penzig has lately introduced from Abyssinia to the gardens at La Mortola and Genoa, *A. abyssinica*, *A. commutata*, and three other species. Mr. Hanbury also grows *A. variegata*, and has some curious varieties of *mitriformis* and *humilis*, which are different from anything I have seen at home. He grows many Apicras, Haworthias, and Gasterias, none of which seemed materially different from what we have at Kew. A *Gasteria*, called *multipunctata*, with glossy lorate leaves 1–1½ feet long, with obscure immersed greenish-white blotches, is probably an undescribed species.

Order BROMELIACEÆ.

The species which are hardy on the Riviera are *Tillandsia xiphioides*, *Puya gigas*, *Hechtia Gheisbreghtii*, *Dyckia brevifolia* (grown under the name of *D. Mazelii*), and *D. rariflora* (grown under the name of *D. remotiflora*).

It is quite evident that the climate and soil of the Riviera are admirably fitted for the growth of a large proportion of these plants. As might be expected, there is a general tendency in the leaves to be more glaucous than at home. A great many species reach their full development on the Riviera which we get at home only in an undeveloped condition. The principal groups of Agaveæ, which are not represented and are but little represented on the Riviera, are the *Aloideæ* and *Viviparæ*, and Furcraeas of the *cubensis* group. It is probable that these require more moisture, and perhaps more heat, than they get in the Riviera climate. My best thanks are due to Mr. Hanbury for his kindness and the trouble which he took to help me in every way; and to his principal gardeners, MM. Cronemeyer and Villa, to whom, during my stay, I was constantly applying for information.

J. G. BAKER.

Herbarium, Kew,
December 17, 1891.

LXVIII.—MADAGASCAR PIASSAVA.

(*Dictyosperma fibrosum*, Wright.)

[K. B., 1894, pp. 358–359.]

For nearly twenty years a fibre closely resembling Brazilian Piassava (described in *Kew Bulletin*, 1889, pp. 237–242) has been obtained from the island of Madagascar. It was moderately long, of a rich brown colour, and evidently obtained from the stem of a palm as ordinary Piassava. The quantity produced was never very large, and in the early stages of the enterprise the fibre was shipped in a very rough, uncombed state. Latterly the quality has much improved, and during the period when this class of fibre commanded specially high prices the shipments were probably remunerative. Owing, however, to the discovery of West African Piassava or "bass fibre" obtained from *Raphia vinifera* (described in *Kew Bulletin*, 1891, pp. 1–5), the prices obtained for Madagascar Piassava have apparently fallen almost as low as the cost of production, hence little of it has appeared lately in the London market. For the first specimen of Madagascar Piassava, now in the Kew Museum (No. ii.) we are indebted to Messrs. J. Puddy & Co., of Mincing Lane. This was received in 1890. At that time the plant yielding it was not known. The more common palms of Madagascar such as species of *Hyphæne*, *Dypsis*, *Raphia* and *Bismarckia*, were believed not to yield this fibre. Hence it was inferred that there existed in the island a palm not yet described. This eventually proved to be the case. Through the efforts of Messrs. Proctor Brothers, of East India Avenue, E.C., Kew obtained in 1890 specimens of the complete plant known locally as *Vonitra*, with stem and leaves showing exactly the manner in which the fibre was produced. Each plant had a slender stem about 5 feet high and $2\frac{1}{2}$ inches in diam. This was surmounted by a crown of graceful pinnate leaves 5–6 feet long. The whole stem, to the base, was thickly invested by a dense mass of fibres formed from the inner sheaths and the edges of the petioles. The individual fibres were finer and more flexible than Brazilian Piassava and also slightly shorter; in other respects they resembled it very closely. As to the commercial position of the fibre Messrs. Ide and Christie are good enough to inform us: "Of late, Madagascar Piassava "has been well combed, straight, and clean, and in this state it is worth "from 30*l.* to 37*l.* per ton; but as the quantities sent home, even at these "rates, are small, we are led to conclude the preparation as now done is "costly." The shipments are made from Tamatave and some of the ports to the south. In September 1894, Madagascar Piassava was reported to be "in demand," and the price had risen to 46*l.* per ton. Fresh seeds were obtained from Messrs. Proctor Brothers, and from these numerous plants, now about 2 feet in height, have been raised at Kew. They are nearest to *Dictyosperma album*, a well-known ornamental palm from Mauritius and Bourbon, but are easily distinguished both from this and other species. Many of the plants raised at Kew have been distributed to botanical establishments in the Colonies. Very soon the species will probably be well represented under cultivation.

As a new species, the following description of this palm has been prepared from such material as is now available. No flowers have yet been received.

Dictyosperma fibrosum, *C. H. Wright;* arbor, caule erecto fibris ex petiolis obsoletis vestito, foliis juvenilibus bifidis adultis æqualiter pinnatis,

petiolis elongatis supra leviter concavis subtus convexis (*i.e.*, sectione transversali lunata) leviter furfuraceis, foliolis lanceolatis acutis basi contractis glabris, nerviis centralibus prominentibus lateralibus 3-4 minus conspicuis transversalibus paucis conjunctis, floribus ignotis, fructu subgloboso pericarpio fibroso stigmate terminali, semine embryone subbasilari, albumine ruminato.

Folia 5 ped. longa; *petiolus* 2 ped. longus; *foliola* 1½ ped. longa, 1 poll. lata. *Fructus* 8 lin. diam.

Habitat: Madagascar. *Nom. vulg.*: Vonitra.

This species differs from *D. album*, H. Wendl., in having the trunk covered with a dense mass of brownish fibres, about 18 inches long, which furnish the "Madagascar Piassava" of commerce. Specimens of this from Messrs. Proctor Brothers are deposited in the Museum of the Royal Gardens, Kew. The lateral nerves of the leaflets are also more conspicuous than in *D. album*, and the fruit is subglobose.

LXIX.—WEST AFRICAN BASS FIBRE.

(*Raphia vinifera*, Beauv.)

[K. B., 1891, pp. 1–5.]

This palm is described in the *Flore d'Owure et de Benin*, vol. i. p. 76 (tab. 44, fig. I. et tt. 45 and 46), from which the following notes have been extracted. It is very abundant on the borders of rivers, intersecting the countries near the sea in the kingdoms of Oware and Benin. The tree is of medium height, having leaves of from 6 to 7 feet or more in length with spiny leaflets. The fruiting spadix is very large, about 4 feet long, and forms a heavy load for one man to carry. What this tree lacks in height is compensated for by the beauty of its form, the brightness of its colour, and its imbricated shining fruits. The stems are used to form the framework of native dwellings, and the leaves, bound with lianes, are used for thatching. Huts so built are substantial, and afford a good protection from the rain and heat of the sun, but at the same time serve as a haunt for vipers, rats, and other vermin. From the trunk an intoxicating beverage of a whitish colour is obtained, and is called by the natives "Bourdon"; it is not quite so sweet as ordinary palm wine; but is more vinous, and appears to contain a larger quantity of spirit. The fruits of this palm, which are collected all the year round, are likewise said to afford a beverage of a second quality which will keep for a considerable time.

The *Board of Trade Journal* [November 1890, p. 596] quotes from the *Lagos Weekly Times* an account of the fibre, and states that it "promises to become an important and valuable addition to the ex-"ports from Lagos."

It will probably be found a useful substitute for Piassava, an account of which is given on p. 227.

. The following correspondence has taken place between this establishment and the Colonial Office on the subject of West African Bass fibre :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, October 3, 1890.

I AM directed by Lord Knutsford to transmit to you a copy of a despatch from the Governor of Lagos, reporting that he had forwarded to you for analysis and report, a box containing 20 lbs. of bass fibre obtained from the *Raphia vinifera*.

Lord Knutsford will be glad to be informed of the result of your examination of the parcel in question.

I am, &c.
(Signed) EDWARD WINGFIELD.

The Director, Royal Gardens, Kew.

Sir A. MOLONEY to COLONIAL OFFICE.

Government House, Lagos,
August 20, 1890.

MY LORD,

I HAVE the honour to report that there will go forward by the next mail steamer, addressed to the Royal Gardens, Kew, a box containing 20 lbs. of a bass fibre obtained from the *Raphia vinifera* or wine palm of West Tropical Africa.

2. The sample I had hurriedly prepared during my last visit to the eastern district.

3. On its "find," area of supply, local preparation and uses, as also on its prospects as an export, for which I anticipate a bright and profitable future, I have drawn up a minute with a view to its advertisement.

4. May I ask your Lordship to let the Director of the Royal Gardens, Kew, who takes such deep interest and gives such encouragement to the development of the economic botany of our colonies, have a copy of this despatch, and to allow of the circulation of the minute among the various Chambers of Commerce.

5. I attach a copy of the notice that has locally appeared inviting the attention of the public to this fibre.

I have, &c.
(Signed) ALFRED MOLONEY,
Governor.

The Right Hon.
Lord Knutsford, G.C.M.G., &c.

EXTRACT of MINUTE by the Governor of Lagos on the Bass fibre of the Bamboo palm (*Raphia vinifera*).

In a letter received by me, shortly after my arrival in Lagos in February last, from a well-known Manchester firm, a sample of a fibre known as "African Bass" was forwarded, with the following remarks :—

"If this can be found and shipped in quantity I could sell large quantities. It should be kept straight, tied up first in small bundles, thickness of a man's wrist, and these made up into bales of about half a hundredweight each. It must be kept straight, whatever the length, as the bends spoil the fibre and make it difficult to work."

* * * *

"Please note the brown fully mature fibre is preferable to the light red colour; present value 30*l*. to 32*l*. per ton."

In the "African Bass" of which the sample was sent to me I was surprised to recognise one of the commonest of the native fibres of this colony, used, I may say, by every fisherman in the manufacture of his

lines, and prepared from one of the most plentiful of the palm trees of the colony, the *Raphia vinifera,* or "Bamboo" palm.

The "African Bass" is in appearance a stiff and wiry fibre, varying in colour from dark brown to light red, dependent for its shades on duration of soaking. It is most readily obtained in lengths of from 3 feet to 4 feet, beyond which length it is inconvenient to pack and difficult to procure without injury to the tree. In diameter it varies from $\frac{1}{16}$ to $\frac{1}{30}$ of an inch, the latter of which may be accepted as the limit of fineness to be admitted in a commercial sample for the European market. It is used, I believe, mainly in the manufacture of hard brushes for various domestic and manufacturing purposes. The demand appears to be very large, and the price, as shown above, is exceedingly satisfactory.

The source of its supply in this colony alone may be said to be practically inexhaustible, as will readily be acknowledged when its origin is explained.

The "Bamboo" palm, or *Raphia vinifera*, is perhaps the commonest tree in the swamps and low lands which line the waterways of the colony. Dense thickets of these palms, traversed only by the palm wine gatherer or the bamboo cutter, push their way into the lagoons, and extend over the flood grounds, and even to a distance of from 15 to 20 miles up the river valleys into the interior. The area occupied by these *Raphia* forests it would be impossible to calculate, but it may be accepted without doubt that they extend throughout the length of the colony, and to a distance of at least 15 miles from the sea coast, and that over this area of about 5,000 square miles they form a considerable proportion of the vegetation, next only in numbers to the oil palm (*Elæis guineensis*) and the Mangrove (*Rhizophora mucronata*). The fact that one can steam for miles, as I have frequently done, wondering to what commercial advantage they could be put, through uninterrupted *Raphia* groves on either hand in the Eastern waters, impresses one with the extent of the acreage which must be overrun by this graceful palm.

Everybody in the colony is aware of the manifold uses of the *Raphia* palm; how from its leaves hats, cloth, and cordage are made; from its leaf-stems rafters, fences, and walls; and from its crown or bud of unopened leaves palm wine of excellent quality. Of one part only the use seems not generally known, and it would appear that this particular portion of the tree, though hitherto treated as useless, is in reality of more value commercially than all the rest.

When the "Bamboo" cutter clears away the leaves from the lower stem of the palms the trees present a very ragged and uneven appearance, owing to the practice of leaving a portion of the leaf-stalk adhering to the parent stem. These base-stalks partially encase the bole of the tree and project upward and outwards, forming the scaly covering which gives so strange an appearance to a grove of *Raphia* palms. From these stumps of the leaf-stalks the native fishing lines are made. The fibre is extracted by a process of soaking and scraping, which is exceedingly simple and is fully understood by every bamboo cutter and line maker. It is this fibre which is known in the European market as "African Bass," and there is no apparent reason why, with a population who are in the habit of preparing it, and a source of supply which may be regarded as practically unlimited, we should not be able to compete on even terms with the sources of supply which at present monopolise the market.

* * * *

In the Yoruba language the *Raphia vinifera* is known as *Igi-oguro*, *Eriko* and *Akpako*, the Bass fibre as *Iyo*, and the fishing line *Iyo-oguro* or *Iyo-agbe*. Along the inland waters or lagoons from Popo to Mahin the natives use this fibre for fishing lines, and as twine and rope.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
October 10, 1890.

DEAR SIR,

WE duly received your letter of 8th instant, and to-day brings us the sample of fibrous material found at the base of the leaves of the "Bamboo" palm of West Africa (*Raphia vinifera*).

We have seen this material before, and the small importations that were made (some years ago) were not at all well received by consumers, who found that the expense of cleaning and the ultimate result were most unsatisfactory when compared with the price and results of South American Piassava.

During the past year or two, however, the market values of the latter have undergone a great change, Bahia Piassava having largely risen in price. We think, therefore, that it might be well worthy of producers' attention were they to select only those fibres of which we return you specimens herewith, and clean them effectively from all the adherent small fibre. Only the strong healthy fibres should be selected and prepared, and the various lengths should be bundled separately.

The material being somewhat of a novelty, it might be well for shippers to confine their first shipment to, say, 10 to 20 tons, so as to try the market adequately. If properly selected and cleaned, we estimate that it would sell at 25*l.* per ton to-day in London, a figure that, in our opinion, should leave a handsome profit to the producer.

Yours &c.,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.

MESSRS. IDE AND CHRISTE to ROYAL GARDENS, KEW.

72, Mark Lane, E.C.,
October 24, 1890.

DEAR SIR,

WE have your favour of the 23rd instant, and duly note the contents of enclosed extract from Minute of Governor of Lagos on the fibre of *Raphia vinifera*.

Since we last wrote to you on this subject, a few bales of "African Bass" recently imported have been sold, and reached the extreme price of 42*l.* The fibre had been carefully selected and remarkably well cleaned, hence the excellent market it met with. We scarcely expect this price would be maintained for substantial quantities, but for fibre of equal merit the immediate outlook would seem to indicate that 35*l.* to 40*l.* might be the range of value.

Yours, &c.,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.

LXX.—WEST AFRICAN BASS FIBRE—(continued).

(*Raphia vinifera*, Beauv.)

[K. B., 1892, pp. 299-300.]

The following extract from a letter from Mr. W. Crowther, Curator of the Botanical Section at Aburi, Gold Coast, refers to the shipment of West African Bass from Appam, a port between Accra and Cape Coast Castle in the Colony of the Gold Coast :—

On my way to Cape Coast I noticed a small quantity of the Bass fibre being shipped from Appam. This valuable fibre is obtained from the palm which is so common and plentiful in this part of the colony, namely *Raphia vinifera*. It is a very important product, being worth from 25*l*. to 60*l*. per ton, according to quality. Great interest is at present shown in England in the discovery of similar fibres to this, and there is a good market for them, but the supply is very small, owing chiefly, I think, to the difficulty experienced in extracting and cleaning the fibre. It is chiefly used for brushmaking. I will make inquiries and endeavour to obtain information respecting suitable machinery for cleaning and preparing this fibre, which information, if I am able to procure it, shall be published in my next report.

LXXI.—RAFIA FROM WEST AFRICA.

(*Raphia vinifera*, Beauv.)

[K. B., 1895, pp. 88–92.]

In the *Kew Bulletin* for 1891, pp. 1–5, an account is given of West African Bass fire, prepared from the base of the leaves of the Bamboo palm (*Raphia vinifera*). Since that time African bass has become a recognised article of commerce. The price at first was about 42*l*. per ton; it rose to 56*l*. per ton, but latterly, in competition with similar fibre from the Palmyra palm, the Kitool, and the original bass produced in Brazil, known as Para and Bahia piassaba, it has been quoted at 20*l*. to 30*l*. per ton. Even at the latter price it supports a considerable industry in West Africa.

It appears probable that the Bamboo palm may be made available also for other uses. A strong, useful material known as Raphia or Rafia is shipped to this country from Madagascar. According to the Rev. Richard Baron, F.L.S. (*Kew Bulletin*, 1890, p. 211), it is obtained "from the young unopened leaves of the Raphia palm." *Raphia Ruffia*, Mart. *Hist. Nat. Palm*, iii., p. 217 (*R. pedunculata*, Beauv.) is confined to Madagascar. It is widely spread in the island, chiefly in valleys, up to an elevation of 4,000 feet. It is also found abundantly along the coast. The pinnate leaves are 20 to 30 feet in length, with numerous narrow leaflets, varying from $2\frac{1}{2}$ to 5 feet long. Rafia is prepared by peeling off the cuticle (with some of the underlying fibro-vascular bundles) on one or both sides of the leaf. It is used locally for delicate plaited and woven fabrics, cloths, and hats, as well as for mats for covering floors and wrapping up goods. More recently it has been woven into superior matting, tastefully coloured, and used instead of tapestry for covering walls in London houses. The loose strips of Rafia are in demand in this country and elsewhere in place of Russian or Cuban bast as tie-bands by gardeners and nurserymen. For the latter purpose

the strips are usually loosely plaited in hanks 1½ to 3 pounds in weight made up into bales weighing 1½ to 5½ cwt. Each strip is a straw-coloured flat band about 4 feet long, and about ½ to ¾ inch wide, but capable of sub-division into fine threads.

Owing to the French expedition to Madagascar, Rafia has already shown an advance in price. It was sold recently at 55*s.* per cwt. Apart from this, however, there is apparently a steady demand and a good price for Rafia fibre.

Raphia Ruffia is closely allied to the Bamboo palm of tropical Africa. If the supply of Rafia from Madagascar were greatly reduced or cut off, it is very probable that within a short time it would be possible to obtain an almost identical article from West Africa. One of the first notices of a Rafia from this part of Africa is contained in the Report by Mr. C. F. Cross, F.I.C., on the Miscellaneous Fibres shown at the Colonial and Indian Exhibition 1886. Mr. Cross mentioned that this was so closely similar to Rafia "as to be applicable to precisely the same uses." The following particulars were given :—

"Grass (epidermal strips of *Raphia vinifera*). Exhibited by Mr. A. Sibthorpe in the Sierra Leone Section, with specimens of straw plait illustrating its more usual application by the natives. This specimen also proved itself on analysis to be worth the attention of paper makers. The following determinations were made :

Moisture - - - - -	9·8 per cent.
Ash- - - - - -	2·7 „
Cellulose - - - - -	60·8 „
Ultimate fibres. Length - - -	1·5 to 2·5 mm.

