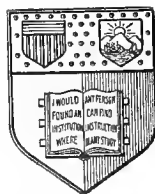


SB241
G9



New York
State College of Agriculture
At Cornell University
Ithaca, N. Y.

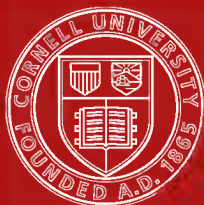
Library

Cornell University Library
SB 241.G9

Fibres from plants, indigenous and intro



3 1924 003 400 953



Cornell University
Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

DEPARTMENT OF AGRICULTURE, VICTORIA.

FIBRES FROM PLANTS,

INDIGENOUS AND INTRODUCED,

ELIGIBLE FOR INDUSTRIAL CULTURE AND
EXPERIMENT IN VICTORIA,

BY

WILLIAM R. GUILFOYLE,

F.L.S., F.R.G.S., F.R.H.S., C.M.R.B.S., London,

Director of the Melbourne Botanical Gardens.

/

By Authority:

ROBT. S. BRAIN, GOVERNMENT PRINTER, MELBOURNE.

1894.

FIBRES FROM PLANTS,

INDIGENOUS AND INTRODUCED,

*Eligible for Industrial Culture and Experiment in Victoria.**

BY WILLIAM R. GUILFOYLE, F.L.S., ETC.,

Director of the Melbourne Botanical Gardens.

THAT the colony of Victoria possesses special advantages, and, no less, offers special facilities for the cultivation of a very wide range of plants indeed, cannot be denied. Blessed with every variety of soil, climate, and natural configuration, and, generally speaking, with a fairly liberal water supply, plants of all kinds, except perhaps those of the tropical and arctic regions, may be fairly grown within its boundary. It is to be regretted that, with the undoubtedly splendid opportunities which beneficent nature has showered on this colony with so lavish a hand, in the form of various kinds of soil and characters of climate, so little has been done in the way of taking practical advantage of those opportunities. This deficiency arises from the fact, perhaps, that we as a nation sprang into existence having almost all things ready fashioned to our hands. From the finest broadcloth to the coarsest sacking, from the heaviest cable to the most delicate thread, from the strongest pasteboard to the thinnest paper, all were at our command and easy of acquisition; and therefore, probably, we have not troubled ourselves, as we might have done under other circumstances, about their production.

In the earlier ages of the world, men had at first to find the wherewithal to satisfy the natural cravings of hunger, and, having done that, being neither protected with wool nor fur nor hair like the beasts, nor with feathers like the birds, to cast about for something to protect them from the inclemency of the weather. Necessity was, indeed, the mother of invention, and the earliest Biblical records show us that even our first parents sewed to themselves clothing of leaves, a sufficient internal proof that they must have discovered, at least, the filamentary properties of certain plants, while, later still, the ancient Egyptians must be credited with having utilized the fibre of the flax plant for

* Being the substance of a recent lecture at the Chamber of Rural Industries, Melbourne.

weaving, not only into their mummy cloth, as has been shown by microscopic examination, but also into the fine linen mentioned in Holy Writ.

If further proof were needed as to the cultivation of flax by that remarkable people, it is only necessary to refer to the description of the plague of hail mentioned in the Book of Exodus:—"For the barley was in the ear, and the flax was bolled," or in seed. Even in our own time, and in this part of the world, we know that the Aborigines of this country, who are, perhaps, among the lowest in the scale of civilization, used the fibres of plants for their cordage, fishing nets and lines, and bags for carrying food, while our neighbours, the Maories, wove the fibre of the so-called New Zealand flax-plant (*Phormium tenax*) into mats, some of them highly if rudely ornamental, for clothing, as well as for cordage, nets, bird snares, and other purposes. It may be said, in fact, that the use of fibrous plants is coeval with the creation of the human race, and has come down throughout all ages and with all peoples to the present day.

VICTORIA ADAPTED FOR FIBRE PLANTS.

All this is, nevertheless, perhaps somewhat beside the question of why we in this colony should not devote some of our energy and enterprise in the direction of cultivating, for economic purposes, the very many fibre-producing plants which lie close to hand, or which may readily and successfully be grown in our midst. That they may be so grown, and that fibres of commercial value can be produced from them, is amply demonstrated by the fact that large collections have been, from time to time, shown at various Exhibitions at home and abroad, and that some of them have gained high commendation from scientific, manufacturing, and mercantile experts.

I have much pleasure in bringing under notice more than 130 samples of fibres produced from as many different plants (indigenous and exotic) grown in the Melbourne Botanic Gardens, and of which in most instances specimens have been sent to the following Exhibitions:—The Centennial of Philadelphia, 1876, and the preparatory one here in 1875; the Paris Universal, 1878; Melbourne International of 1880; that of Amsterdam, 1883; New Orleans, 1884-5; the Colonial and Indian, 1886; Jubilee International, Adelaide, 1887; Melbourne Centennial, 1888-9; the New Zealand Exhibition of the same year; and last, not least, to the Imperial Institute.

The samples were all prepared by hand, under my direction, by garden employés, and with very crude appliances, such as blunt knives and scrapers, which were used for the purpose of removing the soft vegetable matter after the leaves or stems (as the case

might be) had been either steeped for a few days in the lake or boiled in coppers. The heckling or combing out afterwards, to separate the filaments or threads, was effected by simply drawing handfuls of the fibre through eight or ten nail-like spikes, 6 to 7 inches long, inserted in a board placed on a table—a very simple process indeed, it will be said, but one which would be a very tedious and unprofitable device in dealing with, say, the produce of an acre. No doubt suitable machinery would soon be found for extracting the most of the new fibres I shall refer to, especially should they prove to be of marketable value; but I may here remark that manufacturers in these colonies as a rule, though they do not object to *test* new kinds, seldom care to have anything more to do with them, probably because of the uncertainty of cheap production and the possibility of not being able to obtain a sufficient supply of material. Again, it may be stated that it would be utterly useless for any one to attempt the cultivation of any fibres, no matter how common or how valuable, if not kept up to a uniform quality by careful preparation.

It would occupy too much space were I to attempt to describe the merits or demerits of the whole of the fibres (*vide* appended list). I have, however, classified them in their natural orders or families as they are related to each other in botanical sequence, merely referring to some, but dwelling more particularly upon those which, in my opinion, may be most worthy of experimenting with farmers or enterprising agriculturists.

First, then, I begin with

THE MALLOW FAMILY, ORDER MALVACEÆ,

which includes the well-known Cotton of commerce (*Gossypium*), cultivated in warm climates for its capsular fibre and not for its bast. Although one or two kinds of cotton plants have been known to grow to fair size in a season in certain favoured localities within the boundary of Victoria, it is extremely doubtful whether it would ever become a profitable industry, even by the aid of irrigation, in any part of the colony. Be that as it may, however, we have in the Mallow family an abundance of hardy perennial plants (including shrubs and trees indigenous and introduced) that will grow freely almost anywhere, and which will yield from their bast (or inner bark) fibres of excellent quality, known to be useful for many purposes. *Sida rhombifolia* (syn. *S. retusa*) for instance—known as “Queensland Hemp,” but in no way related to the true hemp (*Cannabis sativa*)—will grow as rapidly in Victoria as in Queensland or New South Wales, where it is indigenous. It is found also in North and South America and the East and West Indies. By retting (steeping) from six to ten days it gives a fibre similar to the best jute, useful for rope

making, weaving into textile fabrics (by itself, or as an admixture with other fibres of softer and finer character), and is also capable of being made into excellent paper.

Professor Charles R. Dodge, of the Department of Agriculture, New York, one of the greatest authorities on the subject of Fibres, and who examined the samples sent to Philadelphia in 1876, speaks well of this so-called "Queensland Hemp," and particularly of a sample sent by Mr. Alexander McPherson, of Brisbane. He says—"It is very white and lustrous, the filaments fine and even; in a portion of the sample the ribbon-like character of the bark is retained, filled with delicate indentations, giving it a lace-like appearance. These ribbons of fibre break easily, but a twisted cord of the finer prepared fibre, the size of cotton wrapping twine of the shops, broke only after repeated trials with the hands." Dr. Forbes Watson, another acknowledged authority, says, in the Descriptive Catalogue of the East Indian Department, International Exhibition, 1862:—"It is similar to jute in appearance, but intrinsically so superior that it is worth from £5 to £6 more per ton," and places it next to that fibre in order to attract to it the attention which it deserves. Professor Dodge adds that experiments with the fibre demonstrated the fact that a cord half an inch in circumference would sustain a weight of 400 lbs.; and in speaking of Dr. Roxburgh's samples from India, Royle says—"The filaments are from 4 to 5 feet in length and display a fine soft and silky fibre, as well adapted for spinning as jute, but infinitely superior." It is a semi-deciduous shrub, 3 to 5 feet high, and should yield a handsome return if extensively cultivated, as it is content with a moderately good soil and requires no particular skill in preparing the fibre for market.

The *Abutilons*, or "Lantern flowers," are well-known garden shrubs, of quick growth and robust habit. There are of these six samples of fibre, several of which have been valued by experts at £10 to £20 per ton. Mr. Lefranc, of Philadelphia, states that some of the *Abutilons* are good for weaving tissues and for mixing with a certain class of woollen goods.

Abutilon Bedfordianum, from Brazil, is a tall shrub, of very rapid growth in Victoria, and the bark yields a fibre of superior quality. Three other Brazilian species (*A. venosum*, *A. striatum*, and *A. vexillarium*) also grow readily here, produce fibre and bast of fine quality, suitable for whipcord, matting, paper, &c., and are all easily prepared by the simple process of macerating the young shoots or rods in the same way as jute.

Several species of the closely-allied *Hibiscus* yield white silky fibres. They are chiefly denizens of India, the Cape, America, &c., but a number of beautiful kinds are found in New South Wales and Queensland. Those which are hardy in Victoria are,

like the *Abutilons*, easily propagated by stout cuttings a foot in length, and should be planted in rows, in a sandy or loose soil, during the winter season. Perhaps the best known here are—*Hibiscus Syriacus* (syn. *Althæa frutex*), or “Syrian Rose-mallow”; *H. splendens*, “Hollyhock tree” of Queensland and New South Wales; *H. heterophyllus*, the Queensland “Sorrel tree,” native name “Batham”; and *H. mutabilis*, or “Changing Rose-mallow,” from China and India. These shrubs average from 10 to 12 feet in height, and the bast from their stems and branches may be spun and woven into fine textures. The first mentioned affords a long beautiful white fibre of considerable strength, which could be worked into cloth or converted into cord. *Hibiscus esculentus*, besides giving a fibre of fair quality, produces mucilaginous seeds, the capsules being used as an article of food in the West Indies and South America, and known as “oëhro,” “gohbo,” or “baudakai.”

The “Ribbonwood of Otago” (*Hoheria populnea*) is a handsome tree, not unlike the Aspen, and the delicate lace-like bast from its young branches, being strong and glossy, might be used for other purposes than matting and string. The same may be said of *Plagianthus pulchellus*, known as the “Victorian Hemp bush,” but which is indigenous also to New South Wales and Tasmania. It abounds on the banks of the Yarra near Melbourne, and will flourish on any land subject to occasional inundation. In this case, as in many others, it may be said that familiarity breeds contempt, and that a prophet is not without honour save in his own country, for this plant will produce fibre quite equal to that of the *Sida rhombifolia*, or “Queensland Hemp,” and is, in fact, longer in staple. It may be obtained fully 8 feet in length if necessary; but, although the tree is of rapid growth and easily reproduced from seed, a good crop of bark could not be obtained until the plants are, say, from five to six years old. Another species of this tree (*P. betulinus*), the “Lace-bark,” or “Ribbon tree” of New Zealand, also grows well in moist rich soil, and furnishes good fibre. Nor are the Mallows* themselves to be despised.