"It is needless to say that the raw material is particularly clean ; in length of fibre, but more especially in yield of cellulose, it is superior to Esparto ; it only remains, therefore, to determine the cost of production, and if within the limit, to introduce this raw material into European commerce. A further examination of this substance comparatively with Rafia, which still commands a high price amongst gardeners and nurserymen, showed that it was so closely similar as to be applicable to precisely the same uses, and such an application would, of course, take precedence of that above indicated. This fibrous material is well worthy of further attention.

"I have received from Messrs. Joynson satisfactory reports upon the papers made from the Rafia strips exhibited in the West African Section. They were treated by the (basic) sulphite process, and bleached to a good colour. The paper was reported to be of exceptional strength." [*Colonial and Indian Exhibition Reports*, pp. 379, 385.]

Small shipments of West African Rafia have already been made to this country. It was, however, badly prepared, and the results were not satisfactory. The strips were too short, and they reached their destination curled up so as to resemble very fine twine. It is necessary the strips should be very strong, of good length, and dried perfectly flat. Some of the best Madagascar Rafia is about 3½ to 4 ft. long. Very exceptionally it is 5 ft. long. This shows that the long leaflets in the middle of the frond are chiefly used and the shorter ones discarded. West African Rafia, to replace the Madagascar fibre, must be as long as possible, with a width of about ½ to ¾ in., but none less than ½ in.

If the Bamboo palm (*Raphia vinifera*) does not afford the best material for Rafia strips, it is possible some other species may do so. The West Africa Raphia so far known are as follows :—

Raphia vinifera, Beauv.—Bamboo palm. Abundant in West Africa, extending also to central tropical Africa, where it was found by

Schweinfurth. Its distribution in Lagos is thus described by Sir Alfred Moloney (*p.* 230) :—

"The 'Bamboo' palm (*Raphia vinifera*), is perhaps the commonest tree in the swamps and low lands which line the waterways of the colony. Dense thickets of these palms, traversed only by the palm-wine gatherer or the bamboo cutter, push their way into the lagoons, and extend over the flood grounds, and even to a distance of from 15 to 20 miles up the river-valleys into the interior. The area occupied by these *Raphia* forests it would be impossible to calculate, but it may be accepted, without doubt, that they extend throughout the length of the colony, and to a distance of at least 15 miles from the sea coast. Over this area, of about 5,000 square miles, they form a considerable proportion of the vegetation, next only in number to the Oil palm (*Elæis guineensis*) and the Mangrove (*Rhizophora mucronata*). The fact that one can steam for miles, as I have frequently done, through uninterrupted *Raphia* groves, impresses one with the extent of the acreage which must be overrun by this graceful palm."

Raphia Hookeri, Mann and Wendl.—The *Ukot* of Old Calabar, where it is cultivated as a wine palm. The natives also manufacture cloth from the epidermis of the leaflets. On the Sherboro, in Sierra Leone, they make hammocks from it, as well as all sorts of basket work, mats, &c. This is one of the largest of the Raphias, the whole plant often attaining a height of 70 feet. The fronds are 40 feet long, with leaflets 4 to 5 feet long. If in other respects suitable, this should yield Rafia fibre as long as the best from Madagascar.

Raphia Gærtneri, M. and W.—Apparently confined to the Spanish Island of Fernando Po, in the Gulf of Guinea. It grows from the shore up to 500 feet above the level of the sea.

Raphia longiflora, M. and W.—The only locality given by Mann for this species is the island of Corisco, off the French Colony of Gaboon. This palm is 40 to 50 feet high, with fronds 33 feet long. The leaflets are 5 to 5½ feet long and 2 to 2½ inches wide. A figure, showing the natural habit, is given in *Trans. Linn. Soc.*, xxiv., t. 39.

Raphia Welwitschii, Wendl.—A new species, collected by Dr. Welwitsch, in Angola. It grows in humid places on the rivers in the interior, and especially in the district of Galungo. The epidermis of the leaflets is used by the natives in the manufacture of cloths, &c. *R. textilis*, Welw. *Apont.*, 584, n. 2, yielding also textile filaments, is apparently a closely allied plant.

Epidermal strips, somewhat similar to Rafia, are available from many species of palms, notably the Cocoa-nut palm and the Palmyra palm. Specimens of these are in the Kew Museum. A variety of the Palmyra palm, known in various districts under the native names of *Morintshi, Kelingoos, Run, and Sibboo*, is well known to be abundant in West Tropical Africa. The epidermal strips from the segments of its fan-shaped leaves could, no doubt, be produced quite as long as those of the Madagascar Rafia.

While suggesting these other sources, it would be well, however, to confine attention at first to the Rafia palms, and especially in view of the fact that they form, as in the colony of Lagos, the prevailing vegetation over immense tracts of country.

The commercial position with regard to Rafia fibre is given below by Messrs. Ide and Christie. It will be noticed that particular attention is drawn to the fact that previous shipments of West African Rafia have failed because the strips were too short, and not presented in the flat broad condition characteristic of the Madagascar fibre. Too much reliance should not be placed on the exceptionally high price of Rafia at

the present time. It would be safer to count only on the more normal price of the fibre, and this during the last few years has been about 30*l.* per ton :—

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
March 4, 1895.

DEAR SIR,

YOURS of the 2nd instant, with sample of West African Rafia, to hand. This we have seen once or twice before, and sold with difficulty, being very inferior to the Madagascar. The former is very short and hairy, not long and broad like the latter, and would appear to be peeled from much smaller leaves.

We return your specimen along with a piece of the usual Madagascar. Whilst the latter is available the trade would only look at the West African at about half the price.

Yours faithfully,
(Signed) IDE AND CHRISTIE.

The following account of the production of Rafia fibre has been published in the United States' *Consular Reports* for April 1894. It was prepared by Mr. Edw. Telfair Wetter, the United States Consul at Tamatave :—

Rafia Palm Fibre.

This fibre is the product of the Rafia palm (*Raphia Ruffia*), one of the most useful of the palm family. The tree is a native of Madagascar, growing profusely along its entire coast line near fresh water rivers, lagoons, and marshes, and the very best quality actually in the water. It is practically indigenous in the valleys all over the island. The natives cut the new leaves from the tree after they have obtained a height of some seven feet, and have just commenced to spread or open. Two new leaves always sprout out simultaneously from each tree and from the same sheath. In appearance and gracefulness, a fully opened Rafia palm leaf is midway between the leaf of the cocoa-nut palm and the plume of the ostrich.

After removal from the tree the leaves are separated, the leaf spears or feathers being cut away from the heavy leaf stalk or large centre rib and their tips cut off or not, according to the whim or needs of each worker. The inhabitants of the fishing villages are the main producers of Rafia fibre, because they are the main consumers of the by-products, making their finer fish nets from the small centre rib or spine that runs down the middle of each leaf spear. The entire native population use the leaf stalk or large centre rib in all their building and portage operations.

The first process of manufacture, in turning these leaf spears into the Rafia of commerce, consists in the removal, with a very small sharp knife, of the centre ribs of the spears. These ribs divide each spear in half. Each of these halves of leaf flesh are then striped of their under covering, which, in the closed condition of the spear is, for the moment, the outside. This removal is readily accomplished by making a small cut across the leafy flesh above mentioned, about one inch from the base. The fibre, which exists in the shape of a vegetable film or covering on the under side of the leaf spear, is pressed up and loosened with the knife, and, being caught between the thumb and said point, is ripped off at one pull. The same thing is done with the other half of the spear flesh by merely reversing the same in the other hand and

repeating the operation. Practice makes the process a simple, perfect, and rapid one, and a woman can readily strip, per day, what will yield some 5 lbs. of Rafia. It must be understood that the men cut the Rafia leaves and carry them to their homes; the women do the rest. They, however, rarely strip more than what would yield 2 lbs. of Rafia, because the curing of the fibre is partly accomplished the afternoon of the same day that it is stripped from the spear flesh.

The strips of whitish fibre thus secured, ranging from 2 to 4 feet and over in length, are spread out upon mats in the sun to dry in loose bunches. When partly dry, they are knotted into 1 lb. bunches and spread, usually upon the roof edges of small sheds or outhouses, to finish curing, and are mostly carefully guarded against rain or dew. In three days of good sun drying the Rafia is ready for market.

I regret to say that, owing to the cupidity of the natives and traders, much the larger portion is marketed after only one day's curing. The greener the fibre the heavier the weight; hence the temptation. . . . There is no particular time for preparing, cutting, or curing Rafia. The crop is a constant one, harvested to suit the wants or appetites of the natives, being received in the seaport towns at all times and seasons, weather permitting its transport, and shipped as shortly after receipt as possible. . . . It may be roughly stated that fully 50 per cent. of the young Rafia palm trees are annually destroyed in this way, and but for its remarkable hardiness, ready growth, and the ease with which it is propagated, this fact alone would mean its speedy and total extinction. Within four years, local Malagasy laws have been promulgated forbidding this terrible destruction. Yet it still exists, but in a surreptitious manner; or whenever they crave rum, cloth, or vazaha finery, for which Rafia fibre alone can be bartered.

. . . . Rafia is one of the most staple of Madagascar products, finding an even more ready market than rubber or caoutchouc. The price in Tamatave, or we might say free on board, as the cost of putting on board in quantity is a very nominal one, ranges from 5 to 9 cents for A 1 Rafia, while red Rafia usually brings about 2 cents per lb. less than the A 1 white. . . . Practically, every one doing business in Madagascar buys Rafia either for speculation, in barter for goods, on commission, or as agents.

LXXII.—RAFIA FROM WEST AFRICA—(continued).

(*Raphia vinifera*, Beauv.)

[K. B., 1895, pp. 287–288.]

A brief account was given in the *Kew Bulletin*, 1895, (pp. 88–92), of the production of the material known as Rafia, from species of palms in West Africa. This fibre has hitherto been exclusively obtained from Madagascar. It is used for tie bands by gardeners, as well as for making mats and decorative articles.

A sample of West African Rafia, obtained from the leaflets of *Raphia vinifera*, locally known as the Bamboo palm, was brought to Kew by Mr. Henry Millen, Curator of the Botanic Station at Lagos, in August last. The following reports were obtained on this sample :—

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.
September 4, 1895.

DEAR SIR,

YOUR favour of yesterday and samples to hand. The latter show just as we formerly experienced, bad colour (*i.e.*, brown in lieu

of creamy white), very short (one sample was longer), all stringy, not flat-open. The trade, unless in famine, would not entertain it ; appearance goes a long way nowadays, although for some tying purposes, this West Coast product should do as well as the Madagascar.

If asked for a value, we would hazard 20*l.* per ton.

Yours faithfully,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., C.M.G., D.Sc.,
Royal Gardens, Kew.

MESSRS. J. A. NOBLE & Co. to ROYAL GARDENS, KEW.

136, Fenchurch Street, London, E.C.,
September 6, 1895.

DEAR SIR,

WE are favoured with your letter of the 3rd instant, with sample of Lagos Rafia. We are desirous of showing this to the consumers as well as to the dealers. With the latter there will be difficulty in getting them to put it forward in the place of the Madagascar Rafia, as it is not so sightly and the smaller buyers will prefer the broader and lighter colour. Our own opinion is that with more care in the preparation it will come into use with those who do not look to colour so much as strength. We see no reason why it may not be broader, as it has simply been allowed to curl up in the preparation, and is consequently harsh, with a tendency to cut in the using. It is certainly the strongest we have seen from the West Coast ; what we have seen before has been soft and good colour, but very tender and unsaleable.

We will write you again after we have given the consumers an opportunity of testing it and have received their opinion upon it. In the meantime, Mr. Millen should continue his experiments, and we feel no doubt he will be able to improve considerably on this sample. There is very little doing at the present time, and prices have fallen back from 48*l.* per ton to 32*l.* nominal. We consider this should sell at about 20*l.* per ton on the basis of 32*l.* for the Madagascar.

Yours truly,
(Signed) J. A. NOBLE & Co.

D. Morris, Esq., C.M.G., D.Sc.,
Royal Gardens, Kew.

As already mentioned, small shipments of West African Rafia have been made, from time to time, for many years, but no commerce has arisen in it owing to its unfavourable character as compared with Madagascar Rafia. The natives all along the coast manufacture cloths, mats, baskets, and hammocks from Rafia, and samples are in the Kew Museums from the Gambia, Sierra Leone, Gold Coast, and Old Calabar.

Further specimens of Rafia from West Africa were brought to Kew recently by Mr. Walter Haydon, Curator of the Botanic Station at the Gambia. The plant yielding these has not yet been determined. It is evidently a species of *Raphia*, but different in the fruit from any *Raphia* so far represented at Kew. Mr. Haydon's specimens of Rafia were soft in texture and of good colour, but rather short. They were, however, superior to any specimens previously received from West Africa. The following Report shows also, that they were valued commercially at a higher price than any former specimens ;—

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
November 14, 1895.

DEAR SIR,

REGARDING the sample and letter dated 13th from the Royal Gardens duly to hand, we beg to say that for colour and texture, this is the best Rafia we have seen from the West Coast of Africa, and in these respects equal to the Madagascar product. The uncut ends, shortness and fine points are all against the sale and would interfere both with sale and value.

As it is, we put it about 20*l.* to 25*l.* per ton. A small shipment of the usual West Coast we sold a few days ago for 25*l.*

Yours faithfully,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., C.M.G., D.Sc.,
Royal Gardens, Kew.

LXXIII.—PALMYRA BASS FIBRE.

(*Borassus flabelliformis, L.*)

[K. B., 1892, pp. 148–150.]

Owing to the scarcity of the Bass fibres hitherto obtained from two Brazilian palms, *Attalea funifera* and *Leopoldinia Piassaba*, inquiry has been made in most tropical countries for palms likely to yield fibres of a similar character. A bass fibre has been obtained in Madagascar from a species of *Dictyosperma* (probably *D. fibrosum*, Wendl.), and more recently Lagos or West African bass has been obtained from *Raphia vinifera*, just described. A fibre almost identical has still more recently been prepared in Ceylon from the Palmyra palm (*Borassus flabelliformis*). The following information has been obtained on the subject.

DIRECTOR OF NAVY CONTRACTS to ROYAL GARDENS, KEW.

Admiralty, Whitehall, S.W.,
June 1, 1892.

SIR,

I SHALL be much obliged if you will be good enough to inform the Department whether anything is known of a material called "Bassine," said to be grown in India and dressed for the English market at Colombo, as to its value as a substitute for Brazilian Bass, and whether it is likely to displace bass on account of its quality or price.

I am, &c.,
(Signed) C. M. HEATH,
For Director of Navy Contracts.

The Director,
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to DIRECTOR OF NAVY CONTRACTS.

Royal Gardens, Kew,
June 8, 1892.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 1st instant on the subject of fibre prepared from the Palmyra palm as a substitute for Brazilian Bass.

As shown in the enclosed extract from the Report of the Director of the Botanical Gardens, Ceylon, the fibre from the Palmyra palm is being prepared in small quantities in the north of the island. The quantity available is evidently limited, and as the palm is an important source of food supply to the people it would be impossible to develop the industry to any very large extent without affecting that supply.

As regards the value of the fibre in European markets, it may be useful to communicate to you a copy of a letter received from Messrs. Ide and Christie, a firm of fibre brokers in the City, giving particulars of the prices recently obtained for the fibre. A small quantity of the fibre as received to day is forwarded to your address in a separate parcel.

This fibre is apparently not so good as the West African Bass (*Kew Bulletin*, 1891, p. 1), and it is decidedly inferior in length and flexibility to the Bahia Piassava (*Kew Bulletin*, 1889, p. 237). Its chief use would probably be to adulterate these fibres, and not to be used alone.

I am, &c.

The Director of Navy Contracts,
Admiralty, Whitehall, S.W.

(Signed) D. MORRIS.

EXTRACT from the REPORT of the DIRECTOR of the ROYAL BOTANIC GARDENS, CEYLON, 1891, p. 15.

Palmyra Fibre.—The sheathing leaf-stalks of the palmyra, as of many other palms, contain a stiff thick fibre, and a new industry in the collection of this has sprung up, under the auspices of a Colombo firm, in the north of the island. These fibres or bristles are much like the "Piassaba" so largely exported from Brazil (the produce of the palms *Attalea funifera* and *Leopoldinia Piassaba*) for brush-making, and are doubtless exported hence for the same purpose. Immense numbers of the palmyra exist in the Jaffna peninsula and the islands near, and it is in the latter especially that the business of collecting the leaf-stalks for sale has been carried on by the inhabitants. In Elavaitivu the value thus collected in six months was about Rs. 3,000, a great addition to the means of the people. Unfortunately, in their eagerness for this easy method of money getting, they have treated the trees so badly that it is reported that in that island alone 1,000 young palmyras have been destroyed. As this palm is the principal permanent source of food in the country, and is besides of immense utility for timber, fences, &c., it became obviously necessary to put a stop to this reckless destruction, and I understand that steps have been taken to regulate the fibre industry, which, properly conducted, should become a valuable addition to the means of living for the inhabitants.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
June 7, 1892.

SIR,

WE duly received your favour of the 2nd instant, and have pleasure in sending you a sample of Palmyra fibre as offered on this market. This is of average quality and valued to-day at 28*l.* per ton in London.

The first arrivals of this fibre took place about a year ago, the scarcity and high values of Brazilian Piassava having induced the production and shipment of substitutes. The early imports realized from 36*l.* to 42*l.* per ton, against West Coast African Piassava 55*l.* to 65*l*.., but with fuller supplies of these brush-making fibres (including split bamboo) market values have receded, and Palmyra ranges to-day from 22*l.* to 33*l.*

The chief objection to Palmyra by manufacturers is that it lacks straightness, but experiments are being made in this country to overcome this defect, and should they prove successful, it is claimed by importers and dressers that Palmyra should, for wear, then, be found equal to the best Brazilian.

We are, &c.
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.,
Royal Gardens, Kew.

LXXIV.—OIL PALM FIBRE.

(*Elæis guineensis*, Jacq.)

[K. B., 1892, pp. 62–67.]