The “Common Tree Mallow” (*Lavatera arborea*), a tall biennial plant, yields a bast highly recommended for paper pulp; the Sea Mallow (*L. maritima*) gives a fine fibre 3 to 4 feet long, easily prepared; and the “Velvet Mallow” (*L. Olbia*), which is a perennial evergreen, supplies from its bark a substance not unlike white horsehair, and quite as useful for many purposes. *Malva Capeensis*, the “Cape Mallow,” and *Sphæralcea umbellata*,

* *Lavatera plebeja* (Australian Mallow)—a white-flowered perennial often attaining a height of 5 feet, and found in Victoria, New South Wales, and South Australia—produces a strong soft silky fibre, which has been converted into fine twine of great strength. It is frequently used by the Aborigines for fishing lines and nets.

known as the "Globe Mallow," a native of Mexico, both yield silky fibres useful for cordage—that of the latter averaging from 4 to 5 feet in length. *Lagunaria* (*Fugosia*) *Patersonii*, the "Whitewood," or "Cow-itch tree" of Norfolk Island, is a vigorous grower in this climate, and a specimen of its bast sent to the Philadelphia Exhibition was placed in the third division of Professor Dodge's Economic Classification, under the heading of "Fibres capable of employment in the arts, &c."

Closely allied to the Mallow tribe is

THE "BOTTLE TREE" FAMILY, ORDER STERCULIACEÆ,

several representatives of which are trees of large size, notably the *Sterculias* themselves, one of which, *Sterculia diversifolia*, is known in Victoria, New South Wales, and Queensland as the "Currijong," and by the settlers of Gippsland also as "Bottle tree," because of its thick swollen trunk; *Sterculia acerifolia*, the "Flame tree" of New South Wales; *S. lurida*, *Commersonia Fraseri*—known in parts of Victoria as "Black-fellow's Hemp;" *Dombeya Natalensis*, or "Cape Wedding-flower," and other members of the family all yield from their stems and branches strong fibre not easily affected by wet, and therefore suitable for ropes, matting, baskets, &c., whilst the refuse or tow, after heckling, supplies no mean substitute for horsehair, its elastic nature rendering it invaluable for upholstering purposes.

THE "LINDEN TREE" FAMILY, ORDER TILIACEÆ.

supplies us with that valuable fibre, the Indian jute, which in Bengal has been cultivated and woven into various fabrics from a remote period, and yet, little more than half a century ago, was considered a weed and unfit for textile purposes, the green tops only being used as a pot herb or vegetable by the Jews in the East, and known as "Jew's Mallow."

Indian jute is obtained from two distinct species of the plant (*Corchorus capsularis* and *C. olitorius*), principally the former. Several other species, however, are supposed to possess filaments of great tenacity. According to Baron von Mueller's *Census of Australian Plants*, there are no less than seventeen species of *Corchorus* found growing wild in the north of this continent, and *Corchorus olitorius*, one of the Indian kinds, is included in the number. Again, the Baron states in his work *Select Plants for Industrial Culture*, that the first-named (*C. capsularis*) is also indigenous to North-West Australia.

Now, the question arises—Can jute be cultivated in Victoria? In certain favoured warm localities, where there is rich loose soil that can be easily irrigated and drained, I am inclined to believe it can, and in such places its cultivation, on a small scale, may be worthy of trial; but, speaking generally, I think it extremely doubtful that it would ever become a profitable industry in this colony. As regards the kind of climate and soil most suitable for jute, and the mode of treating the crop in Bengal, I cannot do better than quote from Mr. D. A. Curr's interesting article, which appeared in the *Bury Times*, Lancashire, in January last.* "Jute is the most extensively cultivated of plants throughout the whole delta of Bengal. It is generally grown during the rainy season, on high land, and not, like rice land, subject to submersion, which would utterly ruin the jute plant for textile uses. The seeds are sown in† April or May, when there has been a sufficiency of rain to moisten the ground, on land ploughed and rolled, and the seeds which had been sown broadcast are then harrowed over to cover them. No plant is more grateful for kindly cultivation than jute. It thrives best in a warm loamy soil, well manured. A hot and moderately rainy season suits it best; but excessive rain injures it. In this respect it is a delicate plant. It also requires to be carefully weeded when young, but it soon acquires altitude and strength enough to suppress all intruders on its territory. A good crop attains the height of from 10 to 12 feet; I have used some even longer. Heat and moisture produce the most luxuriant crop of jute. The land is irrigated according to need; where the soil is damp and cold, irrigation is not required. In about 100 days the crop is ready for cutting. It is cut like corn, but close to the roots; no stubble is left. It is tied up in bundles and laid in a shallow tank or ditch, and over the bundles elods are laid to sink them overhead in the water until rotted, that is to say, the bark rotted off, which requires about ten days' immersion, or steep, as it is called. When the bark is easily removed, and the fibrous substance soft, it is ready to be taken out of the steep, and the water wrung out of it, as a washerwoman does with her clothes, and hung up on lines to dry; afterwards cleaned from all bits of bark and other impurities, then bundled up and sent to Calcutta to be sorted and made up in the bazaar, where there are many wealthy merchants who deal in jute." The same writer, speaking of the uses of jute, says—"The clothes we wear are more or less composed of jute; what is called canvas padding is made of jute; the stuffing of women's stays is jute; in fact, the increase and ubiquity of jute is truly marvellous. The bags that contain our coal, the sacks that hold our

* Kindly placed with other useful records at my disposal by Mr. J. Arbuckle-Reid of this city.

† The month of October would be the best time to sow seed in most parts of Victoria.

grain and flour, are jute; seed bags of all sorts are jute; every bale the eye can look upon is wrapped in jute; every bale in our docks and warehouses is jute; every bale in every ship at sea is jute. Many scores of tons of jute-yarn, which covered the Atlantic telegraph wire to America, taken out and reeled off by the *Great Eastern* steam-ship, now lie quietly at work at the bottom of the sea; and thousands of tons of jute are doing a similar service to mankind in every quarter over the terraqueous globe, constituting the peaceful medium of intercourse among all nations. In the time of the Crimean War millions of jute bags filled with earth or sand were used for the construction of bastions or earthworks. A large proportion of the paper used in the world is made from jute; hops from the sunny south of England are conveyed to their destination in bags of jute; screens for upholstery and for protecting fruit and other trees are woven from jute." We learn from the *British Trade Journal*, September, 1893, that the imports of jute into the United Kingdom, in 1892, amounted to 255,000 tons, the value of which was nearly £4,000,000, and, independent of the quantity of material exported, 170,000 tons were used principally for yarn and piece goods for the export market. The value of jute as imported into England and Scotland is from £17 to £24 per ton.

Another member of the Jute family is *Sparmannia Africana* (*vide* Fig. No. 1), a well-known evergreen garden shrub from the Cape, but the value of which as a fibre plant has yet to be proved by experts. If the fibre be really worth anything, I can safely lay claim to having been the first to discover the textile properties of the plant; and in forwarding a somewhat roughly-prepared specimen to Philadelphia, I gave it the provisional name "African Hemp bush." Professor Dodge's opinion of it, as expressed in his general report on fibres, is rather favorable; he says—"The fibre is of a brilliant silvery-grey colour when it has been properly prepared; some of the filaments of the sample are brilliant and lustrous, and it possesses considerable strength, in fact seems almost equal to China grass (*Rheea* or *Ramie*) in tenacity." This fibre could be produced in enormous quantities in Victoria, as the shrub grows with extraordinary rapidity in any loose fairly good soil, with or without irrigation, although a liberal water supply during the warm season would improve the growth of the plant, and render it capable of producing at least two crops of "canes" or shoots in a year. The double-flowered variety (undoubtedly the best) is of dense habit, attains a height of 10 or 12 feet, and can be readily propagated by cuttings, seeds, or division of the roots; whilst the mode of obtaining the bast is by simply macerating the stems and branches for eight or ten days, according to temperature and the age of the wood, and afterwards heckling.

THE "FLAX FAMILY," ORDER LINEÆ,

follows the three preceding orders in a direct line of botanical relationship, according to Hooker and Bentham's standard work, the *Genera Plantarum*. The birthplace of the flax (*Linum usitatissimum*) is supposed to be Asia, but it is found all over Europe, particularly in the south. The cultivation of this annual has now an almost world-wide distribution. Fine linen or mummy cloth was used by the Egyptians 1200 years B.C. Indeed the plant seems to have been cultivated from the remotest antiquity, manufactured flax having been discovered in the pre-historic lake cities of Switzerland.

The uses to which flax can be put are almost innumerable, but the principal are the manufacture of linen, lace, holland, drills, sheeting, shirting, and clothes of many kinds, table-cloths, floor-cloths, sail-cloth or canvas tents, woolpacks and bagging, paper, cambric, string, twine, sewing thread, cord, &c., while the refuse fibre is utilized for packing for steam-engines, &c., and the seeds for oil, oilcake, and linseed meal.

That good marketable flax has been grown in Victoria is proved by the fact that Mr. James Miller, the rope merchant of this city, has given as much as £40 per ton for some grown in Gippsland, and a few weeks ago he showed me a splendid sample, fully 2 feet in length, that was produced at Yarram (South Gippsland), where there are about 100 acres or more now under cultivation. Mr. Miller also told me that a number of growers there have just formed themselves into a co-operative company for the purpose of developing the industry, and that 100 acres more (50 at Orbost and 50 at Glengarry) have been sown down this season. I am informed also that Mr. D. F. Mackenzie, who is an enthusiastic believer in the ultimate value of the Victorian-grown article, has been good enough to grant the farmers at Yarram the use of a water-power engine and turbine, to drive certain machinery useful in connexion with the preparation of the flax for market, and that a skilled man, approved by the growers, is to be appointed to superintend the work. This, it must be admitted, is a step in the right direction. No doubt better encouragement will be given to the rope manufacturers here if the flax is carefully prepared, kept up to a good standard quality, and if a regular yearly supply can be depended upon. It may be said of flax, as of sugar cane and many other crops, that the product is made in the field. The crop must be well cultivated. Flax will succeed in any place where wheat will grow, and as well inland, north or south, in this colony as near the coast; moreover, it will flourish in soil that will produce inferior crops of grain. It delights in soil in which its roots can ramify freely, such as that of the rich uplands and river flat lands of Gippsland, or the fine loam found

in patches all over the Goulburn Valley, and in other parts of the colony. A light loam on a clay subsoil is said to be good; in fact, flax may be cultivated in any fairly good land, but perfect drainage and a moderate amount of moisture are indispensably necessary. It will not succeed in soddened wet soils, or in harsh clay liable to get hard, nor is it likely to do well in sand where there is a substratum of coarse dry gravel only a few inches beneath the surface. Although in rich soils no manure need be used, it is never wise to crop with flax too many years in succession. Some Continental and American growers limit it to five, others to three years. Many cultivators adopt a judicious rotation of wheat or oats, clover, vegetables of various kinds, such as potatoes and turnips, for the purpose of maintaining the fertility of the soil, but the latter vegetable, it is said, should never immediately precede flax. There is no plant which needs more careful attention in regard to cleanly cultivation. Weeds are its greatest enemy, and should be kept down, or freed from the crop at intervals, before it has become 6 or 7 inches high. In some soils, however, flax grows so rapidly that any weeds which crop up (excepting, of course, such strong growers as docks and thistles) are smothered at once, and thus a considerable amount of labour is saved. But should weeding be necessary, an industrious man, who, by the way, should be either barefooted or shod with woollen socks, to prevent permanent injury to the plants by treading them down, can get over an acre of ground in three or four days, perhaps less. Children also can be made useful for the work, which should always be performed in moist weather (because the weeds are more easily pulled up), and facing the wind, so that the trodden-down plants may the more readily regain an upright position.