The African oil palm is probably the most valuable of the indigenous plants of West Africa. From the pericarp of the fruits the well-known palm oil is prepared, while from the kernel of the nuts another kind of oil is extracted, scarcely less extensively used. According to Sir Alfred Moloney (*Forestry of West Africa*, p. 57), "although the palm oil " industry has existed since 1790, if not before, the valuable palm kernels " on the Gold Coast did not attract attention until 1842 or 1843, when also " the ground-nut industry, at least in the Gambia, had its birth." The palm oil received in this country during the year 1885 amounted to 872,342 cwts., of the value of 1,172,862*l.* The palm kernels received during the same period amounted to 34,507 tons, of the value of 406,856*l.* We have therefore two important products from the African oil palm, the value of the quantity reaching the United Kingdom amounting to about one million and a half sterling yearly. To these we have now to add a third industry connected with the production of fibre from the leaves. It may, however, be mentioned that the immediate prospects of this new industry are not very hopeful. The fibre is extracted in a laborious manner by the natives, and it is not, as yet, produced in commercial quantities.

Its extensive use locally for fishing lines and other purposes requiring great strength shows that it is one of the most valuable and lasting of tropical fibres. Very little, if anything, has hitherto been published respecting this fibre. Kew is indebted for the first specimens received for the Museums of Economic Botany to Mr. George Arbuthnot Moore, Managing Director of the Palma Trading Company, Liverpool. These were received in June 1891. Since that time a very complete series of specimens illustrating the method of extracting the fibre, with samples of twine and fishing lines, have been received from the Government of Lagos. A small specimen was received from Mr. Scott-Elliot from Sierra Leone, January 1892.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.,
June 23, 1891.

DEAR SIR,

WE have your favour of yesterday's date with specimen of fibre said to be prepared from the pinnæ of leaves of the African oil palm *Elæis guineensis*.

This fibre has been known to us for the last 15 years at least, but only from small samples such as you send us. It has never been received in merchantable quantity to our knowledge, and hence no practical experiments have ever been made with it. Some spinners to whom it was shown, when the first specimens came to hand, stated their opinion that it was too hard and gritty to spin readily, but we are inclined to think this view might have been modified had they had the opportunity of testing it practically. It has great strength and fineness, and if really spinnable we would value it at 50*l.* to 60*l.* per ton to-day in London.

We should be pleased to learn there is a prospect of this fibre being prepared and sent home in quantity, so that its actual value might be ascertained, the small samples, mere handfuls, hitherto received having, as we have said, afforded no means of arriving at this.

We desire to thank you for sending us also some fresh pinnæ of *Elæis guineensis*, and it will afford the writer much pleasure if his examination of them should lead to his arriving at any further opinion of the fibre worth communicating to you.

Yours faithfully,
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.,
&c. &c. &c.
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

Royal Gardens, Kew,
September 4, 1891.

SIR,

* * * * *

6. Another subject on which information might be obtained from the Government of Lagos is the extraction of fibre from the leaves of the oil palm. A specimen of fibre, said to have been obtained from the flat blades or pinnæ of the leaves of the oil palm, was lately presented to the Museums of Economic Botany at Kew by Mr. G. A. Moore, of the Palma Trading Co., Liverpool. This fibre was of good quality, and was described by Messrs. Ide and Christie as worth from 50*l.* to 60*l.* per ton. No previous specimens of this fibre existed in the Kew Museums, and hitherto it has only reached this country in small and inconsiderable quantities. It is very desirable to obtain as much information as possible respecting the method adopted by the natives for the extraction of the fibre, and the special purposes to which it is locally applied. It would also be desirable to obtain leaves in different stages of preparation, a good quantity of the raw fibre, and any articles such as cords, fishing lines, nets, or cloth made from the fibre, for the use of this establishment.

I have, &c.
(Signed) D. MORRIS,
Assistant Director.

The Hon. R. H. Meade, C.B.,
Colonial Office, S.W.

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, E.C.
January 21, 1892.

DEAR SIR,

WE are to-day favoured with the specimens of fibre and cord from the leaf of the oil palm (*Elæis guineensis*), for which accept our thanks.

We should be glad to know if your correspondents at Lagos led you to suppose that this material is, or could be, produced in merchantable quantity for export to this country. As we informed you in a previous letter (23rd June last) nothing but small samples have ever been seen here, and, until a quantity of, say, 5 to 10 tons comes home, no true estimate of the value can be arrived at.

Permit us to point out that the fibre should be sent untwisted and unplaited.

We fear the per-centage of fibre in the pinnæ is small, and that the extraction must be attended with considerable difficulty.

We are, &c.
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.,
&c. &c. &c.,
Royal Gardens, Kew.

In reply to the request for information respecting the methods pursued in extracting fibre from the leaves of the oil palm, a report was received through the Colonial Office from the Government of Lagos. It was prepared by Mr. Alvan Millson, the Assistant Colonial Secretary, and contains much interesting information on the subject. The fibre is extracted from the young leaves only. The process is identical with that used by natives in many parts of the world, and notably, as mentioned by Mr. Millson, by the Caribs of St. Vincent, and of the mainland of tropical America. Some Caribs who were attached to the St. Vincent's Court, at the Jamaica Exhibition, 1891, illustrated the process at the request of the Assistant Director of Kew, during his late visit to Jamaica. There were several excellent specimens of similar palm fibre shown amongst the St. Vincent exhibits.

NOTES on the preparation of fibre from the pinnæ of the Oil Palm (*Elæis guineensis*).

The inner side of the leaflets of the oil palm contains a fibre almost as fine and tenacious as human hair. This fibre is called Awshawn by the Yorubas, Poaiñ by the Kroos, and N'K'aw by the Accras. It is used all along the coast of the Gulf of Guinea for making fishing lines. Its use is very similar to that of the Supa or Gri-gri palm (*Astrocaryum*) fibre with which the Caribs of the island of St. Vincent and the reef-fringed Honduras coast make their deep sea lines.

In the preparation of this fibre a considerable amount of skill is shown.

The pinnæ of the young leaves which have not been hardened by exposure are the only ones that can be made use of. If too old, the fibre cannot be separated from the tissue, and if gathered before the leaves have opened it has not sufficient strength to stand the rough handling which it has to undergo while in process of manufacture. If gathered at the right age the stripping of the fibre offers no difficulties, although the process is both tedious and wasteful.

The mid-rib of the leaflet to be worked is separated with the thumb nail for about six inches of its length, as shown in the accompanying series of Specimens (Specimen A.).*

The pinna is then laid flat on the left hand with the smooth face upwards as shown in Specimen B, and in the following sketch.

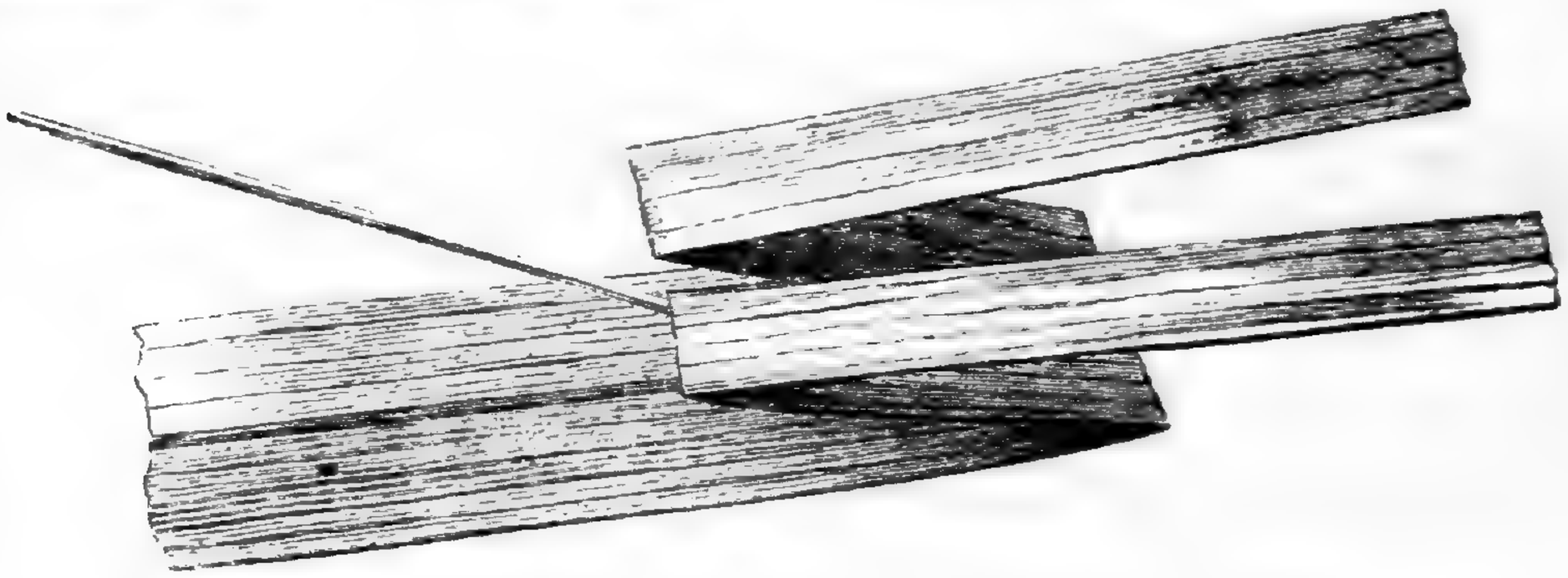

Fig. 1. First stage in preparation of oil-palm leaf or fibre.

It is next taken by the cleft end in the right hand, is laid over the worker's left thigh, and held below the fold in the left hand. The lower part of the folded part is firmly pressed against the leg with the side of the left thumb, the mid-rib being turned back under the same hand. The two loose ends are then pulled separately by the right hand, stripping the tissue from the fibre for the length of the fold, *i.e.*, about an inch (Specimen C.).

The leaflet is now drawn from left to right by the two loose ends across the thigh, against which it is held by the flattened left palm, while the thumb of the same hand is inserted between the flap of tissue and the fibre, and is used to help in separating them by raising the remaining tissue with an upward and backward motion as it is pulled across the leg (Specimen D.).

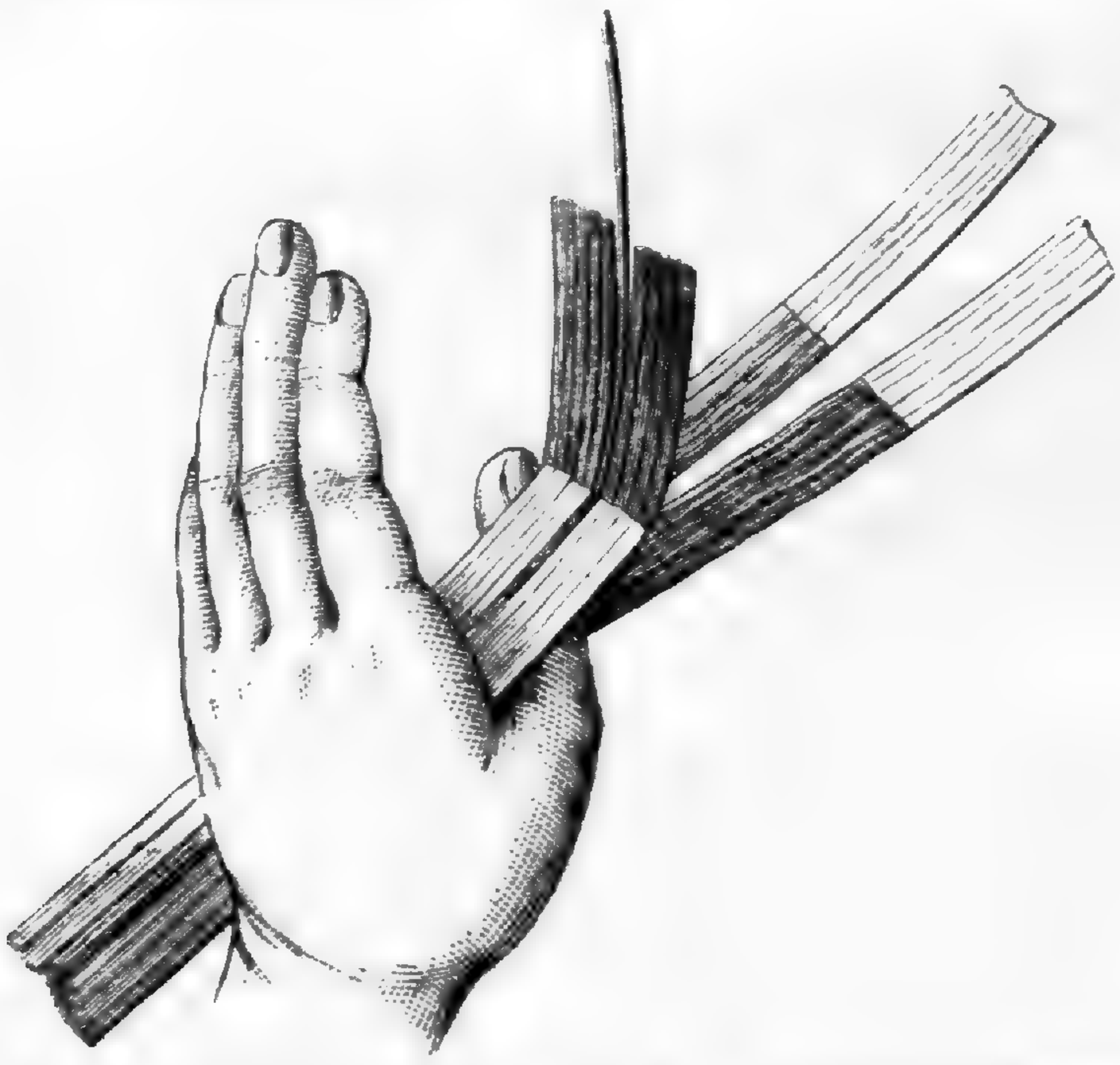

Fig. 2. Splitting of palm leaf to obtain the fibre. The latter is shown below the thumb in sketch.

* These specimens are mounted for reference in Museum ii., Case 61.

The loose ends of the divided leaflet are then taken between the right finger and thumb with the fibre hanging over the first finger. The ends of the remaining tags of tissue are patted with the left forefinger for about half an inch of their length above where they join the fibre. This bruised portion is twisted round between the thumb nail and finger so as to separate it from the remaining tissue, and is pulled forcibly through the loose fibre, cleaning it thoroughly as it passes.

The tags with the fibre attached (Specimen E.) are now held in the right hand, and rolled on the thigh in pairs by the left palm so as to twist the fibre into double stranded twine. This primitive method of string making I have noticed also in central America and among the peasantry in Scotland. Three of these double strands are next made into a cord, and holding the loose green tags of tissue one at a time between the thumb and forefinger of the left hand, the remaining fibre is drawn out (Specimen F.) and rolled up on the thigh so as to complete the cord (Specimen G.). The cords are plaited into pigtails, and are hung up in the shade to dry (Specimen H.).

After they are thoroughly dried the short lengths are made into lines by rolling on the leg and inserting new lengths from time to time (Specimen I.).

Fig. 3. Sketch illustrating method of preparing fine cord and fishing lines from oil-palm fibre.

The method of insertion, as roughly shown in the above sketch, is unusually clumsy, but has the advantage of strength. In the finer lines the inserted pieces are frayed out at the end, and worked into the material in the usual manner.

So far as can be ascertained the only use to which this fibre is put is the making of fishing lines and fine cords. It would appear to be too costly for native cloth, net, or bag making. The following results of actual experiments will serve to show the tedious and expensive nature of the process which has just been described.

A day's hard work is counted well spent on the production of six ounces of fibre from 36 pounds of the raw material. Estimating the value of labour to the native at not more than 3*d*. a day, and leaving out of consideration the time expended in collecting and sorting the leaves in the forest, the actual cost of this material to the producer cannot be calculated at less than 75*l*. a ton. It is therefore clear that it would be impossible to develop an export trade in this article at the present rate of European prices.

(Signed) ALVAN MILLSON,
Assistant Colonial Secretary.

LXXV.—COCOA-NUT COIR FROM LAGOS.

(*Cocos nucifera*, L.)

[K. B., 1889, pp. 129-132.]

As may be gathered from the reports published in the *Kew Bulletin* (1888, p. 149, and 1889, p. 69), Governor Moloney has organised very extensive nurseries in different parts of the Colony of Lagos for the purpose of extending the cultivation of the cocoa-nut palm. Plantations consisting of 30,000 trees have already been established by the Government, whilst seedlings in large quantities are supplied at low rates to private persons with the view of making the industry as general as possible. In this work the recently established Botanic Station is actively engaged, as also the Government organisations attached to the Commissionerships of the Eastern and Western Districts, and of Palma. With the view of utilising to the best advantage the produce of these cocoa-nut plantations, when in full bearing, Governor Moloney has recently prepared experimentally some samples of cocoa-nut fibre so that an opinion might be obtained as to its value in this country. This West African coir was sent to Kew, and very interesting particulars respecting it are contained in the following correspondence :—

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, February 2, 1889.

I AM directed by Lord Knutsford to transmit to you a copy of a despatch which he has received from the Governor of Lagos reporting that he had despatched a bale of [cocoa-nut] coir to Kew.

2. His Lordship will be much obliged if you will kindly furnish him with your opinion on the specimen forwarded.

I am, &c.
(Signed) R. H. MEADE.

The Director, Royal Gardens, Kew.

[Enclosure.]

GOVERNOR MOLONEY to LORD KNUTSFORD.

Government House, Lagos,
December 23, 1888.

MY LORD,

AT the Colonial Exhibition of 1886 I was given to understand that the natural colour of Lagos coir had, in the opinion of brush and mat manufacturers (I may mention Messrs. Treloar, of Ludgate Hill), a special advantage which should command for it a ready demand and a comparatively high price, if it could be put regularly and in sufficient quantity on the English markets.

2. Accordingly, and in anticipation of the later development of a local manufacture for export of cocoa-nut oil, for which I entertain the opinion that the present annual crop of fruit offers a sufficient encouragement, I have had prepared by prison labour in the gaol of Lagos, a bale of coir weighing 42 lbs.

3. This return represents the yield of 400 cocoa-nuts, the average present price of which is at the rate of 2*s.* 6*d.* per hundred.

4. The bale has been addressed to the Royal Gardens, Kew, and sent through the Crown Agents for the Colonies.

5. It is now my duty to request that your Lordship will be good enough to invite the co-operation of the Director of the Royal Gardens and obtain an authoritative opinion on the specimen forwarded.

I have, &c.
(Signed) ALFRED MOLONEY.

The Right Hon. Lord Knutsford, G.C.M.G.
&c. &c. &c.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

Royal Gardens, Kew,
February 21, 1889.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 2nd instant, forwarding a copy of a despatch from the Governor of Lagos on the subject of a specimen of cocoa-nut coir which he had forwarded to Kew for an opinion as to its merits.