The preparation of the ground for sowing is a very important matter, and to do this thoroughly means ploughing deeply in the autumn for spring sowing. Heavy land will probably require deep cross ploughing again during the winter. Ground which has already been cropped with wheat or potatoes, &c., needs only shallow ploughing—say 3 to 4 inches after the first deep ploughing—and should be stirred up with a cultivator (the Planet is the best, I think), the weeds removed, and then harrowed several times diagonally. If the soil happen to be of a loose friable character, so much the less trouble in rolling, which must be done prior to sowing, so as to render the ground as smooth and uniform as it can be made. The object of this is, the seed can be scattered evenly broadcast, and the crop thereby made regular and better for pulling or mowing. As regards the proper time to sow, there is great diversity of opinion, and the farmer must be guided by circumstances, and the climate with which he has to deal. I think that the advice given by an old flax

grower in New York would be a safe rule to adopt in Victoria—"Sow when the soil has settled, and is warmed by the influence of the sun, and when weeds and grass have begun to spring up, and the leaves of trees begun to unfold." It would be wise not to sow until the frosts have ceased, and never in wet weather. The months of October and November are quite early enough, I should think, for most parts of this colony. After the seed has been sown, the ground should be lightly harrowed several times, and then rolled.

It is very necessary indeed to be careful as to quality of the seed, for on that depends, in a great measure, the success or non-success of the crop. If the seed contain weed seeds, it should be carefully passed through sieves. Dutch seed is said to be best for heavy soils, but Riga or Russian seed is the kind generally used in Ireland, Belgium, France, and America. Change of seed is no doubt desirable occasionally, the same as with wheat and other cereals, to prevent deterioration; and the Belgians, who are perhaps the most successful and careful cultivators of flax in the world, use the precaution of obtaining fresh seed from Riga every second year, for the purpose of sowing and producing home-grown seed for the following season. As regards the quantity of seed necessary per acre, from $2\frac{1}{2}$ to 3 bushels will be required if the crop be intended for fibre, in which case it must be sown thickly; if for linseed, 2 bushels, or even less, will be sufficient. In about ten or twelve weeks after spring sowing (the exact time depends upon the nature of the soil and climate) the crop will be ready for pulling or mowing. Pulling is the system adopted by careful cultivators if the crop be intended for fine fibre. To pull too early or too late is to alter the texture of the fibre, perhaps to spoil it. If too soon, the fibre is weak or very fine; if too late, it is of coarse quality. When very fine fibre is required, the crop is pulled while in flower, or when the "bolls" or seed pods are just forming. If fibre of a stronger character be desirable, the crop is said to be at its best when the stalk of the plant, for about half its height from the ground, has turned yellow, and the upper capsules have begun to turn brown. In pulling, a sudden jerk and slight shake is necessary, so as not to drag up the soil. Flax is seldom of uniform height in the field, therefore the tallest plants should be grasped at the first handful and the shorter ones at the second handful. In this way, the short and the long stems can be kept separated and tied up in distinct bundles.

Flax intended for stacking or housing is allowed to remain long enough on the ground to dry. In this climate only a short weathering will be necessary, and after being rippled it may be tied up again in bundles, and either stacked for the purpose of being dealt with afterwards or the preparation of the fibre can be proceeded with at once. The process of rippling or threshing out

the seed (linseed) is usually performed by means of an iron comb consisting of teeth 18 inches long, set upright upon a board or form. The stems are taken in double handfuls, grasped tightly, and drawn through the spikes several times until the "bolls" have been removed. Next comes the retting or steeping process, which facilitates the separation of the fibre from the "boon," or woody part of the stem, and decomposes or dissolves the gummy substance which holds the filaments together. The duration of retting varies according to the nature of the crop and temperature of the water; if warm, submersion for four or five days and nights may suffice; but if cold, a much longer period will be necessary before fermentation ensues. Flax not intended for stacking is usually placed in steep the same day it is pulled, and should not be mixed with the pulling of the following day. The sheaves or bundles are put into the water, roots downwards, in rows close together, and kept submerged by weighted planks or inverted grass sods. Various methods of retting are practised, such as dew-retting—the system adopted in Russia; retting by steam and hot water, &c. Machinery has been invented for separating the fibre without retting, known as the "dry process." The old method, however—"water-retting"—just described, may be effected in creeks, rivers, ponds, or dams, and, being considered the best, is the plan usually adopted by farmers. River water is supposed to be good, but brackish water or water containing lime are to be avoided, because they not only delay fermentation but ruin the fibre. A pond 50 feet long, 9 feet wide, and 4 feet deep will ret the produce of an acre. Ponds should be dug in clay or hard soil, and be so constructed that the water can be readily let out. Water in which flax has been steeped is poisonous, and gives out a most intolerable odour, caused by the mucilage; nevertheless, it is a most valuable manure, and, according to some acknowledged authorities on flax culture, should be returned to the soil. With regard to knowing exactly when the flax has been sufficiently steeped (for to allow it to remain a few hours too long in the pond or dam will depreciate the value of the fibre), the progress of the operation must be tested occasionally by selecting a few stalks of average thickness from bundles in various parts of the pond, and by twisting them in opposite directions, or pulling the fibre gently from the end along the entire length of the stem; if it feel slimy and peel readily, the flax is sufficiently retted. When the bundles have been taken out of the water, they are set on end, roots downward, placed loosely together, and allowed to drain for a few hours, after which (same day) they are untied, and spread out evenly in thin layers on clean short grass, and turned over frequently for several days till perfectly dry. In Belgium and Holland flax is frequently dried in the field prior to retting. Breaking and scutching, which removes the fragments of wood or

pith, is done by machinery, and the fibre is then ready for the manufacturer. Our own Australian native flax (*Linum marginale*) produces a very fine silky fibre of long staple, but, with the exception of a few samples produced in our laboratory, I have never heard of it having been tried elsewhere.

A FEW OTHER FIBRE-YIELDING PLANTS FOR TEST CULTURE.

The "Bean and Pea family" (*Leguminosæ*) supplies few fibre-yielding plants of value. *Crotalaria juncea*, however, the "Sunn-Hemp," which is an annual abounding in India, and found wild also in parts of tropical Australia, produces a useful fibre almost equal to jute; but as the plant is not sufficiently hardy in Victoria to be worthy of extensive cultivation I need not enter into further particulars concerning it. Some 50,000 acres, Spon informs us, are occupied by it in the Punjab.

In the "Spurge Laurel family" (*Thymelæaceæ*) we have several species of *Pimelea* indigenous to Victoria and to other parts of Australia that yield fibre suitable for string and paper pulp. *Pimelea axiflora*, known by the early Victorian settlers as "tough bark," and *P. clavata*, a shrub of 8 or 9 feet, and native of West Australia, thrive well under cultivation, and yield strong fibres, which may be considered valuable for textile manufacture. *Dais cotinifolia*, or "African Button Flower"—a small tree allied to the *Pimeleas*—produces not only a fibre of fine quality but also a rich yellow dye.

The "Spurge-wort family" (*Euphorbiaceæ*), to which order the castor oil, croton oil, and Cassava plants belong, supplies us with a small shrub, *Amperea spartioides*, the fibre of which being soft and silky, although dark in colour, may yet prove useful for many purposes. It is found growing in quantity in Gippsland and other parts of the colony.

To the "Nettle family" (*Urticaceæ*) belong many important fibre plants, notably the true hemp and the "Ramie," "Rhcea," or "Grass-cloth plant" of the Chinese. The hemp plant (*Cannabis sativa*), an annual often attaining a height of 18 feet or more in warm latitudes, is indigenous to Central and Western Asia, but has long been naturalized in Brazil, Canada, and Venezuela, also in tropical Africa, and is extensively cultivated in Italy, France, Spain, Germany, and many other European countries, particularly Russia and Poland. In India, besides the lowlands, it is cultivated as high up in the Himalayas as 9,000 or 10,000 feet. Hemp grown in England is said to be of superior quality, but the plant does not pay the farmers in consequence of the immense quantities imported, and very little of it is grown. The average yield per acre there is from 6 to 8 cwt. of fibre, and from 14 to 16

bushels of seed. In some of the United States—Kentucky, Missouri, and Tennessee for instance—it is a crop of considerable importance. Italian hemp is said to be the very best, that of Russia and Poland being next in value.

In giving a few particulars of the

MODES OF CULTIVATION AND PREPARATION

of these important fibres, hemp and ramie, I have consulted the best authorities on the subject—Spon, Haldane, and others, whose knowledge and advice can be depended upon. With regard to hemp, like flax, it only requires a few months of summer temperature to bring it to perfection; the climate therefore, as well as the soil, of most parts of Victoria being adapted for its cultivation, it needs only a little enterprise on the part of our farmers to make it a profitable industry. I have seen some very fine samples of hemp that were grown in Gippsland, and even in our Botanical Gardens have we grown the plant to 6 (six) feet high, on a plot of poor sandy soil, with the aid of irrigation alone. It was thirteen weeks exactly from the date the seeds were sown till the plants flowered. Over-rich soils, it is said, produce coarse but good fibre, and poor soils, fibre of very fine texture but small returns. The most suitable soils are friable loams containing vegetable matter, or alluvial lands where sand and clay are intimately mixed. Stiff cold clays are to be avoided. Fairly rich soil, moisture, and heat are essential for the production of good hemp in quantity, and even light poor soils, if well manured and moistened, will bear crops for several years in succession. Land intended for hemp must be well ploughed and drained, harrowed as for potatoes, rolled, and thoroughly cleansed from all weeds. The quantity of seed per acre, if fibre be the object, is from $2\frac{1}{2}$ to 3 bushels. If for seed $1\frac{1}{2}$ to 2 bushels. The hemp plant being dioecious—or male and female existing in separate plants—the male plants should be pulled as they come into flower, and the female plants left in the ground for about a month longer, to admit of the seed becoming ripe. The crop intended for fibre is generally pulled or cut when in flower, without any regard to sex of the plant.

The best time to sow the seed is during spring, after the frosts have ceased. Frosts injure the young seedlings, and sowing too late conduces to thinness and weakness of the plants. To prevent deterioration in the quality of fibre, constant changes of seed are beneficial. As soon as the young plants appear the ground should be kept free from weeds, and the crop thinned out according to the class of fibre required and the capability of the ground; but as a rule hemp grows so rapidly that after one weeding there will probably be no more trouble with the crop in that respect

afterwards. About thirteen weeks after sowing, or when the male plants have shed their pollen, and the flowers begun to turn yellow, the crop is ready for harvesting. The stems are then pulled or mown, and carefully shorn of leaves and flowers at once, which help to manure the land. When the stems are stripped they are bound in small bundles, and the dry soil adhering to the roots is knocked off. The bundles are then set on end in stooks like corn. If the crop is to be kept for long, the bundles are made of larger size, and are stacked or thatched. The seed-bearing or female plants, after gathering, are allowed to stand in the air for a few days to allow the seed to dry and ripen, the heads are then cut off, and the seed is threshed out. The length of time for which the pulled plants intended for fibre should remain in stook to dry before retting is a much debated point. Some authorities declare that one or two days sun drying is essential, while others state that it is unnecessary, and that ripe plants should be retted immediately after they are pulled, the retting being then reduced from eight or ten to four days. Some cultivators merely dry the crop and sell it on the ground, leaving the purchaser to do the rest.

There are various ways of retting hemp as of most other fibre plants. Water-retting and dew-retting are, however, the methods usually practised. 1st. Watering or steeping is conducted in ditches 3 to 4 feet deep, and of varying length and breadth, dug on the margins of rivers. The bundles are laid at the bottom, covered with straw or sods, and weighted down by logs and stones. Putrid standing water makes softer fibres than running water. The most satisfactory plan would seem to be a series of basins at different altitudes, a small stream constantly trickling from one to another. The progress of the operation is readily ascertained by taking out a stem by the root-end and drawing the thumb-nail along it to the top; when the fibre slips up the stem the process has been carried sufficiently far. 2nd. In dew-retting, after the stooks have been allowed to remain standing several days they are opened, the stems spread out carefully on the grass, subjected to the effect of showers and dews and an occasional watering, if necessary, for a period which may extend to six weeks, care being taken to turn them constantly during the whole time. The appearance of pink spots on the stems must be watched for, whereupon the stems must be gathered up, tied in bundles, and piled in stooks to dry. By this method a valuable white hemp is produced, but the operation is very tedious, and entails great expenditure of labour. After water-retting the hemp is removed from the water to a field of clean grass. There it is spread out evenly and allowed to lie for three weeks or more to bleach, and to enable the fibre to free itself; during this it is turned over with light long poles every three or four days. When

dry, and the pink spots on the stems have commenced to appear, it is again tied up in bundles and carried to a barn or rick. The same kind of machinery used for breaking and scutching flax is applicable to hemp, but as the stems of the latter are coarser and tougher than those of the former the machinery must be somewhat stronger.

Hemp or flax crops are well adapted for cultivation by small farmers, especially those with large families, as a great deal of the work of weeding, pulling, drying, &c., can be done by children; moreover, quick returns can be obtained, as from the time the seed is put into the ground till the crops are ready for harvesting or the scutching mill occupies only a few weeks.

Much has been written of late years concerning the cultivation and manufacture of fibre from that near relative of the hemp and member of the nettle family—

THE "RAMIE," "RHEEA," OR "CHINA GRASS-CLOTH PLANT" (*BOEHMERIA NIVEA*),

and although it will grow freely enough in most parts of Victoria, its value here at present as a remunerative marketable crop is, so far as I can judge, extremely doubtful. Unlike the hemp, it is a bushy spreading perennial, averaging from 5 to 7 feet in height, according to the conditions of heat, moisture, and soil. Numerous specimens of the plant may be seen in the Botanical Gardens, where it has been growing for nearly 40 years; and although during the past twenty years I have freely distributed roots to settlers and others, and have prepared crude samples of fibre for our local Exhibitions, I have never heard of any attempts having been made to cultivate it as a crop; that, however, is hardly to be wondered at, as will be seen presently. From ramie is produced that beautiful creamy-white fabric known as China Grass-cloth, which is frequently mistaken for silk; indeed the better qualities of it are often sold as such in England and many parts of the Continent. In Assam, Nepal, and other parts of India it has been known from time immemorial as "Rheea." The Malays call it "Ramie," the Chinese "Tchuma" (Chuma), and in Japan, under the name of "Karao," the cultivation of it and hand preparation of its fibre dates back to 1660.

The great drawback to the spread of the ramie industry is undoubtedly the want of suitable machinery for treating the fibre in an expeditious and economic way, or of getting rid of the gummy substance which holds together the filamentary portions of the plant. Could that difficulty be solved, ramie cultivators would be counted by the thousand wherever the plant would grow, and its production would ultimately rival the flax, hemp, and jute industries. Although in 1869 the Indian Government

offered a prize of £5,000 for a thoroughly capable machine, it would appear by the following extracts from the report of the Secretary for Agriculture, Washington (Mr. J. M. Rusk, 1890), that no machinery had been invented that would decorticate and prepare the fibre at a sufficiently cheap rate to enable it to compete with fibres of similar character, and according to still later reports on the subject the difficulty still exists. Mr. Rusk says—"Practically the culture of ramie is at a stand-still both here and in Europe, the knotty problem of economical decortication of the stalks when grown not having received satisfactory solution. . . . To those who know nothing of the story, it may be briefly stated that the invention of machinery and processes for the extraction and cleaning (degumming) of ramie fibre in the last 30 years in the various countries where experiments are going on might foot up a hundred or more could the entire catalogue be enumerated. In spite of the vast inventive effort, ramie up to the present time has not been grown in any country (excepting China and Japan) save in a limited way, because no machine or process for decortication thus far has been presented that has filled all the requirements demanded of a thoroughly practical decorticator." Mr. Rusk adds—"It should be stated that while little of importance has been done in the past year (1890) which would give evidence of progress in culture, there are indications that some considerable areas will be planted during the coming season. The interest is greatest in the states of Louisiana, Texas, and California. Should a practical decorticator be presented during the coming season, or should any of those now under experiment fulfil the requirements of the economically successful machine, ramie culture is in favorable condition, I think, for early establishment of the industry." Since the publication of Mr. Rusk's report I have frequently endeavoured to ascertain from correspondents in the United States whether any new process had been discovered for degumming the ramie in an economic way, but the answers have always been in the negative.

The cultivation of ramie in Victoria presents no difficulties as far as suitable soil and climatic conditions are concerned. A free rich light soil, a fair amount of summer heat and moisture, are all the plant requires. Where irrigation can be applied, of course the greater the crop; but free drainage is absolutely necessary, as the roots will not bear stagnant moisture. The land should be well ploughed to a depth of 10 or 12 inches, cross harrowed, and made ready for planting by the end of September, or when the frosts have disappeared. Immediately before planting the ground should be thoroughly scarified, brush harrowed, and rendered perfectly free from weeds. From half-an-acre of plants three years old sufficient roots can be obtained to furnish 10 acres.

In this climate rooted offsets are more certain to grow than cuttings, and should be inserted in furrows 5 feet apart and 6 inches deep; a foot or 18 inches should be the distance between each plant in the rows. The soil should be well pulverized, drawn over the roots with a hoe, and tightened with the foot. When the shoots have attained, say, 10 or 12 inches in height the rows should be hilled up like potatoes. The object of close planting in the rows is to cause the stalks to run up straight, and prevent branching. When the crop is ready for cutting a brown tinge is noticeable at the base of the stems. The stools or ratoons sprout up thicker every season, and under favorable conditions two or three crops of "canes" several feet high can be cut in a year. After two or three years, if the plants happen to spread too far into the spaces between the rows, it will be necessary to chop out with a spade the advancing stools or suckers; and these may be used for other plantations. To those who are engaged in silk culture the Kew *Bulletin* for August, 1890, states that the leaves of the ramie may be used as food for silkworms in the same way as those of the Mulberry and the "Osage Orange" (*Maclura aurantiaca*).

Several other species of *Bœhmeria* have been recently introduced by me from India, and grown in the gardens; and from these have been produced some fairly good samples of fibre—notably from *Bœhmeria macrophylla*, which is more robust in habit than the true ramie. Fibres have also been prepared from other members of the Nettle family—the great "stinging-trees" of New South Wales and Queensland—"Laportea (*Urtica*) gigas," "*L. photinifolia*," and even the ordinary annual weed nettle. The common wild perennial nettle of Europe (*Urtica dioica*), so common in Germany, is supposed to yield a fibre little inferior to hemp. Every member of the "Plantain and Banana family" (*Scitamineæ*) is fibrous.

SOME ADDITIONAL FIBRE-YIELDING PLANTS.

*Musa textilis** yields the well-known Manilla hemp, so useful for rope making and other purposes. The climate of Victoria, however, is quite unsuitable for its cultivation. Its near relatives, *Canna gigantea* ("Indian Shot plant") and *Alpinia nutans* (or "Indian Shell-flower")—which may be seen in most large gardens around Melbourne—supply fibres of fair strength. That obtained from the stalks of the former somewhat resembles Manilla hemp, whilst the refuse from the roots after the arrow-root has been extracted can be converted into strong packing paper.

* Good samples of fibre of *Musa Ensete* (Bruce's Banana) and of *Musa sapientum* (Common Banana) were also exhibited. That of the former measured over 4 feet in length. The plant grows freely in the Botanical Gardens, where it sometimes attains a height of more than 18 feet. Several specimens fruited and produced an abundance of seed last year. *Musa sapientum* is not so hardy in Victoria as the former.

The "Pine-apple family" or Order (Bromeliaceæ) includes several valuable fibre plants, notably the common pine-apple itself. We have but one species, however, likely to prove hardy enough for cultivation in this colony—"Bromelia sylvestris," the wild pine-apple, or "Silk Grass" of British Honduras.

Of the "Blood-root family" (Hæmodoraceæ) there are two samples from "*Anigozanthos flavida*" or "Kangaroo-foot flower" of West Australia (a plant which thrives here remarkably well), and also of *Sansevieria* or "Bowstring Hemp," but I cannot recommend the latter plant for even trial, as it will not withstand our Victorian winter.

More than twenty kinds of fibre belong to the closely-allied families of the Iris, Narcissus, and Lily. First, the "Iris family" (Iridææ) gives "*Moræa* (Iris) *Robinsoniana*," or "Wedding-flower" of Lord Howe's Island, whose fibre is suitable for paper making. In

THE "NARCISSUS FAMILY" (AMARYLLIDÆÆ),

the *Doryanthes* or "Spear Lilies" of New South Wales and Queensland (four species) furnish from their long broad leaves masses of fibre of great strength suitable for rope, matting, cordage, coarse cloth, &c. (*Vide* Figs. II. and III.) They are easily propagated by division of the roots or from seed, which is produced in great abundance. Samples of fibre from these plants forwarded to the Colonial Institute measured 5 feet in length. A rich-red colouring matter exudes from the leaves of *Doryanthes Palmeri** during the process of boiling, so that, in addition to its usefulness as a fibre, it may prove valuable as a dye plant. *Fourcroya gigantea*, known as "Mauritius Hemp," "foetid green Aloc," "Cabuja," and "Giant-fibre Lily," and "*Fourcroya longæva*," known in Mexico, Jamaica, and other places as "Silk Grass," "Cuba Hemp," &c., have also yielded, from specimens grown in the Botanical Gardens, fibres 4 to 5 feet in length; and, although frosts will sometimes discolour and somewhat damage the outer coating of the leaves, yet the fibre remains uninjured. The fibre of the first-named species has been known to realize as much as £28 per ton in England. The Agaves are amongst the most useful of this family for the manufacture of stout ropes. (See Figs. IX. and X.)

Agave Americana, under the various names of "Century Plant," "American Aloe," "Mexican Aloe," "Spanish Aloe," "Toddy Lily," "Carata," and "Pita" or "Pita-Hemp," is the most common and best known in this country. The drought-enduring character of the plant is extraordinary, and it will thrive in any soil, rich or poor. Barren waste lands in arid regions might be planted with profitable results. After, say,

* Also from *Doryanthes Guilfoylei*—"The Giant Queensland Lily."

from six or seven to ten years, the Agave will go on yielding annual crops of huge fleshy leaves, 4 to 6 feet in length, for a term of eight or ten years longer. Spon observes that—"The culture of the plant is being extended in America, but not to the extent it deserves. . . ." The product is often known commercially as "Agave thread," and is exported for admixture with Manilla hemp. The fibre may be separated by bruising the leaves, macerating, or by a boiling or steaming process. Most effective machinery for the preparation of it has been used of late years in Mexico and other parts of America, by the aid of which it can be made ready for cleaning a few hours after the leaves have been cut, or in the same way that "Agave sisalina" and other species or varieties are prepared at the Bahamas and Yucatan. The variegated kinds of the *A. Americana*, frequently seen in our gardens, yield fibre quite equal to that obtained from the glaucous green-leaved or normal form, and this is more easily prepared by the water process. Professor Dodge says that—"In Mexico the common kind is utilized in the manufacture of ropes for use in the mines, and, in some cases, for the rigging of ships. In South America it has been used for large cables. Humboldt mentions a bridge in Quito, with a span of 130 feet, constructed of ropes made of this fibre, some of them 4 inches in diameter. The name 'Pita' follows it to Spain and Sicily, where it is used for cordage and mats." Dr. Forbes Royle says—"That it has been found superior in strength to either coir, jute, or Sunn-Hemp. In a trial of strength near Calcutta, the tests were made with ropes 1 fathom long and 3 inches in circumference, with the following results:—The Agave or "Pita" broke in a strain of 2,519½ lbs., coir 2,175 lbs., jute 2,456½ lbs., and Sunn-Hemp 2,269½ lbs. In an experiment with Russian hemp and "Pita" (stout cords), the first named broke with 160 lbs. weight, and the latter with 270 lbs." These experiments, Professor Dodge adds, show the great strength of the fibre, which is worthy of more extended cultivation and employment in the arts. An enterprising firm in Sydney, known as "The Australian Hemp and Fibre Company," have recently established a plantation of 600 acres of this Agave and *Fourcroya gigantea* ("Mauritius Hemp") at Jervis Bay, from which they expect to obtain handsome returns in the course of a few years. The following letter from one of the principal shareholders in the company was received by me:—

The Australian Hemp and Fibre Company Limited,
11 Central Chambers, 173 Pitt-street, Sydney,
11th December, 1893.