2. The specimen, consisting of a bale weighing 42 pounds, was duly received from the Crown Agents on the 11th ultimo. Samples were prepared and submitted to respectable brokers and dealers in the city, with a request that they would report upon the value of Lagos coir as compared with other coirs now in the London market.

3. The result of the inquiry is contained in the accompanying papers. It would appear in the first place that it is necessary to separate coir fibre, as yielded by the cocoa-nut, into two classes, namely, "bristle" fibre and "mat" fibre. The former is usually sold at about 30*l.* per ton, and the latter at about 10*l.* per ton.

4. The sample from Lagos contained these two fibres mixed together, and hence it was not presented in a state suitable for sale in this country. It is evident that Lagos fibre possesses no particular merit on account of its colour, but, on the other hand, in Messrs. Harrison and Johnson's Report, it is stated to be "of very good length, which increases its value."

5. Although these reports are not so encouraging as Governor Moloney was led to suppose from the specimens exhibited at the late Colonial and Indian Exhibition, they furnish useful hints as regards the character of coir fibre necessary to command ready sale in this country.

6. With the view of further assisting in this direction, Mr. Thiselton-Dyer has caused the specimens of Ceylon "bristle" and Ceylon "mat," forwarded by Messrs. Ide and Christie, to be sent direct to Governor Moloney as samples of coir fibres which are acceptable to the London buyers. Other samples of fibre are enclosed in the parcel for Governor Moloney, including "brush" fibre, "mat" fibre, and "rough stuffing" fibre, prepared by Messrs. Toye and Bromley from the crude Lagos coir.

I am, &c.
(Signed) D. MORRIS.

The Hon. R. H. Meade, C.B.

[Enclosure No. 1.]

MESSRS. IDE AND CHRISTIE to ROYAL GARDENS, KEW.

72, Mark Lane, London, E.C.
February 7, 1889.

SIR,

WE are duly favoured with Mr. Jackson's letter of the 5th inst., and samples of coir from Lagos. These contain soft, half-prepared "bristle" fibre, used in the manufacture of brushes, mixed with short or "mat" fibre. Such a mixture is unfortunate, and detracts from the value of the samples, as the two kinds, being used for different purposes, have to be

separated. In the Ceylon coir they are always kept apart, and for your guidance we send you specimens of Ceylon bristle, value 30*l.* per ton, and Ceylon mat, value 10*l.*

There is nothing either in the colour or other character of the Lagos fibre which would justify the expectation of its commanding a ready demand and high price, as the Governor of Lagos has been apparently led to believe. On the contrary, we value the "bristle" portion of your samples at 15*l.*, and the "mat" portion at 9*l.* to 10*l.* per ton.

We are, &c.
(Signed) IDE AND CHRISTIE.

D. Morris, Esq., M.A., F.L.S.

[Enclosure No. 2.]

MESSRS. HARRISON AND JOHNSON to ROYAL GARDENS, KEW.

4, Catherine Court, Trinity Square, London, E.C.,
February 7, 1889.

SIR,

WE are in receipt of your favour of the 5th instant, and also the sample. The coir fibre you send is mixed half prepared brush and mat fibre. The former, if separated, would no doubt find buyers at about 15*l.* per ton, and the mat fibre would sell freely at 9*l.* to 10*l.* per ton.

There is one sample consisting entirely of mat fibre; this is clean and long, and would sell well at about 11*l.* to 12*l.* per ton. If the brush fibre were properly combed out like sample we have sent you by post, it would readily fetch 28*l.* to 32*l.* per ton present market value. The samples of fibre you send are very good length, which increases the value.

We would suggest that a small sample shipment be made; you would then get a good idea of the value. It would be no use sending any fibre unless the mat and brush were kept separate.

If in future we can be of any help to you or to the Governor of Lagos in bringing this article before the trade we should be pleased if you would make use of us.

We are, &c.
(Signed) HARRISON AND JOHNSON.

[Enclosure No. 3.]

MESSRS. TRELOAR AND SONS to ROYAL GARDENS, KEW.

68, 69, and 70, Ludgate Hill, E.C.,
February 9, 1889.

SIR,

WE are in receipt of your letter of the 5th and of the sample of Lagos coir. In our opinion this is badly cleaned or dressed, and not so good for brush-making as the usual sort. It certainly has no special advantages for mat-making, and is not in our opinion calculated to command a high price here. We have seen better fibre sold at public auction for 22*s.* per cwt. in London.

We are, &c.
(Signed) TRELOAR AND SONS.

[Enclosure No. 4.]

MESSRS. TOYE AND BROMLEY to ROYAL GARDENS, KEW.

116, Fenchurch Street, London, E.C.,
February 19, 1889.

SIR,

WE confirm our letter of the 11th instant, and now beg to hand you our report on the fibre samples you sent. We trust this will give you the information desired. Should you require any other point answered we shall be happy to do so.

We are, &c.
(Signed) TOYE AND BROMLEY.

REPORT.

This fibre would find a ready sale here both for brush and mat making purposes, but the two sorts should be kept separate. For brush-making the long fibre can only be used, and should be kept straight, and tied in small bundles and then made up in bales weighing about 1 cwt. or 2 cwt. each. The other sort for mat-making should be towselled and packed up into bales. Practically speaking the mat fibre is the combings or short from the brush fibre. There is also in the sample sent us a stuffing of rough fibre in each of the small bundles; this should be avoided, as it deteriorates the value considerably; but if this stuffing was separately packed it would also sell here. We consider the value of the three sorts, if made up in the way we have described, would be based on the *present* value of fibre as follows:—

Sample.
No. 1. Brush fibre at 29*l.* to 31*l.* per ton.
No. 2. Mat fibre at 18*l.* to 19*l.* per ton.
No. 3. Rough stuffing sort at 10*l.* to 11*l.* per ton.

We return a sample of each quality to show more clearly our meaning. The brush fibre, we suggest, should be tied up about the size of our sample No. 1. You will notice that we have taken your sample as received, and dressed it into the above three sorts, which your friends will find far more advantageous than sending it in the rough condition.

(Signed) TOYE AND BROMLEY.

LXXVI.—BAHIA PIASSAVA.

(*Attalea funifera*, Mart.)

[K. B., 1889, pp. 237–242.]

A valuable fibre, largely used in this country under the name of Bahia Piassava, is obtained from the leaf-stalks of a Brazilian palm known as *Attalea funifera*, Mart. This palm has a wide distribution in the lowlands of Brazil, and is found throughout the province of Bahia parallel to the coast, from San Salvador or Bahia in lat. 13° to Caravellas in about lat. 18°.

Para Piassava, which is exported from the port of that name, is slightly different in texture and colour from Bahia Piassava, and is derived from another palm, *Leopoldinia Piassaba*, Wallace. Specimens of both Bahia and Para Piassava, together with appliances used in the industry, as well as finished articles, are shown in the Kew Museum

No. II. An excellent series of Bahia Piassava is shown in Case No. 62. One of the earliest notices of Bahia Piassava, and probably the first where the plant yielding it is authoritatively determined, is contained in an article in Hooker's *Journal of Botany and Kew Garden Miscellany*, vol. i. (1849), pp. 121–123. In this notice Sir Wm. Hooker states :—

"Few have walked the streets of London without remarking that of "late years those streets are, in places at least, kept peculiarly neat "and clean by the stiff fibres of a new material for making brushes "and brooms, those of the machines, as well as those employed by "hand; and if anyone is asked what be the origin of this fibre, the "frequent reply is 'Whalebone, I suppose.' But, no; it is not of "animal but vegetable origin, the coarse fibre of a species of palm "(*Attalea funifera*) which grows abundantly in Brazil. This curious "material, according to its stoutness and tenacity, is employed for "cordage and mats as well as for brooms and brushes. The dilated "base of the leaf-stalks separates into a long coarse fringe, which is "collected by the natives and used in the country or exported to Europe "for the purposes above mentioned, and now constitutes a considerable "article of commerce.

"The fruit or nuts of this palm are another article of commerce, "long brought into England under the name of *Coquilla nuts*, and "extensively used for various kinds of turnery-work, especially in "making handles of bell-pulls, umbrellas, &c., &c.; for the shell (or "putamen) is of great thickness, excessively hard, beautifully mottled "with dark and light brown, and capable of taking a high degree of "polish."

As far as we are aware, no detailed account of Bahia Piassava has hitherto been published in an accessible form. We are therefore happy to avail ourselves of the courtesy of Mr. W. S. Booth, Belle Vue House, Gloucester, who has prepared from personal observation the following excellent account of the present condition of the industry in Brazil for the *Kew Bulletin* :—

BAHIA PIASSAVA.

"The fibre of the palm (*Attalea funifera*) is obtained chiefly in the province of Bahia, along the coast south of Valença, where the supply is now exhausted, to Porto Seguro, which will soon be in the same condition.

"Throughout this tract the Piassava palm is found growing scattered in the woodland (Piassava do Mato), and in some places in extensive patches, called campos, nestling in the heart of immense virgin forests.

"Naturally, the 'Piassava do Campo' is more easily obtained than the 'Piassava do Mato'; for while the former grows in spots where it is only interspersed among ferns, it is often necessary to traverse a large tract of country to come upon a sufficient quantity of the latter. Moreover, a certain 'pratique' is required to discover the isolated trees at first sight in the dense tangle of a tropical jungle.

"Piassava of either denomination is divided according to its age, into two kinds, viz., Bananeira and Coqueira.

"Bananeiras, are young plants, whose trunks are not yet developed, and which yield a fresh coloured and supple fibre.

"Coqueiras, are fully developed plants, yielding two or three qualities of fibre, according to its age, viz. :—

(1.) Ordinary fibre, which is found wound up among the broken leaves, and the upper part of the trunk.

(2.) Balloon, formed by the older fibre which has fallen to the ground round the base of the trunk.

(3.) Piassava d'olho, or 'eye Piassava,' which is the latest growth, and is in all respects similar to that yielded by the 'Bananeiras.'

"The Piassava d'olho, by reason of its flexibility and colour, is used chiefly for tieing up and embellishing the bales. Its yield is always small, being about 15 to 17 per cent. of the total 'pull' of the tree, which is from $3\frac{1}{2}$ to 5 arrobas (1 arroba=$32\frac{1}{3}$ lbs.) on a fully grown tree.

"The palm grows in the neighbourhood of rivers, and on land that is always in a half swampy condition, being below the flood mark in the rainy season. 'They are erect trees, terminated by a crown of large 'pinnatisect leaves (between which the spathes appear); flowers, yel-'lowish, succeeded by ovate or elliptical fruits (drupes), of a brown or 'greenish brown colour.' The hard thick shell of the nut contains two oleaginous edible seeds, and is enclosed in a thin polished fibrous case which is capped at the base like the acorn. The campos, as a rule, are not liable to flood, but lying as they do surrounded by swampy land, the conditions of moisture are fulfilled in which it is necessary for the trees to flourish. The mean temperature of the Piassava district is about 77° F. On reaching the age of six to nine years, the palm begins to bear fibre fit to pull. The present mode of obtaining it is to cut the tree down, and pull the fibre from the trunk afterwards, a very foolish proceeding, considering the time the fallen nuts take to germinate and grow into bearing trees. The base of the petiole of the leaf wraps round the trunk (as can be seen in many other palms) like a sort of fibrous wrapper which splits in the course of the trunk's growth, and falls over on either side. The petiole contains two transverse layers of fibre, the one going up into the midrib of the leaf, and the other to form the wrapper, both protruding in a festooning fringe from the edge of the petiole.

"From this it will be seen that the fineness or coarseness of the fibre depends largely on its position in the petiole, the coarsest fibre lying closest to the midrib.

"*Two commercial kinds of Piassava.*

"There are two kinds of Piassava used in commerce: the round, stiffish fibre from the districts I have mentioned, which is shipped from Bahia, and is known as 'Bahia Piassava' (*Attalea funifera*); and that collected on the Amazons and the Rio Negro, shipped from Manáos, and Pará, and known as 'Pará Piassava (*Leopoldinia Piassaba*, Wallace, 'Palm trees of the Amazon,' p. 17). This latter is flat, soft, and flexible, altogether differing from 'Bahia' fibre, and commanding on occasions three times its price, which at present stands at 38*l.* for good red fibre.

"In Brazil, these fibres are used for cables, ropes, baskets, hats, tieing, fencing, and many other purposes; but in this country, and in Europe, solely for brush and broom work, by itself and mixed with other fibres.

"The nuts of the Piassava are exported to Europe for the manufacture of buttons, knobs, &c.

"*Method of Collection and Preparation for the Market.*

"Immediately after the exploration (often very arduous) undertaken to discover crops which will repay the cutting, it is necessary to

establish the 'camp,' and to stock it with food and implements indispensable to the men; also to find a pasturage for the animals employed, and a supply of fodder to augment the unsubstantial food that is yielded by the forest. Through failing to take this precaution, the best troops of mules will be reduced in a few months, and the number of sick animals will be considerable, to say nothing of the difficulties which will follow from this false economy.

"As soon as the cutters have arrived in the camp, each takes a different direction, thus endeavouring to secure an advantageous cutting position, from which, when found, he does his utmost to keep his companions.

"The weighing of the pulled Piassava should be done every fortnight, as the men are furnished on credit at the 'barracão,' and it is well to settle their accounts by weighing their work fortnightly, or so.

"The average cut of one man per diem may be estimated at three arrobas (1 arroba = $32\frac{1}{3}$ lbs.) of loose, *i.e.*, unbound Piassava; and the amount of his credit should be based on this quantity. It must be borne in mind that these cutters are not only great hunters, so wasting a day from time to time in the pursuit of game, but they are lazy, and could they obtain unlimited supplies on credit, they would not scruple to abuse such credit on all occasions.

"Though I have estimated the daily work of one man at three arrobas, an inexperienced hand is often unable to clear more than one or two; while, on the other hand, a very hard worker has been known to clear as much as six arrobas in one day. It is customary to weigh the fibre only in cabeças; that is to say, after it has been made up into the small bundles of which a bale is composed; though, in my opinion, the Piassava thus weighed is much more favourable to fraud than that weighed unbound.

"It may be useful to note here that the cost of binding up the cabeças is 20 reis a-piece (1,000 reis = 27*d.*).

"As limited above, the cutters always do their best to defraud the principals or buyers. They smuggle stones and pieces of palm inside the mondongas (*i.e.*, parcels supposed to weigh 60 kilos. or 132 lbs., ready for weighing); they spread the fibre out on the ground, leaving it a long time exposed to the rain; and, finally, their shanties being always built by the side of running water, they think nothing of sinking the 'cabeças' in these streams 'end on,' so that they may be impregnated with the fine sand brought down by the current. As a 'set off' to this treatment, the buyers are not slow to imitate these edifying examples; they cause their weighing machines to be tampered with before being used, and they allow errors to creep into their accounts, which never result to their own disadvantage.

"As soon as the fibre is weighed, the proprietor sends it down to his fazenda by the mules. The main track is cleared at the expense of the owner of the cutting, and the cutters are obliged to have their fibre weighed on this path, or make a road themselves to the place where they have built their shanty. The mules are usually driven in troops of seven animals to each muleteer, and the weight carried by each mule is six arrobas (194 lbs.).

"Upon arrival at the fazenda the fibre is unfastened, cleaned, and pressed into bales by a packing press, or by hand.

"It is packed into two kinds of bales, viz.—the molho and the fardo.

"The molho is pressed by hand, it contains three or five cabeças, and is bound in five, seven, or nine places. The charge for making these up is 200 reis ($5\frac{3}{8}d.$).

"The fardo contains 10 or 12 cabeças, and by reason of its size is packed in the press; costing from 240 to 300 reis per fardo for making up. A good packer will turn out from 18 to 20 molhos daily, and two good workmen can press from 30 to 40 fardos in the same time.

"If the fazenda be on a river the goods are shipped down to the coast town by canoe; a large one holding, say 40 to 50 fardos, or about 120 to 130 molhos.

"With very small exceptions for local uses, the whole of the fibre pulled is sent to Bahia to be sold on account of the owners by the consignees.

"The annual export is about 7,000 tons, of which Great Britain takes slightly more than half; Germany coming second with nearly a quarter; while Belgium, France, Portugal, and the Southern Republics together, take the remaining quarter.

"There is an export duty, imperial and provincial together, of 20 per cent, *ad valorem*, which is declared every week, and is assessed on the average weekly prices of the sales made by the brokers.

"Taking into consideration the simplicity of its production (the fibre being ready for the market the moment it is pulled from the tree, and baled), the heavy duty in Brazil, and the high prices realised in Europe, I cannot help thinking that those interested in the development of profitable industries in India, and our other tropical possessions, would find an attempt to transplant the Piassava Palm rewarded ultimately by handsome returns.

"I am greatly indebted to Mr. E. F. Bradley, of the Star Brush Company, Holloway, and to Senr. F. E. Blanchet of the Fazenda Bolandeira, near Canavieiras, for much valuable aid in this inquiry.

"*Appendix.*

"Exports returns of Piassava fibre from Bahia for the year ending January 1889:—

Great Britain - -	535,419
Germany - - -	289,548
Belgium - -	91,385
France - - -	80,123
Portugal - - -	36,247
Argentines - -	5,730
Uruguay - - -	5,706
Spain - - -	1,018
Austria - - -	727
1,045,903	milreis at 27*d.* £117,664.

"Two hundred and fifty milreis is payable annually to the Provincial Government for the right of cutting not more than 60,000 arrobas (say 29*l.* 2*s.* 6*d.* for 866 tons). Although 866 tons be the amount specified on the licence, the proprietor is always well satisfied with 100 tons, and rarely gets more from one camp of cutters.

"I append a first-cast account as it may be of some interest or service. I have not taken into consideration the cost of opening up paths through the forest, as this outlay is a very uncertain amount, depending entirely on the character of the obstacles.

"*Cost per Arroba* (32⅓ *lbs.*) *in Bahia.*

Paid to cutters (say) - - - -	800
Loss in weight (stones, water, &c.) - -	80
Licence - - - - - -	40
Legitimization before shipment - - -	7
Hire of animals - - - - -	666
Wages of muleteers - - - -	90
Packing and labour - - - -	75
Transport to coast town (say) - - -	150
Wear and tear of materials and implements -	35
Municipal taxes at coast town (say) - -	40
Food for animals, corn, &c. - - -	100
Freight to Bahia - - - - -	260
Commission and Insurance 5% on 2,500 - -	125
Reis	2,468

"Taking a milreis as worth 27*d.* this gives 5*s.* 7*d.* in Bahia."

LXXVII.—BHABUR GRASS.

(*Ischæmum angustifolium*, Hackel.)

[K. B., 1888, pp. 157–160.]

This grass, which closely approaches esparto in habit and in the possession of the technical qualities necessary for paper manufacture, was first brought into notice by Dr. King in the annual report of the Royal Botanic Garden, Calcutta, for the year 1877–78. It was there confounded with an entirely distinct plant, *Eriophorum comosum*, a species of *Cyperaceæ*, with which it often grows intermixed, and from which, as it rarely flowers, it is hard to distinguish. This error appears to have originated with Royle, who (Illustrations, p. 415) identifies *Bhabar* with *Eriophorum comosum* var. *cannabinum*. It was referred to in the Kew Report for 1878, p. 45, as follows :—

"*Eriophorum comosum*.—This plant is well known in North-Western "India, where, under the name of *Bhabar-ghas*, it is largely used as a "material for ropes. It was submitted by Dr. King to Mr. Routledge "(of the Ford Works, Sunderland), who writes to us :—'A small "'quantity of bleach brings it up to a good colour. The ultimate "'fibre is very fine and delicate, rather more so than esparto, and of "'about the same strength ; the yield, however, is 42 per cent., some-"'what less. I think I may venture to say that it will make a quality "'of paper equal to esparto.'"

In the following year Mr. Duthie, Superintendent of the Government Botanical Gardens, Saharunpur, sent a specimen to Kew for identification. He wrote, May 2, 1879 :—

"I am sending a specimen of a Cyperaceous-looking plant, which I "have been asked to identify. It is a native of the Nepal Terai, and "in the district of Gorakhpur, at the extreme east of these provinces. "Its native name is *Bankas*, and it is largely used in making ropes, "&c. It has been sent to me three times, but on each occasion "without flowers. It is said to flower only once in three years."

This recalled a grass which, under the name of *Bunkuss* appears, from the Bengal Catalogue of Indian products, to have been shown at the

London Exhibition of 1862 (section 1, pp. 137, 168), as used in N.W. India for making ropes.

Mr. Duthie's specimens, though extremely imperfect, were submitted to the late General Munro, C.B., F.R.S., in the hope that his incomparable knowledge of grasses might enable him to ascertain what it was. He succeeded in identifying it with *Spodiopogon angustifolius* (Trinius in *Act. Petrop.* vi., ii., p. 300; *Spec. Gram.*, t. 336). He added :—"It is *Andropogon involutus*, Steudel, and *A. Notopogon*, "Nees and Steudel. It is mentioned by name only as *Spodiopogon* "*laniger* in Royle's Illustrations (p. 416). It is very common in all "parts of the Lower Himalayas, and I have seen it from Afghanistan, "collected by Griffith."

Mr. Duthie subsequently informed us that it was also known under the name of *Bhaib* grass, and that it was used for the manufacture of string matting and a variety of other articles, of which a fine collection was sent by him to the Kew Museum in 1880 (*see* Kew Report, 1880, p. 60).

We were indebted to Sir Dietrich Brandis, K.C.I.E., late Inspector-General of Forests to the Government of India, for pointing out that the grasses variously known as Bhabar, Bhaib, and Bankas were all identical. The following note upon the subject is contained in a paper entitled "Suggestion regarding Forest Administration in the "N.W. Provinces and Oudh" (Calcutta, 1882, pp. 7, 8) :—

"The export of the grass known as Bhabar, Bhaib, Bankas "(*Andropogon involutus*, not as has often been erroneously stated, "*Eriophorum comosum*), from the Siwalik Hills, and from tracks of "broken raviny ground outside the hills, is very considerable. . . . "The grass grows abundantly on dry bare slopes, and no apprehension "regarding the sufficiency of the supply need at present be entertained. "It is used chiefly for rope-making, and it is by no means impossible "that the establishment of paper-mills in North India will eventually "lead to the employment of this grass for the manufacture of paper."

Early in 1883 the India Office furnished us with a copy of a report by Mr. C. E. Edwards, the manager of the Lucknow Paper Mills, to the Director of the Department of Agriculture and Commerce of the North-West Provinces and Oudh, which contained the following observations with respect to the use of Bhaib for paper making :—

"This grass we have used here, but not to any great extent, owing "to the price being too high, besides the out-turn is not so great as "with jute. I found it not to yield more than about 35 per cent. of "paper. This is to a great extent owing to the top part of the "plant being somewhat perished, I presume owing to the tops being "more exposed to the atmosphere, as this part appears to get ripe "much earlier than the bottom. In the process of boiling the perished "or top part gets destroyed before the bottom part of the stem gets "sufficiently reduced to a pulp. This accounts for the great loss in the "manufacture, but this could be obviated by having the top parts cut "off before despatching it to the paper mills, and if it could be had at "the same price with the tops off, I have no hesitation in saying it "would be a good and cheap enough fibre for paper-making purposes."

Dr. King, in his annual report for 1882–3, summed up its prospects as follows :—

"In several former reports I have referred to the leaves known by "the vernacular name *bhabur* as the produce of *Eriophorum comosum*. "I have now satisfied myself that the bulk of the *bhabur* used by "natives for rope-making is not derived from *Eriophorum*, as I have

" supposed, but from *Andropogon involutus*. This grass, I find from " inquiry locally made, abounds in the hill parts of Behar and Chota " Nagpore, where it is known as *Sabai*. From these regions it can be " obtained in quite considerable enough quantity to make its utilisation " as a paper material a feasible project, and the people who actually " collect it sell it at a reasonable enough rate. But in order to get it " brought to Calcutta in sufficient quantity for local manufacture, or " for shipment to Europe, middlemen have to be employed, whose ideas " of profit are pitched so high that, until they become modified, the " utilisation of *bhabur* must remain in abeyance. This is only in accord " with the common experience in the Mofussil, that competition in " trade is not sufficiently keen to have much effect in keeping down " prices, but that, on the contrary, traders still form guilds banded " together to enhance prices, even at the risk of choking off demand."

On December 1, 1883, the late Mr. Thomas Routledge, who was always ready to assist us, by making experiments on new paper materials, privately reported, as the final result of his trials of Bhabur grass :—

" I believe it will make a fair sheet of paper, much the same as fine " esparto ; in fact, in many respects, as a natural product, it closely " resembles esparto, but does not contain so much glutinous and " amylaceous matters, nor so much silica. The sample sent, you will " remark, was cut, and not pulled from the roots as esparto is. Like " esparto, *in situ* it is worth very little, and is used for similar purposes, " roping, matting, baskets, &c. The cost of esparto consists in " collection, carriage to port of shipment, and, latterly, baling charges, " freight to England, &c. Whether from India, with long and " probably costly inland carriage, with heavy freight added, it can " come into competition with esparto, is doubtful, and I do not think it " would pay to convert it into stock."

The prospect of utilizing the grass would be no doubt improved if it could be cultivated. From the following account by the Rev. H. P. Boerresen, of Rampore Hât (printed in the *Proceedings* of the Agricultural and Horticultural Society of India for October, 1887) it appears that this is readily practicable.

" (1.) The Sabai or Babui grass yields two crops in the year, one in " September, and the other at the end of October or early in November, " without any irrigation, as the rainy season is then prevalent. It " might yield a third cutting if irrigated, but I cannot say anything on " this head, never having made the experiment, nor have I seen it " attempted by others.

" (2.) I believe it will grow anywhere, as we have transplanted it " from here to all our other out-stations in the Santhal Parganas, and it " thrives in them all. The Santhal Christians have also taken some of " it to our Christian Colony in Guma Duar, Assam, where it also " grows well.

" (3.) I have never attempted to propogate it by seed, but always by " roots. When a clump or tuft is dug out, it may be divided into as " many small divisions of roots as one pleases, and these are put down " again in rows, about three feet from one another, and the same " interval between each root planted. It will yield a very trifling " return the first two years, but by the third or fourth year, when the " roots have spread and multiplied, it gives a *good* crop. The plot on " which it is planted must be kept free from other grass. When it is " seven or eight years old, the roots should be beaten down with " wooden mallets or a plough should be run through them in every

" direction, and fresh earth thrown over the whole increases the yield. " If not treated in this way, it will cease yielding any crop. When " grown too old, it must be taken up entirely, re-divided in small " bunches of roots, and transplanted to a fresh locality.

" (4.) We bought the grass always in local *hâts* for roofing purposes " (*as rope*) before we grew our own, and nowhere in our neighbourhood " am I aware of its being cultivated in any but very small patches by a " solitary man here or there. It is not cultivated as a source of income " or trade, so that I am unable to say whether the roots may be bought, " or at what price. We got a small quantity of the roots originally " from a Hindu village, but by fostering and spreading their cultivation " have now a considerable quantity. It should be planted in a *dry* " spot, where no water lodges, as experience has shown in one of our " stations, where the water oozed up from below and rotted the roots, " that it would not grow there. A sloping site is probably the best.

" When we first started the mission here we had to pay Rs. 4 a " maund in the *hâts* for the grass, in order to twist it into rope or " string, and it was the having to pay so much that led me to try and " cultivate it ourselves. The grass runs to seed in the hot months, shortly " before the rainy season, but these must be cut off and removed, or the " crop will deteriorate."

Besides a great variety of native names, Bhabur grass has, from the difficulty of exactly ascertaining its affinities. received an almost equal number of botanical ones. Under the name of *Pollinia eriopoda*, it is discussed in the *Journal* of the Linnean Society (vol. xx., pp. 409, 410), and it is figured and described in Hooker's *Icones Plantarum* (tab. 1773) as *Ischæmum angustifolium*, the name finally assigned to it by Hackel, the most recent monographer of Grasses.

[NOTE ADDED, 1894 :—An exhaustive account of "Bhabur Grass and the trade in it," by J. S. Gamble, F.L.S., Conservator of Forests, School Circle, N.W. Provinces and Oudh, is given in the Appendix Series of the *Indian Forester*, December, 1893.]

LXXVIII.—BHABUR GRASS—(continued.).

(*Ischæmum angustifolium*, Hackel.)

[K. B., 1894, p. 367.]

A note on Bhabur grass (with a plate) was published in the *Kew Bulletin*, 1888, pp. 157–160. This grass is a native of India, and it is remarkable as possessing the technical qualities, similar to Esparto, necessary for paper manufacture. Its merits were first brought into notice by Dr. George King, C.I.E., F.R.S., Superintendent of the Royal Botanic Gardens, Calcutta, in 1877-78. Since that time the grass has become more largely used in India, and at the present time it affords the chief raw material for paper making in the neighbourhood of Calcutta and other parts of British India. The following additional information respecting it is given in the recently published *Annual Report of the Royal Botanic Garden*, Calcutta, for the year 1893–94, p. 2 :—

" Seed of the grass, known variously as *bhabar*, *babui*, and *sabai* was issued to a few applicants outside of India. This grass (of which the botanical name is now *Ischæmum angustifolium*) first attracted my

notice as a possible raw material for paper twenty-five years ago, while I was in the Forest Department in the North-west Provinces. It is very common in the Siwalik range, and in the Bhabar forests of the Gharwal and Kumaon Himalaya. Samples of it sent home by me in 1873 to a paper-maker in Scotland, were favourably reported upon; and again in 1877 a sample sent by me to the India Office, having been submitted to the late Mr. Routledge, of the Ford Paper Mills (then a leading authority on paper-making), was declared by him to be little inferior to *Esparto* as a raw material for paper. A year or two subsequently to this it was discovered, by the help of Mr. J. S. Gamble, of the Forest Department, that this grass is common in the forests of Chota Nagpur. Samples of it were accordingly sent by me to the Bally Paper Mill, then the only one near Calcutta. The sample was approved of at Bally, and since then the use of this grass has so increased that it now forms the chief raw material of an industry which, in this country, is yet probably only in its infancy. As seed of Bhabur grass is now being applied for from abroad, it is possible that, before long, it may be cultivated in other tropical countries."

LXXIX.—BROOM ROOT OR MEXICAN WHISK.

(*Epicampes macroura*, Benth.)

[K. B., 1887, December, p. 9.)

In the Report of Her Majesty's Consul at Vera Cruz for the year 1886, Mr. Baker draws attention to a comparatively new industry connected with the preparation and export of what is called "Broom Root."

This root was exported from the port of Vera Cruz last year to the aggregate value of 58,632*l*. The bulk appears to have been shipped to Germany and France, while the quantity shipped to England was comparatively small. The Curator of the Museum [*Gardeners' Chronicle*, Vol. II. (third series), p. 104] has established the fact that the broom root exported from Vera Cruz is known in Europe as Mexican or French Whisk. It is used by the Germans and French to mix with Venetian whisk, derived from the roots of *Chrysopogon Gryllus*, for the manufacture of dandy brushes, clothes brushes, carpet brushes, and velvet brushes, which are shipped to this country at exceedingly low prices. The broom root, therefore, appears to be a cheap substitute for Venetian whisk and it is said that when made into brushes and thoroughly dry it is apt to become brittle and break off. For this reason it has never found much favour in England.

As the botanical origin of broom root was unknown, efforts were made through the Foreign Office to obtain specimens of the plants yielding it. These specimens were obligingly forwarded to Kew by Mr. Consul Baker, and received on the 3rd October. It appears that the plant yielding the so-called broom root is a grass whose local name is "Zacaton." This is a plant with coarse tufted leaves, found widely distributed over the highlands of Mexico, and attaining a height of six or seven feet. The roots, in the condition in which they are exported, are called "Raiz de Zacaton." These roots are about nine inches to a foot long, possessing a wavy character, and about one-sixteenth of an inch in diameter. They had evidently undergone some cleansing and

bleaching process, which gives them a bright appearance and a pale yellow colour.

Among the specimens sent by Mr. Baker to Kew there were two species of grasses, both of which evidently belonged to the genus *Epicampes*. One was *Epicampes macroura*, Benth., [Cinna macroura, *Kunth.*], and the other a closely allied species which could not be determined without flowers. There can be little doubt, therefore, that the broom root is derived from one or more species of grasses belonging to the genus *Epicampes*.

Sereno Watson, *Botany of California*, Vol. II., p. 277, mentions the distribution of one species of this genus, viz., *Epicampes rigens*, Benth. (Cinna macroura, *Thurb.*), as San Diego County, California, and also in Mexico and eastward in New Mexico and Western Texas. It is known as "Wood Reed-grass." It is described as a tall-growing, very rigid, wiry grass, of a pale yellowish green colour, growing in sub-alkaline localities, and apparently in tufts. The rigid stems are used by the Indians for making baskets.

LXXX.—BROOM ROOT OR MEXICAN WHISK— (continued).

(*Epicampes macroura*, Benth.)

[K. B. 1897, p. 172.]

An account of Broom root or Mexican whisk obtained from one or more species of grasses belonging to the genus *Epicampes* was given in the *Kew Bulletin* for December 1887 (p. 9). The roots in the condition in which they are exported are known as "Raiz de Zacaton." During some years very little has been exported, but latterly increased interest has been taken in them as a cheap substitute for the well-known Venetian whisk, derived from the roots of *Chrysopogon Gryllus*. The most recent information respecting Broom root is contained in the following "Report for the year 1895 on the Trade of Mexico" (F.O., 1896, Annual Series, No. 1827) :—

"From the roots of a coarse tufty grass, known as 'Zacaton,' which is found growing wild all over the highlands of Mexico, a fibre is extracted called 'Raiz de Zacaton,' which has found a market abroad for the manufacture of certain kinds of brushes and whisks. It is collected by hand, and is subjected to very little treatment before being baled, beyond being soaked in water and bleached in the sun. The principal market for this fibre is Hamburg, but the United States and France both take a certain amount. It has never obtained a foothold in the English market. The export in 1895 was valued at 67,599*l*. The price, according to the New York quotations, ranged in the year under question from 6c. to 14c. per lb., according to quality."

LXXXI.—CHINESE FIBRES.

[K. B., 1891, pp. 247–259.]

Under the name of jute or hemp there are included a number of commercial fibres in China yielded by very different plants. There are

different fibres bearing the same name, and the same product often bears different names at different ports. The fault is probably due to the fact that European traders have used the terms jute and hemp in a generic sense rather than a specific one. There is probably also a fiscal element concerned, as the duty on "jute" is only "2 mace per picul," whereas "hemps" pay $3\frac{1}{2}$ mace. An inquiry made by Kew less than a year ago in regard to the origin of Chinese jute, as quoted in the London trade lists, has brought out very forcibly the confusion which exists in regard to the origin and classification of commercial fibres at Chinese ports.

It has been shown that Chinese jute, identical in all respects with Indian jute, and yielded by the same plant, *Corchorus capsularis*. L., is grown and prepared in the neighbourhood of the town of Wênchow while the so-called jute of Northern China is obtained from an entirely different plant which has been lately identified, from specimens forwarded to Kew by the Acting Consul at Chefoo, Mr. Alexander Hosie, as *Abutilon Avicennæ*, Gærtn. In regard to the application of the term hemp, this appears to be still more widely and loosely used. It is applied, in its usual sense, to the common or Russian hemp, grown in Northern China, the produce of *Cannabis sativa*, L. It is also indifferently used and applied to the China grass or Rhea fibre (*Boehmeria nivea*, Hk.) of Kiukiang; to the fibre prepared from the bark of young trees of *Sterculia platanifolia*, L., at Hupeh, and to the pine-apple fibre (*Ananas sativus*, Baker) of Kiungchow, Hainan, and Formosa.

The application of such well-established terms as jute and hemp to fibres so different in character and origin must lead to much confusion and tend to retard the development of trade. One of the most interesting of Chinese fibres is that derived from the Ko plant, a trailing vine identical with *Pueraria thunbergiana*, Benth. This fibre, known locally as Ko-pou, has also passed under the name of hemp, although the quantity produced is apparently very small. An account of this Ko plant is given in the *Enumeration of Chinese Plants*, Journ. Linn. Soc., vol. xxii., p. 191.

To return to the subject of jute. Seeds and specimens of Chinese jute from South Manchuria received at Kew in 1879 through Mr. Arthur Davenport, Her Majesty's Consul at Shanghai, proved to belong to *Abutilon Avicennæ*, Gærtn. Fibre yielded by the same plant was forwarded to Kew in 1885 by Mr. W. M. Cooper, Her Majesty's Consul at Ningpo. The very complete set of botanical specimens, with fruits and seeds, recently received through the Foreign Office from Mr. Alexander Hosie, Acting Consul at Chefoo, has already been noticed. These specimens, with the full report furnished by Mr. Hosie, afford very conclusive information respecting the origin of the so-called jute of Northern China. This may now be more correctly called Abutilon hemp. Another set of specimens, illustrative of the pine-apple fibre (also called hemp) has been received from Mr. E. H. Parker, Her Majesty's Consul at Kiungchow in Southern China.