Dear Sir,—It gives me pleasure to reply to your esteemed favour of the 8th inst. Any information I may have will always be at your service. This company has, so far, planted about 600 acres at Jervis Bay with Agaves and Fourcroys. We began planting rather more than two years since. The land there forms a peninsula, being bordered by sea on three

sides, and is what Scotchmen call "sand-dunes," cast up by the action of wind and tide. It is covered with light scrub, almost wholly "black-butt" and oak and the common fern. We have every reason, so far, to be satisfied with the result of our work. The plants are growing well, the Agaves making more headway than the Fourcroyas, but both rooted splendidly, and of course no blanks. They all grow, and from such soil—if I may call it soil—we shall get a grand fibre. My only cause of dissatisfaction is that I have not 6,000 instead of 600 acres down; but I have some difficulty in getting plants. We plant about 600 to the acre. I have not as yet secured machinery. I do not want it for another twelve months. I know where to go when I want it.

Yours very faithfully,
GEORGE WHITE.

Mr. W. R. Guilfoyle, F.L.S., C.M.R.B.S., London,
&c., &c.,
Director, Botanic Gardens, Melbourne.

The products of *Agave rigida* and its sub-species or varieties are known commercially as "Grass Hemp," "Mexican Hemp," "Mexican Grass," "Cabulla," "Henequen Hemp," and "Sisal Hemp." They are largely cultivated at the Bahamas and Yucatan, and samples of the fibre have brought as much as £38 per ton in England. From the *Agaves Rumphii*, *angustifolia*, *geminiflora*, *Jaquiniana potatorum*, *Salmiana* (Fig. IX.), and Karatto, fibres more or less useful are produced.

The nearly allied

"LILY FAMILY" ORDER (LILIACEÆ)

is rich in textiles; indeed some of them are said to be far superior for many purposes. New Zealand is the home of several valuable fibre plants belonging to this order. The cultivation of *Phormium tenax*, the so-called "New Zealand Flax" (*vide* Figs. V. and VI.), there is little doubt will eventually become an important colonial industry. Already it is generally known to the commercial world, under the name "New Zealand Hemp," as one of the staples of New Zealand produce, whence the exportation of several varieties of it, both in a prepared and partially prepared state, has of late years attained very high figures. Sir James Hector, F.R.S., &c., Director of the Colonial Museum and Geological Survey Department, Wellington, New Zealand, informs me that since the last date given in his report on the subject the export of *Phormium* hemp has been as follows:—

1889	...	...	4,042 tons,	value £75,269
1890	...	...	17,084	" 361,182
1891	...	...	21,158	" 381,789
1892	...	...	15,809	" 281,514
1893	...	...	12,793	" 214,542

Or a grand total for five years of £1,314,296 sterling.

The Maori or native-dressed Phormium fibre—which by some experts is said to be far the best, because the leaves of only the *best* varieties are selected when quite ripe and carefully stripped—has brought in Scotland as much as £70 to £90 per ton; while in London the price of the ordinary European-dressed article for rope or paper making purposes has ranged from £10 to £25 per ton, according to quality. According to the *New Zealand Trade Review and Wellington Price Current* for January last, however, the market at present is almost at a stand-still. It states—“No orders in force, and little or no disposition on either side to speculate. Small contracts might be made at £12 or £14, but at these low rates millers are unwilling to enter into any large or long-dated engagements.” The Phormium grows in a wild state in most parts of New Zealand, but especially in the North Island, under almost all circumstances of soil or situation, and is found even in the interior at an elevation of 2,000 feet. Most luxuriantly does it flourish near the coast, on river flats liable to inundation, and on the terraces and lower slopes of hills (where in places it forms an almost impenetrable barrier against the advance of the traveller). To the Maori in his native state it is his all in all. With its aid he builds his “wharè” (or house) and his canoe; of its fibre he makes his clothing—those handsome mats and blankets which are the admiration and envy of all who see them; torn into strips and twisted he makes his line and net for fishing, and his snare, wherewith to capture the wild fowl of the forest. It is, as has been well said, his roof, his blanket, his cloak, his kilt, his cable, his ladder, his basket, and his couch.* Sir James Hector states that, although there are 55 different names applied to the Phormium plant by the natives, it is doubtful if more than twenty marked varieties can be distinguished.” These are from the two recognised species—Phormium tenax (Forster) and Phormium Colensoi (Hooker). Again, Sir James Hector says—“One variety of *P. tenax*, called ‘Yellow Hill Flax,’ grows generally in clay hills . . . and the leaves are seldom more than 5 or 6 feet in height . . . fibre very soft and glossy. The leaves of Phormium Colensoi and its varieties are not so strong as those of *P. tenax*, and are sometimes quite brittle.” Thus, it is at once apparent that, in establishing plantations the object of which is the production of good marketable fibre, care should be taken to obtain the right kinds, as with the uninitiated it is an easy matter to mistake one species or variety for another.

Samples of the fibre may be prepared in three ways—first, by stripping the upper cuticle of the green leaves, steeping the

* For full and complete information regarding New Zealand flax, see Sir James Hector's instructive pamphlet *Phormium tenax as a Fibrous Plant*, 2nd edition, 1889: Published by the New Zealand Government.

remainder in water, and afterwards scraping (the primitive method as practised by the natives from time immemorial). This—no doubt a slow and tedious process—produces the finest and softest flax, but it is evident that in order to keep pace with commercial requirements some more expeditious plan of dressing it by machinery has had to be adopted. The second is by maceration for several weeks, which tends somewhat to injure and weaken the fibre; and the third by boiling in a caustic solution for 33 hours. The last process is a vast saving of time and trouble, but it weakens the fibre and imparts a dark colour, which can, however, be removed by artificial bleaching. Samples can also be prepared in the same way from the variegated-leaved variety, which have been proved to be much finer and stronger in quality and more easily prepared than the green-leaved form. According to Sir James Hector, “there has been one almost universal method of manufacture by Europeans in New Zealand having for its object the production of fibre for rope making. The green leaves are stripped by revolving rollers, with projecting beaters, travelling at a high rate of speed, which crush the epidermis against a fixed plate, so set as to allow room for the fibre to remain intact. The fibre thus freed from the leaf of the plant is washed by various methods, put on the ground or on lines to dry and bleach, finished by an arm or barrel-scutch, and when baled is ready for market.” Machine-dressed fibre is said to be in great demand for the production of twine for harvesting purposes, and that “no fibre makes twine that is so suitable for this special use.”

The *Phormium tenax* was introduced into the south of Ireland as long ago as 1798, and a company established soon afterwards for its cultivation, but the slow growth it made caused the project to be abandoned. No later than three years ago I saw some specimens doing remarkably well in gardens at Dublin, Cork, the Lakes of Killarney, also in parts of England and the west coast of Scotland.* Sir James Hector says “that when the colonists first arrived in New Zealand the valuable qualities of the *Phormium* fibre were well known, as it was in constant use by the natives, and a very considerable trade in the article existed as early as 1828, when the islands were only visited by whalers and Sydney traders, as £50,000 worth of the fibre was sold in Sydney alone between 1828 and 1832.” With regard to the cultivation of the plant in this colony, it is sufficient to say that it might be

* Professor Boulger, in his valuable little work, *The Uses of Plants* (1889), states “that *Phormium tenax* is now grown successfully in the Orkney Islands. The demand exceeds the supply, and though there are several varieties or qualities of the fibre, better rope can be made from it even than from *Musa textilis*, and it sells at from £17 to £22 per ton, the refuse only being used for paper.”

profitably brought into culture on patches of spare ground of good quality, especially in swampy country, if well drained. In the latter the drains should be open and the water therein should flow about 12 inches below the surface. Most of the varieties of *Phormium* thrive best in rich moist soil, but dislike superfluous moisture or stagnant marshes. The ground should be well ploughed and harrowed, and the seedling plants or young offsets arranged in rows, say 5 feet apart and 3 feet between each plant in a row.

A recent writer in *Chambers' Journal* says that the fibre is susceptible of being woven into tissues of the most delicate description, and may be made into lace, or it may be wrought as a substitute for silk into tapestry or damask, with a lustre not much inferior to that of silk itself. On the other hand, it can be manufactured into materials of the strongest and coarsest kind, such as cables, running rigging, floor mats, carriage and railway mats, sail-cloth, twine, yarn, sacking, and bed-tick.

Of the nine species of *Cordyline* or "Palm Lily" (*vide* Fig. No. VII.) from which we have extracted fibre five are indigenous to New Zealand, three to New South Wales and Queensland, and one to Norfolk Island. The most common in the Botanical and other gardens of this city is "Forster's Palm Lily" (*Cordyline Australis*), one of the New Zealand species. Under favorable circumstances it grows to a height of 30 to 40 feet, and the leaves afford a large percentage of excellent strong fibre. With proper attention this plant will yield a good crop of leafage in its fourth or fifth year; and, as it will grow vigorously in land subject to partial inundation, it can be utilized in places otherwise comparatively useless. It seeds freely, and can therefore be extensively propagated, so that a young plantation may be always coming on to supersede the old one when the latter becomes unprofitable.

Cordyline Banksii, "Sir Joseph Banks' Palm Lily" (*vide* Fig. No. VIII.) also from New Zealand, attains a height of about 10 feet, and throws out leaves of 3 or 4 feet in length. The fibre is long in staple and of great strength. Like the first-named species, the seeds are produced in great abundance, and especially on irrigated land will it grow rapidly in this colony, as under these conditions two or even three strippings of the outer leaves might be made in a year. Professor Dodge, in his report to the Commissioner of Agriculture, New York, on the fibres sent from here to the late Philadelphia Exhibition, thus speaks of a sample of this fibre, which by mistake was named *Cordyline pumilio*:—"It is convertible into a good quality of paper. The fibre is from $2\frac{1}{2}$ to 3 feet in length, straight, white, and glossy, but very stiff, resembling fibre

of 'Yucca' or 'Agave.' It is fully as strong as Yucca fibre, and would make excellent rope of great tenacity." None of the rest of the Cordylines call for special remark beyond the fact that they produce good fibre easy of extraction by boiling or steaming for five or six hours, that they all more or less possess the characteristics of those mentioned, and that they will all grow readily in Victoria.

There are various kinds of Yucca fibre. The terms—"Bears-grass," "Adam's Needle," "Mound Lily," "Dagger-leaf," "Eve's Thread," "Spanish Dagger," and others are applied to several of the species. They inhabit the southern United States, Mexico, and Central America, and many of them thrive admirably in Victoria. *Yucca gloriosa* (*vide* Fig. No. XI.) produces the "Petre Hemp" of the Mexican Spaniards, and, according to Nuttall, "is used for cordage, ropes, &c., as well as for packing-cloth, and is extremely durable." Elliott, in his *Botany of South Carolina*, speaks of it as "one of the strongest fibres of the Vegetable Kingdom."

There are five species of *Dianella* or "Australian Flax Lily" (*vide* Fig. No. IV.) from which fibres of fair quality have been produced, the most important being the smooth-leaved and broad-leaved kinds. The former (*Dianella lævis*) bears large panicles of pretty blue flowers, followed by large globular blue berries; the latter (*D. Tasmanica*) is of more robust habit, has leaves of 3 or 4 feet in length, and, like the former, inhabits the moist and heavily-shaded fern gullies and ravines of the sub-alpine parts of this colony and Tasmania. It gives an excellent fibre, and the refuse or combings contributes good paper stock. Professor Dodge says—"Some of the filaments are white and brilliant, and quite strong, a few twisted together requiring quite an effort to break them."

Passing over the *Dasyliirions*, *Nolina*, *Beaucarnea*, *Stypandras*, and other members of this important family of the Lilies, all of which yield fibres more or less useful, I will briefly refer to the "Torch Lilies" of the Cape of Good Hope, which are known botanically as "*Kniphofia*" or "*Tritoma*" (*vide* Fig. No. XII.) As fibre plants they were first brought under notice by me in 1875, samples of five kinds having been prepared in the Botanical Gardens, and forwarded to several Exhibitions since. It will be seen that the present specimens are of fair strength and quality, and possibly they are capable of being woven into fine textile fabrics. The plants are all quick-growing perennials, producing a wealth of long leafage, and are readily increased by root division and seeds. With good cultivation they would yield two crops per year, and the fibre can be obtained within a few hours by boiling

or steaming the leaves. The great-flowered Torch Lily (*Kniphofia grandiflora*) and the "Recurved Torch Lily" (*Kniphofia recurvata*) are probably the strongest and best in quality, and these give the greatest percentage of fibre.*

A FURTHER GROUP OF THE FIBRE-YIELDING PLANTS.

The "Rush family," Order Juncaceæ, must not be passed over. There is perhaps no plant more commonly despised and looked upon as worse than useless than the rush, whose presence alone is sufficient to indicate cold worthless swampy ground, or ground at all events liable to submersion. And yet even this despised order of vegetation has its uses, and, in its way, its economic value. There are in this colony at least four species found growing on the marshy tracts, both inland and near the sea, that furnish fibres which, if properly treated, make excellent strong paper. Of these the best is, perhaps, "*Juncus pallidus*" ("the pale-green tall rush") which may be gathered in vast quantities all over this and the other Australian colonies.

A good fibre is obtained from "*Xerotes longifolia*," a tufted perennial commonly called "Tussock Grass" or "Australian Mat-rush"; and from the leaves also of the "Grass tree" (*Xanthorrhœa Australis*) a small percentage of silky fibre can be extracted, which probably is of little value, although the trunk yields a fragrant resin, which has been used as a varnish, for dyeing purposes, and in the manufacture of lacquer for tinware. It also affords a large percentage of wood spirit.

An aquatic perennial belonging to the "Bur Reed family" (Typhaceæ) yields from its leaves a fibre of considerable strength and fineness, and also good paper material. The plant is known all over Australia as the "Native Bulrush," and is, in fact, a cosmopolitan, being found wild on the banks of rivers, ditches, and ponds in all quarters of the globe. In Europe it is called "Reed Mace" and "Catstail," while the botanical name is "*Typha angustifolia*." As a fibre plant it was brought under notice through a sample prepared here and sent to the Amsterdam Exhibition of 1876, and very shortly afterwards an article appeared in an English periodical stating that a French company had been formed for the purpose of utilizing it, and that machinery had been invented capable of converting it into textile fabrics of great fineness. The sample sent from here was partly

* Since this was penned I received, through Mr. H. N. Sleight, of this city, a letter from a London firm of manufacturers, stating the value of this fibre and that of *Sparmannia Africana* to be from £17 to £17 10s. per ton.

prepared by a boiling process, after which the leaves were scraped with a blunt instrument.

The "Sedge family" (Cyperaceæ) includes a number of useful plants suitable for paper pulp. Two species of *Carex* (*Carex paniculata* and *Carex tereticaulis*); the same of *Gahnia* or *Cladium*, "Black Reed"; one of *Scirpus*, or "Knotted Rush"; *Schœnus brevifolius*, "Cord Rush"; and three species of *Lepidosperma*, or "Sword Rush," are all wild in Victoria and other parts of Australia, and all alike useful for the purpose mentioned.

Lastly, the "Grass family" (Gramineæ), which is the most important of all to man, as it produces corn for his bread and food for his flocks and herds, yields perhaps the most abundant and best material for paper making. Our Victorian "Wire Grass" (*Poa cæspitosa*), which grows to a height of 4 feet, might, with proper appliances, even rival the celebrated "Esparto" (*Stipa tenacissima*) of South Europe.

PRACTICAL OUTCOME.

I may remark that this is but a brief sketch of what might and what deserved to be said in reference to some of the experimental fibres, and will suffice to indicate that there is a vast field of enterprise open to our farmers and settlers generally in the way of, if not going in for the absolute cultivation of one or more of them, still of utilizing their waste patches of land by trying such plants as would be most likely to succeed thereon, taking into account whether they be sandy, stony, swampy, or subject to flood. And, further, it may be pointed out that after the first planting (except, of course, low-growing perennial or herbaceous plants) few, if any, of the fibre-producing trees or large shrubs mentioned require any special attention more than can be given them by the women or children of the household. Unlike cereal and other field crops, they do not require continual care and nurture. Given a suitable soil and climate, most of them only need to be left alone until they attain their full maturity.

I should indeed be sorry to be the means of misleading any one by stating positively that a crop of this or that would afford a large profit to the grower. No; my work in the laboratory and experience in the garden are well enough in their way; but, as Bacon says—"I only sound the clarion, but I enter not into the battle." It remains for experts to decide what uses these new native or Australian-grown fibres can be put to, whether for the manufacture of rope, cordage, textile fabrics, or paper, &c.; whether they are equal to the imported fibres, and, if so, what is their market value to the Victorian producer? In the long list

of fibre plants which have been mentioned, and at greater or less length described, there are several to which the special attention of the husbandman has been directed, as being well known and most suitable to ordinary conditions, as being easily cultivated, and as producing the quickest returns. Professor Goodale, in his presidential address delivered before the American Association for the Advancement of Science, in August, 1891, speaking of the possibilities of economic botany, remarked that—"Countless sorts of plants have been suggested as sources of good bast-fibres, for spinning and for cordage, and many of these make capital substitutes for those already in the factories; but," he adds, "the questions of cheapness of production and of subsequent preparation for use have thus far militated against success. There may be much difference between the profits promised by a laboratory experiment and those resulting from the same process conducted on a commercial scale. The existence of such differences has been the rock on which many enterprises seeking to introduce new fibres have been wrecked."

In conclusion, I think it will be generally admitted that what we really require here is a number of experimental farms, say eighteen or twenty, established in various parts of the colony, choosing the best districts, where the soil is fairly good, and placing each farm under the management of a thoroughly practical man, who should be able to prove within a reasonable time the capabilities of his particular district; in short, whether the soil and climate were suitable for cultivating any special economic plants likely to be a source of profit and benefit to the country. It is scarcely necessary for me to remark that what will suit say Ballarat or Dunolly may not thrive at Bendigo or Dookie, or *vice versa*, or that plants which merely exist as miserable specimens in our public gardens may thrive admirably in the warm valleys and splendid undulating or hilly country to be found in Gippsland. By the establishment of such farms experiments could be tried not only with our numerous textiles but also with fodder plants, grasses, and herbs, medicinal and scent plants, &c., devoting, say, a patch of a quarter of an acre to each, thoroughly cultivating and testing them in such a way that the people might be taught what plants they should go in for as likely to become profitable industries and what to leave alone. Then, indeed, might the valuable collection of economic plants in our Melbourne Botanic Gardens be made to serve far more useful purposes in some instances than as botanical specimens in our borders or classified groups, or in our plant sheds. I do not mean to say that such plants should be sent in quantity anywhere, excepting to the experimental farms suggested, in which case, after proving their adaptability for the locality, and after practical lessons had been given in regard to their cultivation, they could be propagated and freely distributed

to all farmers willing to turn them to profitable account. To bring my remarks to a practical issue, let me hope, as indeed I venture to think we well may, that the late and indeed the present disastrous depression may not be altogether without its bright side and its use, inasmuch as it may tend to turn the minds of the manhood and youth of the colony from precarious speculations and other unstable methods of that *ignis fatuus*—the pursuit of wealth without work—into a higher and nobler groove, namely, the making the best of the land we live on, in extracting fresh, and it may be yet unheard of, treasures from the soil, in enriching the country as a whole, and in many cases causing even the hitherto waste and apparently useless wilderness to become rurally picturesque, as well as to yield supplementary and even payable results to well-directed labour.

LIST OF FIBRES (EXTRA-AUSTRALASIAN) IN BOTANICAL GARDENS MUSEUM.

<i>Abutilon album</i> (Hort.) ...	...	White Lantern flower. China.
Order Malvaceæ.		
<i>Abutilon Bedfordianum</i> (Hooker) ...	...	Duke of Bedford's Lantern flower. Brazil.
Order Malvaceæ.		
<i>Abutilon Megapotamicum</i> (St. Hilaire). Syn. <i>A. vexillarium</i> (E. Monro). Order Malvaceæ.	...	Big River or urn-shaped Lantern flower. Brazil.
<i>Abutilon molle</i> (G. Don) ...	...	Soft Lantern flower. Peru.
Order Malvaceæ.		
<i>Abutilon striatum</i> (Dickson) ...	...	Streaked Lantern flower. Brazil.
Order Malvaceæ.		
<i>Abutilon venosum</i> (Lemaire) ...	...	Veined Lantern flower. Brazil.
Order Malvaceæ.		
<i>Adansonia digitata</i> (Linnæus) ...	...	Baobab tree. Africa.
Order Malvaceæ.		
<i>Agave Americana</i> (Linnæus) ...	...	Toddy lily or Pita-hemp plant. South America.
Order Amaryllideæ.		
<i>Agave Americana</i> (Linnæus), var. <i>longifolia</i> . Order Amaryllideæ	...	Long-leaved variegated American Aloe. South America.
<i>Agave Americana</i> (Linnæus), variegata. Order Amaryllideæ.	...	Variegated American Aloe. South America.
<i>Agave angustifolia</i> (Haworth) ...	...	Narrow-leaved Agave. St. Helena.
Order Amaryllideæ.		
<i>Agave densiflora</i> (Hooker) ...	...	Dense-flowered Agave. Mexico.
Order Amaryllideæ.		
<i>Agave geminiflora</i> (Ker) ...	...	Twin-flowered Agave. Central America.
Order Amaryllideæ.		
<i>Agave Ixtli</i> (Karwinsky) ...	...	"Istle fibre." Mexico.
Order Amaryllideæ.		
<i>Agave Jacquiniiana</i> (Schultes) ...	...	Jacquin's Agave. Mexico.
Order Amaryllideæ.		
<i>Agave Karatto</i> (Miller) ...	...	"Karatto." South America.
Order Amaryllideæ.		
<i>Agave Mexicana</i> (Lamarck) ...	...	Mexican Agave. Mexico.
Order Amaryllideæ.		
<i>Agave potatorum</i> (Zuccarini) ...	...	Drinker's Agave. Mexico.
Order Amaryllideæ.		
<i>Agave rigida</i> (Miller) ...	...	The "Chelem" of the Mexicans. Mexico.
Order Amaryllideæ.		
<i>Agave Rumphii</i> (Hasskarl) ...	...	Rumph's Agave. Mexico.
Order Amaryllideæ.		
<i>Agave Salmiana</i> (Otto) ...	...	Prince Salm Dyck's Agave. Mexico.
Order Amaryllideæ.		
<i>Alpinia nutans</i> (Roscoe) ...	...	Indian Shell flower India, Ceylon, &c.
Order Scitamineæ.		
<i>Ananassa sativa</i> (Miller) ...	...	Common Pine-apple. South America.
Order Bromeliaceæ.		
<i>Apocynum cannabinum</i> (Linnæus) ...	...	Indian hemp North America.
Order Apocynaceæ.		