The detailed information so far obtained respecting the distribution and origin of Chinese jutes and hemps, is given in the following correspondence. It is desirable to place this information on record as a basis for the further inquiry which is in course of being undertaken at Chinese ports under the direction of Sir Robert Hart, G.C.M.G., Inspector-General of the Chinese Imperial Maritime Customs. The very interesting memorandum prepared by Dr. Henry, F.L.S., is of special value for the purpose of aiding in such an inquiry, and this establishment is greatly indebted to Sir Robert Hart for the copy of it communicated

in the form of a pamphlet—China, Imperial Maritime Customs, II. :—Special Series : No. 16, 1891.

Inspectorate General of Customs, Peking,
December 27, 1890.

An inquiry respecting "Chinese jute" having been made by the Director of the Royal Gardens at Kew, Dr. Augustine Henry, one of the Service Medical Assistants now on leave, who has paid considerable attention to botanical subjects, prepared a memorandum on the jute and hemp of China, setting forth the present extent of our knowledge, and formulating certain points for elucidation. The original inquiry and the subsequent memorandum are hereto appended, and the ports concerned are requested to keep the matter in view and, while supplying the Inspector-General with such reports as may be drawn up, forward to the Non-Resident Secretary for the Kew Gardens such specimens as can be procured.

By order,
(Signed) E. B. DREW,
Chief Secretary.

ROYAL GARDENS, KEW, to the NON-RESIDENT SECRETARY.

Royal Gardens, Kew,
October 9, 1890.

SIR,

I AM desired by Mr. Thiselton-Dyer to inform you that a sample of "China jute," a small portion of which is enclosed herewith, has lately been presented to the Museum of Economic Botany at Kew. This "jute," we take it, is prepared and shipped from some part of China, but we are unable to trace its origin.

2. This establishment takes a special interest in the industrial application of plant products, and we have received very valuable aid from time to time from officers connected with the Department of the Chinese Imperial Maritime Customs, for which we are very grateful.

3. In the present instance, Mr. Thiselton-Dyer would esteem it a great favour if Sir Robert Hart could assist him in obtaining dried botanical specimens of the plant which yields "China jute," together with some particulars respecting the methods pursued in preparing it for market. The botanical specimens should, if possible, consist of leaves, flowers, and fruit, placed between sheets of paper and strengthened by cardboard. In this manner they would travel very well by parcel or book post.

I am, &c.
(Signed) D. MORRIS,
Assistant Director.

J. D. Campbell, Esquire, Secretary, Chinese Imperial Maritime Customs, 8, Storey's Gate, St. James's Park, S.W.

MEMORANDUM on the JUTE and HEMP of CHINA, by Dr. AUGUSTINE HENRY, F.L.S.

I have read over the letter addressed to the London Office by Mr. Morris, of Kew, and I think the specimen referred to "China jute" is not jute at all, but Abutilon hemp. I am also of opinion that the article comes from Tientsin.

As the Director of the Royal Gardens at Kew seems anxious to obtain information concerning the plants producing textile fibres in

China, and as there is much doubt regarding the various kinds of so-called hemp and jute in China, different products bearing the same name, and the same product having different names at different ports, I take the present opportunity of preparing a statement of the extent of our present knowledge of the subject. While, on the one hand, this statement might assist the Director of Kew in showing him the direction in which information is to be sought ; on the other, it may be of some service to the Inspector-General at any time that he may wish to have the subject gone into by his officers in China. The subject is of considerable importance, I should say, both on the commercial and scientific sides.

A.—*The Plants producing Textile Fabrics in China.*

In Chinese the character *Ma* is generic of plants producing textile fabrics ; and the following kinds are distinguished both by colloquial and book usage [*Ma* also includes certain plants the seeds of which are used for their oil, and also certain herbs the foliage of which simulates hemp in appearance ; but with these we have at present nothing to do] :—

1. *Ta Ma*, of books ; *Hsiao Ma*, colloquially in North China, because there the castor-oil plant is spoken of as *Ta Ma* ("large *Ma*"), from its stature ; *Huo Ma* colloquially in South China.

These names indicate common or Russian hemp, the product of *Cannabis sativa*, L.

So far as my experience in Hupeh goes, this plant is chiefly cultivated there for the oil from its seeds, and for coarse fibres used in making cordage ; and is not apparently used for making cloth or canvas. But in other provinces of China it doubtless is manufactured into cloth, and information on this point is desirable.

2. *Ch'ing Ma.*—This is Abutilon hemp, the product of the plant known to botanists as *Abutilon Avicennæ*, Gærtn. It is commonly cultivated in Hupeh and Szechwan, and is the greater portion, if not all, of the "hemp" passed through the Ichang Customs. According to Bretschneider, it is also cultivated in Chihli ; and I have little doubt it is what is passed through the Tientsin Customs as "jute." In support of this I find in a Customs publication that all the hemp exported from Tientsin is called by the Chinese *Ch'ing Ma*, and by the foreign merchants "jute." But there is some confusion between this and the next article, as will be shown.

3. *Huang Ma.*—This is "Indian jute," the product of *Corchorus capsularis*, L. The plant is figured in Chinese books, and, according to the Vienna Exhibition Catalogue, its fibre is exported from Shanghai. Loureiro mentions it for Canton, and Dr. Faber says it is cultivated in Szechwan under the name *Pai Ma*. This name is given in the Chinese Herbal, the *Pên-ts'ao* as a synonym of *Ch'ing Ma* ; and it would seem, then, that Abutilon hemp and jute are liable to be confused by the Chinese. Perhaps some of the Ichang and some of the Tientsin export may be "Indian jute."

4. *Ch'u Ma.*—This is *Boehmeria nivea*, Hook. et Arn., China grass, out of which most of the so-called Grasscloth (in Chinese "*Hsia Pu*") is made. It is cultivated in Szechwan, Hupeh, Kiangsi, and various other provinces. The Kiukiang Trade Reports for 1868, p. 29, and 1869, pp. 115, 118, give the information that the "hemp" exported from Kiukiang is produced in the districts of Shui-ch'ang in Kiangsi, Hsing-kuo and Wusüeh in Hupeh, and, besides what is exported, a large quantity is locally woven into grasscloth. The 1869

Report, p. 118, enters into the question of grasscloth and its manufacture from the "hemp," and gives tables showing the extensive exportation, &c.

From this it would seem that the "hemp" exported from Kiukiang is really China grass; and I believe a large portion of the Hankow export of "hemp" is the same fibre.

The Paris Exhibition Catalogue, No. 1673, Hankow, gives *Ssŭ Ma*. This probably is also China grass.

5. *Hu Ma.*—This is flax (*Linum usitatissimum*, L.) which is cultivated in Shansi, in Mongolia, and in the mountainous parts of Hupeh and Szechwan. In the last two provinces, from personal observation flax would seem to be entirely cultivated for the seeds, which are a common article in Chinese drug shops, and are used locally for their oil, utilised for cooking and lighting purposes.

So far as I know the Chinese do not make any linen.

6. *Tung Ma*, a local product of Hupeh, and of no commercial importance.—It consists of the fibres obtained from the bark of young trees of *Sterculia platanifolia*, L. f., by steeping them in water. This "hemp" is used for making cordage, and a specimen of it, procured by me, is in the Museum at Kew.

7. *Po-lo Ma*, "Pine-apple Hemp."—This is made into a fabric called *Huang-li Pu* in Formosa (*huang-li* being the local name there for "pine-apple"). The Customs Report for 1876, Takow, p. 98, says this is a strong coarse fabric made from the fibres of the pine-apple leaf, and it resembles the coarser kinds of grasscloth. It is used (in Formosa) almost entirely in the manufacture of inner garments and of the single garment worn by agriculturists in the warm weather.

The Kiungchow Report for 1883, p. 361, says that hemp was exported from Hainan by steamer in that year to the value of Hk. Taels 18,000 (803 piculs in quantity), and that most of this so-called hemp, which is in reality the fibre of the pine-apple plant, finds its way to Swatow, where it is manufactured into a very fine grasscloth.

The export called "hemp" from Hainan and Formosa is evidently, then, the fibre best distinguished as "Pine-apple hemp."

8. *Fan Pu, i.e.*, "Savage Cloth."—This is, according to the Takow Trade Report for 1876, p. 98, a kind of grasscloth worn by the inhabitants of Formosa. It is manufactured by the aborigines, and is finer and more expensive than the Pine-apple cloth. It is sold in the shops of Taiwan-fu; the better kind sells for as much as 8 dollars for a piece sufficient for making a single garment.

It is very desirable that information should be obtained regarding the plant from which this dear article is procured. Particulars regarding its mode of preparation, &c., are also wanted.

B.—*Concerning the different Names of these Textiles in common Use, and their Export from the various Treaty Ports.*

We find the following information embodied in various Customs publications:—

1. The "hemp" exported from Tientsin is called "jute" by the foreign merchants there, and *Ch'ing Ma* by the Chinese; and is allowed to pass at the rate of 2 mace per picul, other kinds of "hemp" paying 3½ mace. No ports but Tientsin and Shanghai seem to export "jute."

2. "China Grass," or "Raw Hemp," *i.e.*, the raw fibre roughly stripped from the stem in "ribbons." An export from Hankow; pays an *ad valorem* rate of 5 per cent.

3. "Hemp Skin," *Ma-p'i*. An export from Amoy; pays 5 per cent. *ad valorem*. I cannot say what kind of hemp this is, nor what is the plant from which it is derived, and information on this point is very desirable.

4. "Pine-apple Hemp." The tariff for "hemp," *i.e.* $3\frac{1}{2}$ mace, is levied.

5. *Export from the different Ports.*—I roughly summarise, with running notes, from the Customs Returns for 1889:—

Tientsin.—Export for that year of 13,619 piculs of "jute." I consider this to be really Abutilon hemp; Chihli is the province of production.

Ichang.—1,506 piculs of "hemp" exported in 1889. This is mainly Abutilon hemp, though some "Indian jute" may be included. Produced in Szechwan. Always called *Ch'ing Ma* on the Ichang Customs documents.

Hankow.—105,278 piculs of "hemp" exported in 1889. No distinction is made in the return between Abutilon hemp, Russian hemp (if any), jute, or China grass. A certain portion is unquestionably Abutilon hemp from Szechwan and Hupeh, and the larger part is China grass from Hupeh.

Kiukiang.—25,704 piculs exported in 1889; all called "hemp." This is probably all China grass from Hupeh and Kiangsi.

Wuhu.—290 piculs of "hemp" exported in 1889. Produced in Anhwei, and perhaps China grass.

Chinkiang.—1,059 piculs "hemp." It is doubtful what this really is.

Shanghai.—390 piculs "hemp," and 21 piculs "jute," of local production. What are they?

Ningpo.—264 piculs "hemp skin."

Foochow.—52 piculs "hemp."

Takow.—1,374 piculs "hemp" (this is "pine-apple hemp"), and 541 piculs "hemp skin."

Amoy.—6,215 piculs "hemp skin."

Swatow.—10,916 piculs "hemp skin."

Kowloon.—913 piculs "hemp" and 1,643 piculs is "hemp skin."

Lappa.—2,355 piculs "hemp," and 1,720 piculs "hemp skin."

Kiungchow.—983 piculs "hemp." This is "pine-apple hemp," and is produced in the island of Hainan.

From the southern ports, it will be noticed, there is a larger export of "hemp skin," a very ill-sounding name. It is, probably, an undressed hemp, and may be the product of the common or Russian hemp plant; but the point ought to be elucidated, and a better English name substituted.

C.—*Points requiring elucidation.*

1. What is the export from each port of the different articles properly classified as being *Russian Hemp*, *Abutilon Hemp*, *true Jute*, *China grass*, *pine-apple Hemp*, &c.?

2. What is "Hemp skin"?

3. From what plant is the "Savage Cloth" of Formosa, made, and what is the process of manufacture, &c.?

4. Grasscloth ought to be distinguished according as it is made from China grass, pine-apple hemp, &c.

5. Are there any other plants than those mentioned which yield textile fabrics in China of any commercial importance?

6. Specimens of the "jute plant," especially in fruit, are required, as the species *Corchorus capsularis*, L., is not settled beyond the shadow of a doubt.

7. Particulars regarding the place of production, the manner of cultivation, and preparation, are wanted, &c., &c.

(Signed) AUGUSTINE HENRY.

London, October 15, 1890.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

Foreign Office, March 25, 1891.

SIR,

WITH reference to your letter of the 26th of November last, I am directed by the Marquis of Salisbury to transmit to you a copy of a despatch from the Acting British Consul at Wênchow, including a report on China grass cultivation in China.

A copy of a further despatch from Mr. Hosie, transmitting a report on another textile plant, is also enclosed.

Mr. Hosie states that a case of specimens illustrative of his reports will be forwarded direct to Kew Gardens. * * *

I am, &c.

(Signed) T. H. SANDERSON.

W. T. Thiselton-Dyer, Esq., C.M.G.,
Kew Gardens.

[Enclosure.]

Acting Consul HOSIE to the MARQUIS OF SALISBURY.

Wênchow, January 26, 1891.

MY LORD,

IN connexion with my preceding despatch of this date, I have the honour to enclose a brief Report on another textile plant cultivated in this neighbourhood. It is to all appearances a species of *Abutilon* [since determined as *Corchorus capsularis*, L.]; but its lanceolate and glabrous leaves, its rugose awnless capsules, and its general appearance and size distinguish it from any *Abutilon* that I am acquainted with, in the Flora of China or of India.

I was reserving these brief notes until I had collected more detailed information; but as I am under orders to proceed to Chefoo, and as it will therefore be impossible for me to conduct further experiments with the plant during the present year, I venture to forward the Report, brief as it is, in the hope that it may be of some interest to the Director of Kew Gardens.

* * * * *

I have, &c.

(Signed) ALEXANDER HOSIE,
Acting Consul.

The Marquis of Salisbury, K.G.

REPORT on the CULTIVATION, at WÊNCHOW, of a FIBRE PLANT, and on the EXTRACTION and USES of its FIBRE.

Cultivation.

The seeds of this fibre plant, called *Lu Ma* in the neighbourhood of Wênchow, are sown in May. The ground having been made into beds in the usual Chinese fashion, shallow openings from nine inches to a foot apart are made in the surface by hand or hoe. Into each opening a pinch of seeds is dropped, and covered with a little vegetable ashes. When the young plants appear they are manured once with liquid manure, and when about an inch high they are weeded out, not more than three plants being allowed to grow together. When a foot high

they are again manured with liquid manure. In July, small yellow flowers appear on the stems, which have meantime grown to a height of five or six feet, and quickly dropping their petals, give place to clusters of seed capsules, usually three in number and firmly attached to the stems. The latter continue growing and flowering until the end of August, blossoms showing on the tips when the seed capsules beneath are fully developed. By this time the stems have attained a height of 9 to 12 feet, with a circumference at the base of from 2 to 3 inches, and with branches commencing some 3 feet from the ground. The stems, which are green and supple throughout, are harvested before the seed capsules have changed colour, that is, before green has given place to brown.

Harvesting.

They are plucked up by the roots, the adhering soil being removed by beating against the nearest stone, and where I saw the stems harvested, the roots were thoroughly washed in a pond close to the field.

Decortication.

Two men are required to remove the peel. One takes hold of the plant by its branches, the other seizes the stem below the first branch between two rounded pieces of wood about a foot long and from three to four inches in circumference, tapering somewhat towards the end so as to provide a firmer grip for the hands. The first workman pulls the stem through the two pieces of wood which crush it, separate the peel from the central woody matter, and remove the root. The plant is then reversed and the branches are pulled through the wooden handles and crushed, and the leaves and seed capsules dislodged. The woody matter that has not meantime fallen to the ground is brushed away by hand, and the peel of stem and branches is ready to be made into bundles for market.

Uses.

Such is the treatment which the plant receives when the fibrous peel is to be made into cordage; but, when it is to be manufactured into sacking or coarse cloth, the plants, when harvested are steeped for a day in cold water, and, when manipulated as above described, much of the outer cuticle is removed in the process, and when bleached, a whiter fibre is obtained.

The plant grows luxuriantly on the plains, but I have also seen it cultivated at an altitude of over 1,300 feet.

* * * * * *

(Signed) ALEX. HOSIE,
Acting Consul.

H. B. M. Consulate, Wênchow,
January 26, 1891.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
May 5, 1891.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 25th March enclosing copies of despatches, in original, received from the Acting British Consul at Wênchow, on certain fibre plants.

2. The specimens illustrative of Mr. Hosie's reports have since been received at Kew, and they are all of an interesting character. The

specimens referred by Mr. Hosie "to a species of Abutilon" and "called in the neighbourhood of Wênchow *Lu Ma*," have proved to belong to *Corchorus capsularis*, L., the plant yielding Indian jute. It would therefore be better to call this fibre simply "China jute." There is a fibre yielded by a species of Abutilon, but this appears to come from Northern China. * * * *

I have, &c.

Sir Villiers Lister, K.C.M.G., (Signed) D. MORRIS.
Foreign Office, S.W.

Acting Consul HOSIE to FOREIGN OFFICE.

MY LORD, Chefoo, September 5, 1891.

WITH reference to the enclosure in your lordship's despatch to me of June 5th last, wherein the Assistant Director of the Royal Gardens, Kew, mentions a plant grown in North China which yields a fibre known in the London market as China jute, I have the honour to forward herewith a brief report on the cultivation of the plant in question, and on the method of extracting the fibre.

I am sending direct to Kew, by parcel post, dried flowering and fruiting specimens of the plant, a packet of seed, and a sample of the fibre. [These were subsequently shown to be derived from *Abutilon Avicennæ*.]

The only other plant cultivated in this neighbourhood for its fibre is *Cannabis sativa* or Russian hemp.

I have, &c.

(Signed) A. HOSIE,
Acting Consul.

The Marquis of Salisbury, K.G.,
Foreign Office.

[Enclosure.]

REPORT on the CULTIVATION of a FIBRE-YIELDING PLANT at CHEFOO.