<i>Attalea funifera</i> ...	...	The Piassaba palm.
Order Palmæ.		Brazil.
<i>Beaucarnea glauca</i> (Lehmann)	...	Sea-green leaved <i>Beaucarnea</i> .
Order Liliaceæ.		South America.
<i>Bœhmeria macrophylla</i> (D. Don)	...	Large-leaved Grass-cloth plant.
Order Urticaceæ.		Nepaul.
<i>Bœhmeria nivea</i> (Hooker)	...	Chinese Grass-cloth plant, or
Order Urticaceæ.		"Rheea," "Ramie." China,
		Sumatra, and Assam.
<i>Bœhmeria Puya</i> (Hooker)	...	Nepaul Grass-cloth plant.
Order Urticaceæ.		Nepaul and Sikkim.
<i>Bromelia sylvestris</i> (Linnæus)	...	Wild Pine-apple.
Order Bromeliaceæ.		South America.
<i>Calotropis gigantea</i> (R. Brown)	...	Yercum fibre plant.
Order Asclepiadææ.		India.
<i>Canna gigantea</i> (Desfontaines)	...	Large Indian Shot plant.
Order Scitamineæ.		South America.
<i>Cannabis sativa</i> (Linnæus)	...	Common hemp.
Order Urticaceæ.		India and Persia.
<i>Caryota urens</i> (Linnæus) ...	...	Jaggery palm.
Order Palmæ.		India and Malay Peninsula.
<i>Cocos nucifera</i> (Linnæus)...	...	Common Cocoonut palm.
Order Palmæ.		Southern India and Malayan
		Islands.
<i>Corchorus capsularis</i> (Linnæus)	...	Jute plant.
Order Tiliaceæ.		Asia.
<i>Crotalaria tenuifolia</i> (Baker)	...	Sunn-fibre plant.
Order Leguminosæ.		Madagascar.
<i>Cyperus Papyrus</i> (Linnæus)	...	Nile Papyrus or Paper reed of the
Order Cyperaceæ.		Ancients. Egypt.
<i>Dasyllirion glaucophyllum</i> (Hooker)	...	Glaucous <i>Dasyllirion</i> .
Order Liliaceæ.		Mexico.
<i>Debregeia longifolia</i> (Weddell)	...	"Wild Rheea."
Order Urticaceæ.		India.
<i>Dombeya Natalensis</i> (Sonder)	...	Cape Wedding-flower.
Order Sterculiaceæ.		Natal.
<i>Dracæna Draco</i> (Linnæus)	...	Dragon's-blood tree.
Order Liliaceæ.		Canary Islands.
<i>Fourcroya gigantea</i> (Ventenat)	...	Giant fibre lily.
Order Amaryllideæ.		Mexico.
<i>Fourcroya longæva</i> (Karwinsky and	...	Long-lived giant lily.
Zuccarini). Order Amaryllideæ.		Mexico and Guatemala.
<i>Grewia occidentalis</i> (Linnæus)	...	African Star bush.
Order Tiliaceæ.		Cape of Good Hope.
<i>Helicteres Isora</i> (Linnæus)	...	The twisted horn fruit.
Order Sterculiaceæ.		India.
<i>Hibiscus mutabilis</i> (Linnæus)	...	Changing Rose-mallow.
Order Malvaceæ.		Java and East Indis.
<i>Hibiscus Sabdariffa</i> (Linnæus)	...	Rosella fibre plant.
Order Malvaceæ.		Tropical Asia and Africa.
<i>Hibiscus Syriacus</i> (Linnæus)	...	Syrian Rose-mallow.
Order Malvaceæ.		Syria.
<i>Hypoxis longifolia</i> (Baker)	...	Long-leaved <i>Hypoxis</i> .
Order Amaryllideæ.		Algoa Bay.
<i>Kniphofia aloides</i> (Mœnch). Syn.	...	Aloe-like Torch lily.
<i>Tritoma Uvaria</i> (Ker). Order	...	Cape of Good Hope.
Liliaceæ.		

Kniphofia aurea. Syn. Tritoma aurea. Order Liliaceæ.	Golden-tinted Torch lily. Cape of Good Hope.
Kniphofia grandiflora. Syn. Tritoma grandiflora. Order Liliaceæ.	Large-flowered Torch lily. Cape of Good Hope.
Kniphofia recurvata (Moore). Syn. Tritoma recurvata (Ker). Order Liliaceæ.	Recurved Torch lily. Cape of Good Hope.
Kniphofia Rooperi (Lemaire). Syn. Tritoma Rooperi. Order Liliaceæ.	Rooper's Torch lily. British Caffraria.
Kydia calycina (Roxburgh) ... Order Malvaceæ.	Large-calyxed Kydia. East Indies.
Lavatera arborea (Linnæus) ... Order Malvaceæ.	Common tree mallow. Europe and Asia.
Lavatera maritima (Willdenow) ... Order Malvaceæ.	Sea mallow. South Europe.
Lavatera Olbia (Linnæus) ... Order Malvaceæ.	Velvet mallow. France.
Lecythes ollaria (Linnæus) ... Order Myrtaceæ.	Winna fibre or Monkey pot. British Guiana.
Linum usitatissimum (Linnæus) ... Order Linææ.	Common flax. Europe and Egypt.
Malva Capensis (Willdenow) ... Order Malvaceæ.	Cape mallow. Cape of Good Hope.
Musa Ensete (Gmelin) ... Order Scitamineæ.	Bruce's or Abyssinian banana. Abyssinia.
Musa paradisica (Linnæus) ... Order Scitamineæ.	Common Plantain fruit. India.
Musa sapientum (Linnæus) ... Order Scitamineæ.	Common banana. East Indies.
Musa textilis (Linnæus) ... Order Scitamineæ.	Manilla hemp plant. Java and Philippine Islands.
Nolina crumpens (S. Watson) ... Order Liliaceæ.	The sprouting Nolina. Texas.
Pandanus utilis (Bojer) ... Order Pandanææ.	Common Screw pine. Mauritius and Madagascar.
Raphia vinifera (Beauvois) ... Order Palmææ.	African bass fibre palm. West Tropical Africa.
Sansevieria fasciata (Hort.) ... Order Hæmodoraceæ.	Pale-banded Bowstring hemp.
Sansevieria Guineensis (Willdenow) ... Order Hæmodoraceæ.	Common Bowstring hemp. Guinea.
Sparmannia Africana (Linnæus fil.) ... Order Tiliaceæ.	"African hemp bush." Cape of Good Hope.
Sparmannia Africana fl. pl. (Linnæus fil.). Order Tiliaceæ.	Double-flowered "African hemp bush." Cape of Good Hope.
Sphæralcea umbellata (Spach) ... Order Malvaceæ.	Umbel-flowered globe mallow. Mexico.
Sterculia villosa (Roxburgh) ... Order Sterculiaceæ.	The hairy Sterculia. East India.
Urtica heterophylla ... Order Urticaceæ.	Neilgherry nettle. India.
Yucca aloifolia (Linnæus) ... Order Liliaceæ.	Aloe-leaved Adam's needle, or dagger-leaf. Mexico, &c.
Yucca aloifolia variegata (Linnæus) ... Order Liliaceæ.	Variegated dagger-leaf. Mexico.
Yucca Californica (Lemaire) ... Order Liliaceæ.	Californian mound lily. California.

<i>Yucca filamentosa</i> (Linnæus)	...	Thread-bearing mound lily.
Order Liliaceæ.		Virginia.
<i>Yucca flexilis</i> (Carriere) ...	...	Flexible Yucca.
Order Liliaceæ.		Mexico.
<i>Yucca gloriosa</i> (Linnæus)	...	"Petre hemp" or "Mound lily."
Order Liliaceæ.		Southern United States.
<i>Yucca gloriosa</i> (Linnæus).	Var.	Superb mound lily.
<i>superba</i> (Baker).	Order	America.
Liliaceæ.		
<i>Yucca Guatemalensis</i> (Baker).	Syn.	The large mound lily.
<i>Y. Ghiesbrechtii</i> (Hort.).	Order	Mexico and Guatemala.
Liliaceæ.		

LIST OF FIBRES (AUSTRALASIAN) IN BOTANICAL GARDENS MUSEUM.

<i>Amperea spartioides</i> (Brongniart)...	Broom-like Amperea.
Order Euphorbiaceæ.	Victoria, N. S. Wales, Queensland, &c.
<i>Anigozanthos flavida</i> (Redoute) ...	Yellow sword lily or Kangaroo-foot flower. West Australia.
Order Hæmodoraceæ.	
<i>Astelia Banksii</i> (A. Cunningham)...	Bank's Astelia.
Order Liliaceæ.	New Zealand.
<i>Carex paniculata</i> (Linnæus). Syn.	Close-spiked Sedge grass.
<i>C. adpressa</i> (R. Brown). Order	Australia, except North, New Zealand, &c.
Cyperaceæ.	
<i>Carex tereticaulis</i> (F. v. Mueller) ...	The round-stemmed Carex.
Order Cyperaceæ.	Victoria, N. S. Wales, South and West Australia, and Tasmania.
<i>Cassytha melantha</i> (R. Brown) ...	Common scrub vine or Dodder laurel.
Order Laurineæ.	Victoria, N. S. Wales, South and West Australia, and Tasmania.
<i>Commersonia Fraseri</i> (J. Gay) ...	Blackfellow's hemp.
Order Sterculiaceæ.	Victoria, N. S. Wales, and Queensland.
<i>Corchorus olitorius</i> (Linnæus) ...	Jute plant or Jew's mallow.
Order Tiliaceæ.	North Australia, South Asia, and Africa.
<i>Cordyline Australis</i> (Hooker). Syn.	Forster's palm lily.
<i>C. Forsteri</i> (F. v. Mueller).	New Zealand.
Order Liliaceæ.	
<i>Cordyline Australis</i> , var. <i>lineata</i> ...	Lined-leaved Dragon tree.
Order Liliaceæ.	New Zealand.
<i>Cordyline Banksii</i> (Hooker, fil.) ...	Sir Joseph Banks' palm lily.
Order Liliaceæ.	New Zealand.
<i>Cordyline Baueri</i> (Hooker). Syn.	Bauer's palm lily.
<i>C. nutans</i> (A. Cunn.). Order	Norfolk Island and Tropical Polynesia.
Liliaceæ.	
<i>Cordyline Cookii</i> (?) ...	Captain Cook's palm lily.
Order Liliaceæ.	