This plant, known in the North of China as *Ch'ing Ma*, or more briefly *Ch'ing*, yields the fibre, also called *Ch'ing*, which appears as "jute" in the export returns of the Imperial Maritime Customs. It is an annual. The seeds are sown towards the middle of April in land that has previously been well worked and manured, several seeds being sown together at intervals of about a foot apart, and not more than an inch under the surface. Unless, however, the soil is rich, only one of the seedlings is allowed to mature. In years of normal rainfall the stems which are branchless with alternate large smooth serrated ovate acuminate green leaves with long leaf-stalks, attain a height of eight to ten feet. They are green and supple throughout, with a circumference at the base of from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches. In July and August they bear numbers of yellow five-petalled flowers on stalks, which spring from the axils of the leaf-stalks. These quickly fall, and are succeeded by seed capsules of comparatively large size, grooved, and semi-spherical in shape. Each capsule is made up of a number (11–15) of cells, with awns at the upper ends curving down, and into the centre of the capsule. Each cell contains three seeds, which, white at first, assume when ripe a dark brown colour. The latter, which have the appearance of each having had a notch made in it, are released at the proper season by the opening of the outer and upper walls of the cells. Towards the end of August the plants have attained maturity. They are then cut down by knife

near the root, and the leaves and tips are lopped off. The stems are made up into bundles tied loosely at the tip end, and placed upright in standing water, so that only the lower halves are submerged. The root halves being more matured than the upper, require more retting, and for this reason they undergo two days' preliminary steeping. After the lapse of two days the bundles are laid on their sides in the water, and covered with sufficient earth to sink and bring them in contact with the bottom of the pond. In four or, at the most, five days the fibrous peel is loose enough to be easily removed by hand from the woody interior. The fibre ribbons, which have now all but lost their green colour, are afterwards washed in clean cold water and spread out in the sun, and when dry they are of a good white colour, such of the external greenness as remains after the retting and washing disappearing in the process of drying.

These remarks apply to the plant as cultivated at Chefoo, but I am informed that in other parts of this province and in the Mongolian hills the stems attain a much greater height and yield a longer fibre. The fibre exported from Tientsin, for example, much of which probably comes from Mongolia, is sometimes found to be as much as fifteen feet in length, whereas the plant itself does not attain that height in the light sandy soil near Chefoo.

The table annexed to this Report gives the climatic conditions under which the plant is cultivated here. [Not reproduced.]

(Signed) ALEX. HOSIE,
Acting Consul.

H. B. M. Consulate, Chefoo,
September 5, 1891.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
November 23, 1891.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 21st ultimo, forwarding a copy of a despatch and report by Mr. Hosie, Acting Consul at Chefoo, on the subject of a fibrous species of *Abutilon* yielding Chinese jute.

2. The specimens mentioned by Mr. Hosie and sent direct to this establishment have now been received. These specimens were admirably prepared, and taken with the report they definitely settle the question raised in my letter of the 5th May last in regard to the origin of Chinese jute from Northern China. The plant yielding it is *Abutilon Avicennæ*, Gærtn., a widely diffused species in Eastern Asia.

3. Mr. Thiselton-Dyer would express the hope that Mr. Hosie may be thanked for the very intelligent manner in which he has prosecuted his inquiries in this matter, and for the valuable assistance he has afforded to this establishment.

I have, &c.,
(Signed) D. MORRIS.

Sir T. H. Sanderson, K.C.M.G.,
Foreign Office, S.W.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

July 17, 1891.

SIR,

I AM directed by Mr. Thiselton-Dyer to inform you that he has read with interest the report on the Trade of Kiungchow for the year 1890, by Acting Consul Parker [F. O. Annual Series, 1890, No. 898],

and the numerous references contained in it to the plants and the plant-products noted by him in the journey inland up the Poh Chung river.

2. Mr. Parker states on page 9 that "another peculiarity of this "region is the ubiquitousness of the dwarf *Pandanus*, probably the "same as the *P. odoratissimus* of Fiji, the fibre of which here, as there, "is used in the manufacture of 'grass-cloth,' and is usually known to "foreign trade here as 'hemp.'" In the marginal note this is described as "cloth from the wild pine-apple."

3. As the various plants yielding what is locally known as "hemp" in different parts of China are now in course of being investigated at Kew, Mr. Thiselton-Dyer would be glad to receive dried specimens of leaves of the *Pandanus* described by Mr. Parker, and also specimens of the fibre as it usually appears in trade at Kiungchow. The latter would be placed for reference in the Museum of Economic Botany attached to this establishment.

I have, &c.,
(Signed) D. MORRIS.

Sir Villiers Lister, K.C.M.G.,
Foreign Office, S.W.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

Foreign Office, November 4, 1891.

SIR,

WITH reference to the letter from this Department on the 23rd of July last, I am directed by the Marquis of Salisbury to transmit a Memorandum drawn up by Mr. Parker, Her Majesty's Consul at Kiungchow, showing that the hemp exported from the above-mentioned place is made from the fibre of the pine-apple, and not of the *Pandanus*.

The parcel of specimens alluded to in Mr. Parker's Memorandum has not yet arrived, but will be forwarded directly it is received.

I am, &c.,
(Signed) T. H. SANDERSON.

W. T. Thiselton-Dyer, Esq.,
Kew Gardens.

[Enclosure.]

REPORT BY MR. CONSUL PARKER, KIUNGCHOW.

The inquiry instituted by the Kew authorities has led to the discovery that the finer kinds of "hemp" which are exported hence are the fibre of the pine-apple, and not of the *Pandanus*.

Mr. Stuhlmann, in his Customs Report for 1877, does, indeed, mention this "pine-apple fibre," other two Commissioners refer to it as "hemp." Mr. Commissioner Neumann, in his Report for 1889, says:—"What is "exported under the name of hemp is the fibre of the pine-apple plant "(*Pandanus*); it comes principally from the Lie-chou peninsula, and "realises as much as $40 to $140 the picul" [1*s.* to 3*s.* a pound].

From the appearance of the ubiquitous *Pandanus*, I should suppose it to be the same plant as the *Pandanus* of Fiji, which colony I have recently visited. I now find, however, that the Fijians only make mats, not clothing, out of the *P. odoratissimus*, and that the *Pandanus* of Hoihow is useless except for hedgerows and fuel. It is said that, somewhere inland, mats are made of it here, and that its root is used in the Pharmacopœia as a febrifuge. Parcel No. 4 contains a few leaves of this plant, and the tin box contains its fruit, which seems to mature from April to September at least, if not all through the year.

Parcel No. 2 contains leaves of the plant from which the so-called "hemp" is manufactured. These come from *Mun-shio* or *Wên-ch'ang*, a district a few days' journey to the east, which district appears to be the only one upon this island where pine apple "hemp" and the cloth from it are manufactured.

Parcel No. 1 contains the leaves of a pine apple plant, *grown for the fruit only*, obtained at a village five miles to the west of Hoihow: natives of *Mun-shio* in my service assert that this is the same as the pine-apple of *Mun-shio*, the fruit of which, though eaten, is of secondary consideration there.

Parcel No. 3 contains imperfect leaves of the pine-apple plant of the *Lei-chow* peninsula, opposite Hoihow, from which the natives there are *said* to manufacture a "grass-cloth," which is *supposed* to be brought over here in junks for export hence.

Parcel No. 5 contains a leaf of the plant (no whereabouts given) from which the Customs here were convinced the local "grass-cloth" was made: they supposed it was the *Pandanus*, until I proved to them that it was not. The *Pandanus* has a prickly seam down the centre of the leaf.

The leaf of the pine-apple is first scraped with a bamboo knife; it is then torn apart, and washed in cold water in which rice has been washed. It is next dried in the sun and aired at night, after which the skeins are combed, and the ends of each thread are joined, by a twist of the fingers, to each other. The material is then sized with rice-gruel, drawn through bamboo tubes, and cleaned of its knots, joinings, and protuberances.

Parcels Nos. 5A, 6, 7, 8, 9, and 10 represent the pure pine-apple fibre in its various stages. Nos. 6, 7, 8, 9 appear to be mere qualities of No. 5A, each of which is capable of becoming No. 10 if sufficient labour is given to it.

Parcel No. 11 contains specimens, with prices, of pure pine-apple "grass-cloth," presumably corresponding in quality to Nos. 6, 7, 8, or 9.

Parcel No. 12 contains a mixed web of ordinary cotton and pine-apple fibre interwoven.

Parcel No. 13 contains specimens of hemp and hemped cloth from *Mun-shio* by way of contrast.

(Signed) E. H. PARKER.
Consul.

Kiungchow, December 22, 1891.

ROYAL GARDENS, KEW, to FOREIGN OFFICE.

Royal Gardens, Kew,
November 26, 1891.

SIR,

I AM desired by Mr. Thiselton-Dyer to acknowledge the receipt of your letter of the 4th instant forwarding a memorandum drawn up by Mr. Parker, Her Majesty's Consul at Kiungchow, on the subject of pine-apple fibre prepared at the above-mentioned place.

The parcel of specimens alluded to in Mr. Parker's memorandum having arrived at Kew, it has been carefully examined in accordance with the information furnished in this and the previous correspondence.

There can be no doubt that the leaves sent by Mr. Parker are those of the pine-apple plant (*Ananas sativus*, Schult. f.), and the fibre corresponds with that usually yielded by members of the pine-apple family. The Pandanus represented by leaves and one fruit, is, as Mr. Parker supposed, *Pandanus odoratissimus*, a native of tropical Asia. The fibre prepared from the leaves of the Pandanus is usually of poor quality,

and it could not be mistaken for that of the pine-apple. The specimens forwarded by Mr. Parker were carefully put up and labelled, and, taken with his memorandum, they may be considered to have definitely settled the point at issue. Mr. Thiselton-Dyer would venture to express the hope that the Secretary of State will communicate the thanks of this establishment to Mr. Parker for the very intelligent manner in which he has assisted in this inquiry.

I have, &c.
(Signed) D. MORRIS.

LXXXII.—ECONOMIC PLANTS OF MADAGASCAR.

[K. B., 1890, pp. 200–211.]

In a valuable paper by the Rev. Richard Baron, F.L.S., on the Flora of Madagascar (*Journ. Linn. Soc.*, vol. xxv., pp. 246–294), it is stated that the "vegetable productions of Madagascar have been very ex-"tensively explored, and that the majority of the plants inhabiting the "island are known to science." The flora of the low lands of the southern parts of the island is still, however, the least known. Our knowledge of the flora of Madagascar is due to the labours of numerous botanists from Flacourt, Dupetit Thouars, and Commerson to Grevé, Bojer, Grandidier, and Ellis. Within the last few years this knowledge has been greatly increased through the very successful labours of Mr. Baron himself, and his collections, received at Kew, have been determined and described by Mr. J. G. Baker, F.R.S. It is estimated that whereas until recently less than 2,000 species of plants were known from Madagascar, there are now named and described abont 4,100 species.

Mr. Baron has been good enough to supplement his paper on the Flora of Madagascar by preparing for the *Kew Bulletin* some brief but interesting notes on the economic plants of the island. These plants are of considerable interest and importance. One of the earliest notices of Madagascar economic plants is contained in Rochon's *Voyage to Madagascar and the East Indies* (English translation, 1793, pp. 280–297). In this work plants from the north of Madagascar, "now trans-"planted in the Royal Botanical Garden at the Isle de France" (Mauritius), are given under their native names. The Ravensara (*Ravensara aromatica*), the Tanguem or Tangèna (*Tanghinia venenifera*) and the Filao (a species of *Casuarina*) and many others are noticed. The latter tree is quaintly and not unappropriately described as "Equisetum arborescens."

Dr. G. W. Parker, a medical missionary sent out to Madagascar, has recently prepared a Malagasy Materia Medica, with special reference to the use of native plants. This, with determinations made at Kew, was communicated to the *Pharmaceutical Journal*, 1881, vol. xi., pp. 853–855.

There are numerous scattered notes respecting the economic plants of Madagascar to be found in other works, but the above appear to include the more systematic attempts to describe them. It may not be inappropriate to mention here that there are still some very valuable plants of Madagascar about which at present we know very little. As shown in the *Kew Bulletin* for May, 1888, p. 135, we are not acquainted with the source of Madagascar Ebony nor of Madagascar Sandal wood. There is also the plant which yields Madagascar Piassava. This is doubtless a palm, but not a species of Raphia as is generally supposed.

The publication of Mr. Baron's notes will serve a useful purpose if they do no more than stimulate others to follow his example and treat of plants growing beyond the special districts covered by his investigations. The Madagascar plants yielding fibrous materials are enumerated in the following extracts :—

Malvaceæ.

Abutilon angulatum, Mast. A shrub, probably introduced, from the fibre of the bark of which the Betsiles manufacture a kind of cloth. (Cent. and E. Reg.) *Hàfopòtsy.*

Pavonia Bojeri, Baker. A shrub yielding a kind of fibre. (Cent. Reg. chiefly.) *Tsòntsona.*

Hibiscus tiliaceus, L. (E. and N.W. Coasts.) *Vàro* and *Bàro* (Betsim).

Adansonia madagascariensis, Baill. The Madagascar Baobab. Its bark affords a fibre and its fruit is edible. (W. Coast.) *Bontòna ; Za* (Sak). Two other species only are known, viz., the Baobab or Monkey-bread tree of W. Africa (*Adansonia digitata*, L.), the pulp of the fruit of which is edible and the bark fibrous, and the Australian Gouty Stem tree (*A. Gregorii*, F. Muell.), the pulp of the fruit of which is also eaten by the aborigines.

Eriodendron anfractuosum, DC. The silk cotton surrounding the seeds is used for stuffing cushions, but is said to be dangerous to the eyes. (W. Reg.) *Moraingy* and *Hàmba* (Sak). This plant has a wide distribution in the tropics of the Old and New Worlds, and the silk cotton, under the name of Kapok, is exported from Java to Europe and Australia for stuffing mattresses.

Sterculiaceæ.

Dombeya, spp. Small trees whose bark supplies a useful fibre largely used by the people. (Cent. and E. Regs., especially forests.) *Hàfotra.* [This was, no doubt, the fibre about which a somewhat lengthened correspondence took place with the Foreign Office in 1881. It was carefully studied by the Leeds and Dundee Chambers of Commerce, and was reported to be, while destitute of textile value, well fitted for paper-making. It, in fact, closely resembled the bark of *Broussonetia papyrifera.*]

Tiliaceæ.

Grewia macrophylla, Baker. A shrub from which the Sihanaka obtain a kind of fibre. There are 45 species of *Grewia* known in the island, chiefly in the W. Reg., many of which yield a useful fibre, *Màkolòdy* (Antsih).

Corchorus olitorius, L. One of the plants which yield the valuable fibre obtained from India known as Jute. (E. and W. Regs.)

Combretaceæ.

Combretum coccineum, Lam. A climbing shrub yielding a fibre. (W. Cent., and E. Regs.) *Salay.*

Rubiaceæ.

Danais Gerrardi, Baker. A climbing plant from the root of which the Sihanaka obtain a dye, and from whose bark they obtain a kind of fibre. (Forests of E. Reg.) *Haizantolòho* (Antsih).

SAPOTACEÆ.

Mimusops? costata, Hartog. A small tree with edible fruit. It also yields a fibre. (River sides near E. Coast.) *Todìnga* or *Vòajàba* (Betsim).

ASCLEPIADEÆ.

Cryptostegia madagascariensis, Bojer. A shrub, the bark of which is used by the Sakalava in the manufacture of rum, and its fibre for fishing lines. (W. Reg.) *Lombiro* (Sak.)

THYMELÆACEÆ.

Dais glaucescens, Dene. The fibre of this shrub is used as string. (Cent. Reg.) *Avòha* or *Havòha*.

PALMÆ.

Raphia Ruffia, Mart. The midrib of the leaf of this palm, which sometimes reaches 35 to 40 feet in length, is used chiefly for poles for ladies palanquins, ladders, &c. The fibre from the young unopened leaves is employed as string, and is largely exported to Europe under the name of "Raphia Grass." Various kinds of cloth, which are known as "Jàbo," "Jiafòtsy," "Sandiadiaka," and "Sìkinivòla" are made from the fibre. From the stem the natives obtain a sweet liquid called "Haràfa," and the shells of the fruits are employed as receptacles for various small articles and as snuff boxes. (Widely spread in the island, but always in valleys.) *Rofià* or *Fòmby*.

PANDANEÆ.

Pandanus, spp. Hats are made from the leaf fibres of some of the species; the leaves of one of them found on the east coast are used, when dried, as covers for packages, and effectually secures them from rain. *Vakòana*, *Hòfa*, &c.

CYPERACEÆ.

Cyperus latifolius, Poir. Commonly employed in the thatching of houses. (Widely spread in marshes.) *Hèrana*.

C. imerinensis, Bœckl. A sedge nearly allied to the Egyptian papyrus. The flowering stems when strung together are largely used for native doors, &c. Mats are made from strips of the same. (Widely spread in marshy places.) *Zozòro*, *Zòrozòro*, and *Bilo*.

Eleocharis plantaginea, R. Br., and *E. Baroni*, Baker. Used in making mats, baskets, and hats. (Marshes in Cent. Reg.) *Harèfo*.

Scirpus paludicola, Kunth., var. *decipiens*, Nees. Employed in making mats, baskets, &c. (Cent. Reg. chiefly.) *Hàzondràno*.

Lepironia mucronata, Rich. Used in the manufacture of hats, also employed by the Betsimisaraka women in making sugar bags, which are exported to Mauritius. (E. Coast.) *Pènja* (Betsim). This species is found also in China, where it is largely used for making mats.

GRAMINEÆ.

Stipa madagascariensis, Baker. Employed in making native baskets, &c. (Cent. Reg.) *Hàravòla.* The plant is closely allied to the esparto (*S. tenacissima*, L.) of Spain and N. Africa, so largely used for paper making.

LXXXIII.—Notes on Articles contributed to the Museums of the Royal Gardens, Kew, from the Colonial and Indian Exhibition, 1886.

[K. B., 1887, September, pp. 4–19.]

The Kew Museums have always benefited largely from the several exhibitions, and, as might be expected, in no previous year have they been so extensively enriched as they were at the close of the exhibition last year, and this not only from the number of the specimens obtained, but also from the interest attached to many.

The following are some of the principal additions in fibrous materials from the different colonies :—

CANADA.

From N.W. America several interesting articles of native manufacture, including a mask, a huge whistle, spoon, &c., made of the even grained wood of the **Native Cedar** (*Thuja gigantea*), were procured, also a native head-dress made of the bark. This bark is remarkable among the Coniferæ for its fibrous character, and is so strong that mats are made from it, and when twisted and plaited it forms a good basket-making material.

NEW SOUTH WALES.

The Kew Museum being already in possession of a very fine set of woods and other vegetable products from this Colony, little or nothing was required or obtained for the collection, except a sample of **Pulu**, a soft woolly substance from the base of the leaf stalks of *Macrozamia spiralis*, a Cycadeous plant of New South Wales and Queensland. This substance is said to be produced in quantities, and used for stuffing mattresses, cushions, &c.

FIJI ISLANDS

As regards the husk fibre [of the cocoa-nut], it is stated that the bulk of the fibre prepared in Fiji has hitherto found a market in Australia and New Zealand, but as the production increases it will be sent to other countries. "The husks from 7,000 cocoa-nuts produce about one ton "of fibre, which is of the value on the estate in Fiji of from 5*l.* to 15*l.* "per ton, according to quality. Brush fibre or bristles is worth from "15*l.* to 30*l.* per ton, and yarn from 20*l.* to 30*l.* per ton in Fiji. The "cost of labour to produce one ton of fibre, exclusive of cost and wear "of machinery, may be put down at from 5*l.* to 10*l.*"

Straits Settlements.

Betel Nut Fibre (*Areca Catechu*).—This is the fibrous husk of the fruit exhibited as a paper material. As a waste product it is said to be produced in almost unlimited quantities. Considering the very general practice of Betel chewing in the East, and the abundance of fruits produced, the adaptation of this apparently useless material for paper-making would seem to be a very probable benefit to the countries where the *Areca Catechu* is common.

India.

A very large collection of fibres was sent from India to the Exhibition, and from these a typical set was selected for Kew. Among the more important of them may be mentioned the following :—

Jute (*Corchorus capsularis*, and *C. olitorius*). The former species yields the Jute fibre of Central and East Bengal, while the latter is that cultivated in the vicinity of Calcutta. Jute is an article of large and increasing importation to Great Britain, being chiefly used in the manufacture of carpets and other fabrics. The people of India use a large quantity of this fibre annually for agricultural and internal trade purposes, added to which an immense number of gunny bags leave India filled with sugar, wheat, rice, and other grains.

Sunn Hemp (*Crotalaria juncea*). This plant is extensively cultivated in India for its fibre, which by careful preparation becomes soft, fine, and white, bearing comparison with flax. The waste is utilised in the manufacture of paper.

Deccani Hemp (*Hibiscus cannabinus*). A small shrub with prickly stems, generally cultivated in India, apparently wild east of the Northern Ghauts. The fibre produced from this plant is considered stronger, though not so good as the Sunn Hemp. In India it is used for nets and ropes, and in the Dacca district, Bengal, it is the chief fibre used in the manufacture of paper. It is also stated to be sometimes met with as an adulterant of jute.

Bauhinia Vahlii, an enormous and perhaps the most gigantic of the climbing plants of the Indian forests. Its uses are almost more numerous than those of any other forest plant except the bamboo. The bark is made into strong cordage, which is used for suspension bridges, and the fibre has been employed as a material for paper-making. The large flat leaves are sewn together, and used as plates, cups, umbrellas, and rain-caps. The pods are roasted, and the seeds eaten.

Cocoa-nut (*Cocos nucifera*). The valuable coir fibre of commerce is obtained from the fibrous pericarp. A fibre is also prepared from the leaf stalks, but compared to the coir it is unimportant. Coir is very largely used in the manufacture of mats and matting. The net of fibres at the base of the petioles is made into bags and paper, and is also used in Ceylon for straining toddy.

Udal (*Sterculia villosa*), a moderate sized tree, common in the forests throughout India and Burma. The tree is so highly valued for its fibre, that in the more accessible forests, it may be said to occur chiefly as a bush from its branches being constantly lopped for the fibre they contain. The fibre is coarse but strong, and is made into ropes and coarse bags, and in Bengal, Burma, and South India, into ropes and breastbands for dragging timber.

LXXXIV. — BOTANICAL ENTERPRISE IN THE WEST INDIES, 1890-91.

[K. B., 1891, pp. 111–166.]

From the notes prepared by Mr. D. Morris, C.M.G., F.L.S., the Assistant Director of Kew, during his mission in the West Indies in 1890–91, and published under the above heading in the *Kew Bulletin*, the following extracts are taken relating to fibrous plants :—

Antigua.

Although operations at the Botanical Station had only been commenced during the past 12 months, considerable progress has already been made in laying out the land, and in starting nursery beds and experimental plots. The latter were devoted to 20 varieties of grape-vines, pine-apples, fibre plants (*Sansevieria*, *Boehmeria*, *Furcraea*), bananas, cacao, Egyptian cotton, coffee, mulberry for silkworms, and fruit trees. The nursery bed contained several hundred small plants ready for distribution, and some ornamental trees and shrubs suitable for shade and shelter.

A good deal of scrubby bush is found at Piccadilly, near English Harbour, and in it are found large quantities of the Keratto (*Agave Keratto*) and the Turk's-head Cactus (*Melocactus communis*).

A plot about $\frac{1}{2}$ acre in extent is opened on Cedar Valley Hill, about $\frac{1}{4}$ mile distant from the Botanical Station in a northerly direction. It contains $\frac{1}{4}$ acre of *Furcraea cubensis* and pine-apples ; and another $\frac{1}{4}$ acre of *Sansevieria lanuginosa* devoted to the experimental growth of this plant on a strong calcareous soil.

The Government possesses an extensive tract of country at Piccadilly, near English Harbour. The land is somewhat poor and arid, but it may be utilised for growing fibres and pine apples, and other parts might be devoted to pen-keeping for cattle, sheep, horses, mules, &c.

The Curator of the Botanic Station, acting under the orders of the Government, has started a small experimental plot with pine-apples and fibres at Piccadilly. An effort will also be made to try cotton there.

Montserrat.

Very fine plants of *Furcraea gigantea*, the unarmed varieties of which yield the Mauritius hemp of commerce, were plentiful in the neighbourhood of the Arrowroot factory belong to the Montserrat Company. They are used chiefly as hedge plants.

Anguilla.

Careful search was made for any plants in the island that would be likely to afford the means for starting a fibre industry. There were numerous species of *Tillandsia*, *Pitcairnia* and other plants of this character on rocks and trees, but only one species of Agave was found, and that was, unfortunately, one that yielded a very inferior class of fibre. It was useless, therefore, to attempt the systematic cultivation of this plant. After considerable difficulty, one plant of *Furcraea cubensis* was found on land to the north-west. This it appears had been introduced there. The leaves were of good length and texture, and the fibre was excellent. It was evident that if two or three thousand acres of absolutely useless land in Anguilla could be established with fibre plants in a few years an important industry might be started there. The cost

of clearing the land, if started as relief work, would be very small, while plants could be obtained from Antigua, Jamaica, or some other islands to the south.

Virgin Islands.

An Agave, which, according to the Baron Eggers, is *Agave Morrisii*, Baker, the Keratto of Jamaica, is found abundantly everywhere. An attempt was being made by Mr. Campbell to start a fibre industry in connexion with this plant. If, as is supposed, it is identical with the Jamaica plant, the fibre is not of great commercial value. The reports received respecting fibre prepared from it by the Death and Ellwood machine at Jamaica were by no means satisfactory. They were as follows :—

(*a.*) *Keratto fibre.*—This fibre is of little strength, and is undesirable ; value 12*l.* to 14*l.* per ton ; it is not an even fibre, and it gives ; hence manufacturers find it very difficult to know what they are to do with it, and will not entertain it. It is very similar to a fibre that comes from Spain (Ide and Christie) ;

(*b.*) *Keratto fibre.*—Very towy ; not well cleaned, value 16*l.* per ton (Collyer).

On returning to the town some plants of *Furcraea cubensis* were found on land to the westward, and also a patch or two of *Sansevieria guineensis*. Both these are excellent fibre plants. The latter yields fibre that could be used for weaving purposes, and the demand for it would be practically unlimited.

St. Lucia.

A good fence of *Furcraea* divided the Botanic garden from the public road on the eastern boundary. The nurseries contained a moderately large stock of economic plants, including such fruit trees as oranges, citrons, limes, and grafted mangoes, purple guava, sweet sop, sour sop, and custard apple, pine-apples and *Flacourtia Ramontchi*, fibre plants such as *Furcraea gigantea F. cubensis*, *Sansevieria guineensis*, *Musa textilis*, *Agave rigida*, var. *sisalana*, and *Boehmeria nivea*.

St. Vincent.

At the time of my visit a portion of the land at the Botanic Station had been cleared, nurseries and seed-sheds had been started, and experimental plots of sisal hemp, cotton, pine apples, and other plants established.

Possibly the most striking and suggestive of the raw products of St. Vincent are its excellent fibres and fibrous materials. There are several very complete sets of these. One set, prepared by Mr. Powell, Curator of the Botanic Station, exhibits the fibres in a remarkably fine condition. Such fibres as "lapite," prepared from a wild variety of the common pine-apple ; "gri-gri," skilfully prepared from the young leaves of a palm ; and "china," prepared from the petiole of a species of *Kanthosoma*, are good examples of what St. Vincent is capable of producing, while the fibre of a form of *Agave rigida* to which attention has lately been directed at St. Vincent is excellent in quality, but apparently too short to compete successfully with the best sorts of Sisal hemp, as produced in the Bahamas and elsewhere.

Barbados.

Besides the experiments in sugar-cane an effort has been made at the Dodd Botanic Station to cultivate other plants, especially species of *Agave*, *Furcraea*, *Sansevieria*, *Boehmeria* for fibre purposes. The land is, however, of too clayey a character for such plants, and also too much exposed to strong and dry winds.

There are several thousand acres of waste land in Barbados where a fibre industry might be successfully established, and there are also other lands where plants yielding tanning barks might be cultivated. None of these can be experimentally tried under favourable circumstances at Dodd owing to the unsuitability of the soil and the exposed character of the locality.

LXXXV.—CULTURAL INDUSTRIES IN WEST AFRICA.

[K. B., 1890, pp. 197–198.]

Of fibre plants there are several that are adapted to West Africa. Already the Bowstring Hemp, yielded by one or more species of *Sansevieria*, has been successfully prepared at Lagos, and the market value of the fibre has shown it to be of high quality. To establish an industry in bowstring hemp it would be necessary to plant at least 200 or 300 acres before steps should be taken to introduce machinery to clean the fibre. The Death Fibre Machine Company, of 147, Leadenhall Street, E.C., might be in a position to supply particulars as to the success of growing bowstring hemp in Cuba and also as to the best machines for preparing the fibre.

The Sisal Hemp plant, *Agave rigida*, var. *sisalana*, could very easily be introduced to West Africa. Small plants, in quantity, are probably obtainable from Florida. The Sisal Hemp would grow in dry, arid districts unsuited to almost any other plants. If 500 plants were introduced at first, these after two or three years would yield sufficient suckers to establish several acres. Ramie may be regarded as unsuited to West African enterprise at present, and it would be useless to devote attention to it unless there is a sufficient supply of labour to work large plantations and suitable machinery is obtainable to decorticate the fibre at a low cost.

Of the jute class of fibre plants there are two very valuable fibre plants already abundant in West Africa. These are the "Bolobolo" (*Honckenya ficifolia*), fully discussed in the *Kew Bulletin* for January 1889 (see p. 30), and the Toja (*Urena lobata*). The fibres of these plants are probably worth 18*l*. to 20*l*. per ton, and the price is always likely to be maintained at such a figure as would render a jute industry remunerative. It might be possible to get the natives to clean these fibres by hand and sell the produce in small lots locally.

LXXXVI.—INDIGENOUS PLANTS OF YORUBA-LAND.

[K. B., 1891, p. 219.]

Fibres.

Agbari Ettu. (*Alafia* sp. ?) Very considerably used, not cultivated, plentiful ; might, if of value, become an object of export, but its value for any but native use appears doubtful.

Fe-ru, or Rawaye. (*Cochlospermum tinctorium*). Bark makes good rope, largely used as such by Yorubas and Houssas ; plentiful, sufficient supply for exportation, not cultivated.

Ake-iri. (*Urena lobata.*) Fair rope bark, used for various purposes by Yorubas and Houssas, chiefly in house building ; plentiful, not cultivated.

LXXXVII.—BOTANIC STATION, ST. VINCENT.

[K. B., 1892, pp. 101–103.]

From a report on the Botanic Station at St. Vincent, for December 1890, Mr. Henry Powell, the Curator, furnishes the following information respecting fibre plants :—

During the latter part of November and the beginning of December a considerable portion of my time was taken up in collecting and preparing the principal fibres of the colony for the Jamaica Exhibition, also in assisting in the preparation of botanical specimens of nearly the whole of the plants possessing economic and commercial properties in the colony.

These specimens proved of great interest and value, and they are mentioned in the official correspondence reproduced in the *Kew Bulletin* May and June 1891, p. 166. Amongst the local plants yielding fibre is an Aroid little used elsewhere. This is *Xanthosoma sagittifolium*, Schtt., known locally as "China." The petioles of the leaves are macerated in water, and a somewhat coarse fibre extracted from them. A form of *Agave rigida*, with short leaves, was found in St. Vincent by Mr. Hart, and latterly there has been received from that island for identification a specimen of *Furcraea gigantea*, var. *willemetiana*. This is similar to the Mauritius hemp plant, but with some teeth.

In his lecture delivered at the Court House, on the 27th December last, Mr. Morris stated that the Sansevieria or Leopard Lily, a valuable fibre plant, could be readily propagated by cutting the leaves into lengths, and inserting the same in sandy soil. About 700 plants have been already obtained in this way.

The original plants were received from Jamaica (12 plants) and Trinidad (6 plants) in July 1890.

LXXXVIII.—FIBRES OF INDIA.

[K. B., 1894, p. 321.]

[EXTRACT.]

Among fibrous plants it may be pointed out that while great tracts of India (in the form of hedges) are regularly under the American aloe, the fibre of that plant is not at all utilised. Everything points to the possibility of this large stock of valuable fibre not only being used up, but to its being found profitable to open out aloe-fibre plantations on an extensive scale. So in the same manner the fibre of *Sida* has from time to time been urged on the consideration of the textile world with comparatively little result. Interest may, however, be said to have at last been aroused in this most admirable fibre, and large supplies are being accordingly collected for experimental purposes. One or two enlightened native gentlemen have more than once been induced to grow this plant, and it is hoped that through their example it may be possible to get the ordinary cultivators to take to it, since it affords a fibre in many respects superior to jute. So, again, while much has been written on rhea fibre, little progress has been made. Numerous inventions have, however, been patented, and it is believed that, should a demand arise, India might largely participate in the supply of this fibre. There are also many most useful fibres known to the people of India which have for centuries been regularly grown to meet local demands. Some of these might be produced on a large scale at low prices, were a trade created for them. Amongst these may be mentioned Sunn-hemp (*Crotalaria juncea*) and Deccan-hemp (*Hibiscus cannabinus*). In the light of the fixation of nitrogen in the soil through the cultivation of plants belonging to the pea family, an extended production of Sunn-hemp would be a positive gain to India.

But the forests and jungles of India are literally teeming with wild fibrous plants, many of which could be grown on a large scale were this found necessary. For example, in the Rajmahal-hemp (*Marsdenia tenacissima*) India possesses a fibre which is far superior to rhea. It has among Indian fibres the highest known per-centage of cellulose, loses considerably less than any other under hydrolysis with soda or acid purification, while its weight is greatly increased by nitration. A line made of it broke when dry at 248 lbs., and when wet at 343 lbs., against a similar line of the finest hemp, which broke at 158 and 190 lbs. But a volume might be written on the unexploited fibres of India, most of which could be easily added to the list of regularly cultivated crops. If those already mentioned do not suffice, any of the following might be tried:—*Abroma*, *Abutilon*, *Anona*, *Bauhinia*, *Calotropis*, *Helicteres*, *Malachra*, *Musa*, *Pavonia*, *Sesbania*, *Sterculia*, *Villebrunea*, &c., &c.

LXXXIX.—FIBRE PLANTS OF FORMOSA.

[K. B., 1896, pp. 73–74.]

[EXTRACT.]

Dr. Augustine Henry reports that there are three chief fibre-yielding plants in cultivation :—

1. *Boehmeria nivea*, known locally as "t'oë," the "ch'o" of Pekingese, the nettle-hemp, yielding China grass fibre. Lately in the customs returns for Tainan it has been distinguished by the last name, but

formerly it had here (and in other ports still has) only the general name "hemp," which in China includes several different fibres. Formosan "China grass" is worth from 11 dollars to 20 dollars a picul (133⅓ lbs.), and is made into a particular kind of grass-cloth at Swatow.

2. Pineapple, the fibre of which in the local dialect is known as "ong-lai-ssü," and is worth about 24 dollars a picul. It is exported to Swatow, where it is made into a kind of grass-cloth distinguished as "ong-lai-ko."

3. Jute (*Corchorus capsularis*), the fibre of which is known to Europeans in China as "hemp skin," a too literal translation of the Chinese "ma-p'i." "Ma" is generic for textile fabrics, "p'i" is "bark," referring to the outer bark of the plant, which is stripped off in long ribbons. Owing to the different preparation of the plant in China and in India the products look very different. The so-called "hemp bags" of customs returns are made out of this coarse Chinese jute, which is also used for making rope and string of inferior quality. The jute is worth from 2 to 4 dollars a picul.

Corchorus olitorius, an allied species, which is readily distinguished by its long narrow fruit, that of *C. capsularis* being globular, occurs in Formosa as a weed, and I have not ascertained that its fibre is ever used.

It may be here noted that the so-called Tien-tsin jute is the product of *Abutilon Avicennæ*, and should be named "Abutilon hemp." I have seen true or Russian hemp, the product of *Cannabis sativa*, the "huo-ma" of the Chinese, from Newchwang, but this plant is more cultivated in China for the oil from the seeds than for the fibre; and of flax (*Linum usitatissimum*), which is cultivated in North-western China, the same may be said. Occasionally small quantities of a fabric named "shan-hsi ma pu," are brought to Tien-tsin, and this is doubtless linen, but I have seen no specimen, and merely infer from the name. The fabric has been described to me as a kind of grass cloth.

Flax is "hu-ma," and the seeds are for sale in drug shops.

"Savage cloth" is a term applied to at least three different kinds of coarse unbleached fabrics made by the savages. The kind made near Tamsui is of China grass, but whether from wild or cultivated plants of *Boehmeria nivea* I am not certain. The wild plant is very common, and has a coarser fibre. In the Kalee mountains "savage cloth" is made out of the inner bark of the roots of small wild mulberry trees, doubtless a variety of the very variable *Morus alba*. I have sent specimens of plant, root, fibre, and cloth to the Kew Museum. Game-bags ("bang-teh"), very serviceable, are also made out of this fibre by the savages, while similar ones are made out of China grass by the Chinese and Pepohuan. A third kind of "savage cloth" is made from the inner bark of *Sterculia platanifolia*, known in Formosa as the "ch'ing-t'ung" tree. I have not been able to get specimens of either fibre or cloth in Formosa, but specimens of fibre, and shoes made out of it, from Hupeh, have been sent by me to Kew. This tree has been utilized for its fibre from classical times, but the product is coarse, and only suitable for making shoes, ropes, &c.

Mr. Hosie mentions a fourth kind of "savage cloth" made out of ban na fibre, but there is no certain information to hand about this.