<i>Cordyline indivisa</i> (Kunth)	...	"Toii."
Order Liliaceæ.		New Zealand.
<i>Cordyline stricta</i> (Endlicher)	...	Erect palm lily.
Order Liliaceæ.		N. S. Wales and Queensland.
<i>Cordyline terminalis</i> (Kunth)	...	Terminal palm lily or ti plant.
Order Liliaceæ.		N. S. Wales, Queensland, Poly- nesia, &c.
<i>Cordyline terminalis</i> (Kunth). Var.		Canna-leaved palm lily.
<i>cannæfolia</i> (Benthm).	Order	N. S. Wales and Queensland.
Liliaceæ.		
<i>Cordyline Veitchii</i>	...	Veitch's palm lily.
Order Liliaceæ.		New Zealand.
<i>Crotalaria Cunninghamii</i> (R. Brown)		Cunningham's Crotalaria.
Order Leguminosæ.		Queensland, South, West, and North Australia.
<i>Crotalaria juncea</i> (Linnæus)	...	Bombay hemp.
Order Leguminosæ.		Queensland, North Australia, and Asia.
<i>Cyperus lucidus</i> (R. Brown)	...	Shining Galingale rush.
Order Cyperaceæ.		Victoria, N. S. Wales, Queens- land, &c.
<i>Dianella cœrulea</i> (Sims)	...	Paroo lily.
Order Liliaceæ.		N. S. Wales and Queensland.
<i>Dianella elegans</i> (Kunth)	...	Elegant native Flax lily.
Order Liliaceæ.		Victoria and Tasmania.
<i>Dianella lævis</i> (R. Brown)	...	Smooth-leaved Flax lily.
Order Liliaceæ.		Victoria, N. S. Wales, Queens- land, &c.
<i>Dianella revoluta</i> (R. Brown)	...	Recurved-leaved Flax lily.
Order Liliaceæ.		Anstralia, except North.
<i>Dianella tasmanica</i> (Hooker)	...	Broad-leaved native Flax lily.
Order Liliaceæ.		Victoria, N. S. Wales, and Tas- mania.
<i>Doryanthes excelsa</i> (Correa de Serra)		N. S. Wales Spear lily.
Order Amaryllideæ.		N. S. Wales and Queensland.
<i>Doryanthes Guilfoylei</i> (Bailey)	...	The giant Queensland Spear lily.
Order Amaryllideæ.		Queensland.
<i>Doryanthes Palmeri</i> (Hill)	...	Queensland Spear lily.
Order Amaryllideæ.		Queensland.
<i>Gahnia psittacorum</i> (Labillardière)		The parrot rush.
Order Cyperaceæ.		Victoria, N. S. Wales, Queens- land, &c.
<i>Gahnia Radula</i> (Benthm)	...	Cutting grass or black reed.
Order Cyperaceæ.		Victoria, South Australia, and Tasmania.
<i>Hibiscus cannabinus</i> (Linnæus)	...	Ambari hemp.
Order Malvaceæ.		Queensland, North Australia, Asia, and Africa.
<i>Hibiscus heterophyllus</i> (Ventenat)		Queensland Sorrel tree.
Order Malvaceæ.		N. S. Wales and Queensland.
<i>Hibiscus splendens</i> (Fraser)	...	Hollyhock tree.
Order Malvaceæ.		N. S. Wales and Queensland.
<i>Hoheria populnea</i> (A. Cunningham)		Ribbonwood of Otago.
Order Malvaceæ.		New Zealand.
<i>Juncus communis</i> (E. Meyer)	...	Common or Candle rush.
Order Juncaceæ.		Australia, except North; Europe, &c.

- Juncus maritimus* (Lamarck) ... Sea rush.
Order Juncaceæ. Australia, except North; Europe, &c.
- Juncus pallidus* (R. Brown) ... Pale-green rush.
Order Juncaceæ. Australia, except North.
- Juncus prismatocarpus* (R. Brown) Prism-shaped fruited rush.
Order Juncaceæ. Australia, except North.
- Lagunaria Patersonii* (Don) ... Norfolk Island Cow-itch tree.
Order Malvaceæ. Norfolk Island.
- Lepidosperma elatius* (Labillardière) The taller Sword rush.
Order Cyperaceæ. Victoria, South Australia, and Tasmania.
- Lepidosperma gladiatum* (Labillardière). Order Cyperaceæ. Coast Sword rush.
Victoria, N. S. Wales, South, and West Australia, &c.
- Lepidosperma longitudinale* (Labillardière). Order Cyperaceæ. Long-leaved Sword rush.
Victoria, N. S. Wales, South, and West Australia, &c.
- Moræa Robinsoniana* (F. v. Mueller) Wedding flower.
Order Iridææ. Lord Howe's Island.
- Pandanus Forsteri* (C. Moore and F. v. Mueller). Order Pandanææ. Tent tree of Lord Howe's Island.
Lord Howe's Island.
- Pandanus odoratissimus* (Linnæus fil.) Moreton Bay Bread fruit tree.
Order Pandanææ. Queensland, North Australia, Asia, &c.
- Pandanus pedunculatus* (R. Brown) Native Screw pine.
Order Pandanææ. N. S. Wales and Queensland.
- Phormium tenax* (Forster) ... Common New Zealand flax.
Order Liliaceæ. New Zealand.
- Phormium tenax variegatum* (Forster) Variegated New Zealand flax.
Order Liliaceæ. New Zealand.
- Pimelea axiflora* (F. v. Mueller) ... Axil-flowered tough bark.
Order Thymelæaceæ. Victoria, N. S. Wales, and Tasmania.
- Pimelea clavata* (Labillardière) ... Club-flowered Pimelea.
Order Thymelæaceæ. West Australia.
- Plagianthus betulinus* (A. Cunningham). Ribbon tree, or New Zealand lace-bark tree. New Zealand.
Order Malvaceæ.
- Plagianthus pulchellus* (A. Gray) ... Victorian hemp bush.
Order Malvaceæ. Victoria, N. S. Wales, and Tasmania.
- Poa cæspitosa* (Forster). Syn. P. *australis* (R. Brown). Order Gramineæ. Australian meadow grass, or wiry grass. Victoria, N. S. Wales, Queensland, &c.
- Schœnus brevifolius* (R. Brown) ... Short-leaved bog rush or cord rush.
Order Cyperaceæ. Victoria, N. S. Wales, Queensland.
- Scirpus nodosus* (Rottboell). Syn. *Isolepis nodosa* (R. Brown). Knotted club rush.
Order Cyperaceæ. Australia, except North.
- Sida rhombifolia* (Linnæus) ... Queensland hemp.
Order Malvaceæ. N. S. Wales, Queensland, North Australia, &c.
- Sterculia acerifolia* (A. Cunningham) Flame tree or lace-bark of N. S. Wales, N. S. Wales and Queensland.
Order Sterculiaceæ.

<i>Sterculia diversifolia</i> (G. Don)	...	Victorian bottle-tree or Currijong.
Order Sterculiaceæ.		Victoria, N. S. Wales, and Queensland.
<i>Sterculia lurida</i> (F. v. Mueller)	...	Pale-leaved Sterculia.
Order Sterculiaceæ.		N. S. Wales and Queensland.
<i>Stypandra cæspitosa</i> (R. Brown)	...	Tufted Stypandra.
Order Liliacæ.		Victoria, N. S. Wales, Queensland, and Tasmania.
<i>Tarrietia actinodendron</i> (F. v. Mueller).		The rayed Staveswood.
Order Sterculiaceæ.		N. S. Wales and Queensland.
<i>Tetrarrhena juncea</i> (R. Brown). Syn.		Climbing Rush grass.
<i>Ehrharta tenacissima</i> (Steudel).		Victoria, N. S. Wales, and Tasmania.
Order Gramineæ.		
<i>Typha angustifolia</i> (Linnæus)	...	Native Bulrush or catstail.
Order Typhaceæ.		Australia, Tasmania, Europe, &c.
<i>Urena lobata</i> (Linnæus) ...	...	Lobed-leaved Indian mallow.
Order Malvaceæ.		Queensland, N. Australia, Asia, &c.
<i>Xanthorrhœa australis</i> (R. Brown)		Resin grass tree.
Order Juncaceæ.		Victoria and Tasmania.
<i>Xanthorrhœa minor</i> (R. Brown)	...	Dwarf grass tree.
Order Juncaceæ.		Victoria, N. S. Wales, &c.
<i>Xerotes longifolia</i> (R. Brown)	...	Native tussock grass or mat rush.
Order Juncaceæ.		Victoria, N. S. Wales, Queensland, &c.

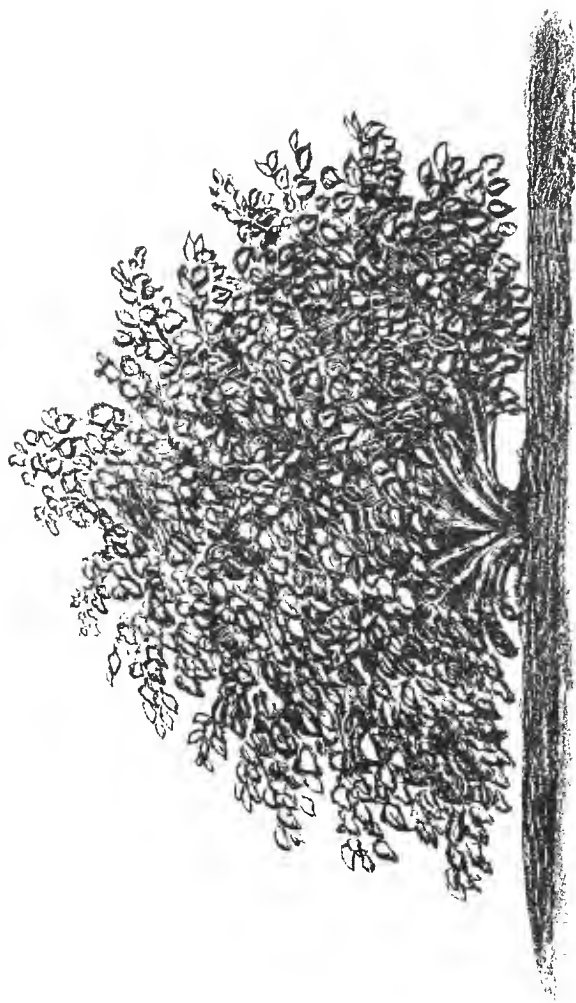


FIG. 1.—SPARMANNIA AFRICANA (DOUBLE FLOWERS).

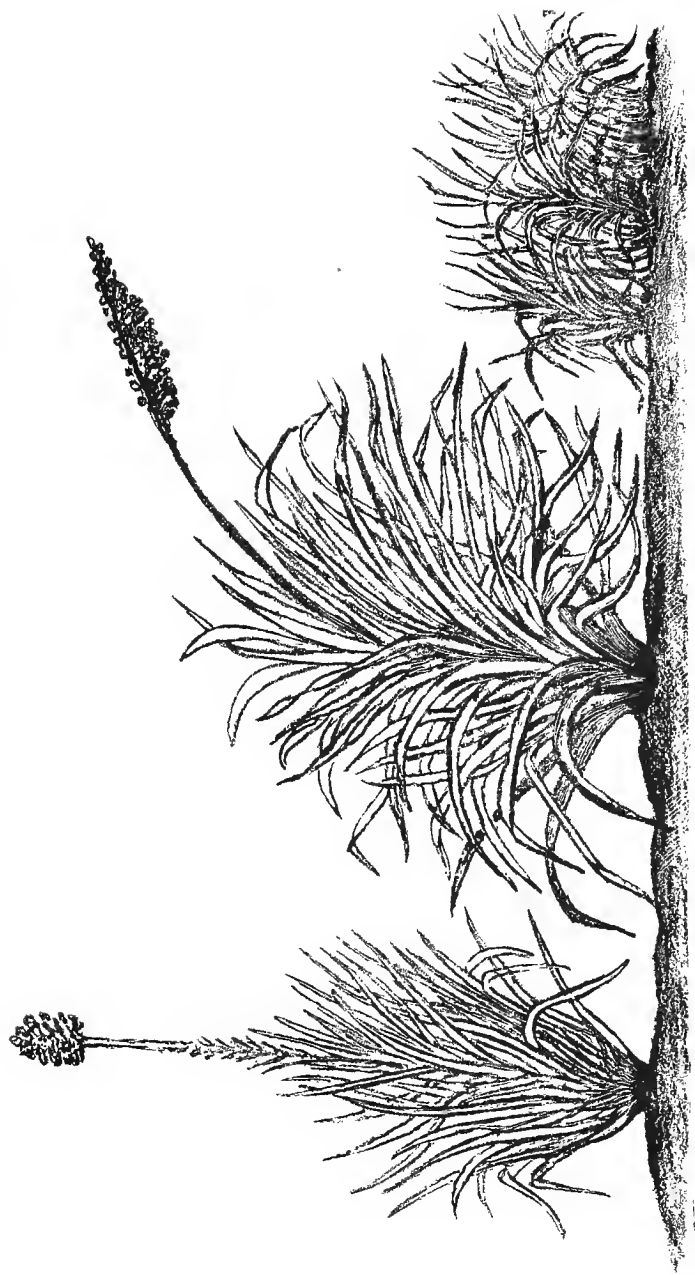


FIG. II.—*DORYANTHES EXOELSA*.

FIG. III.—*DORYANTHES PALMERI*.

FIG. IV.—*DIANELLA TASMANICA*.

QUEENSLAND LILIES.

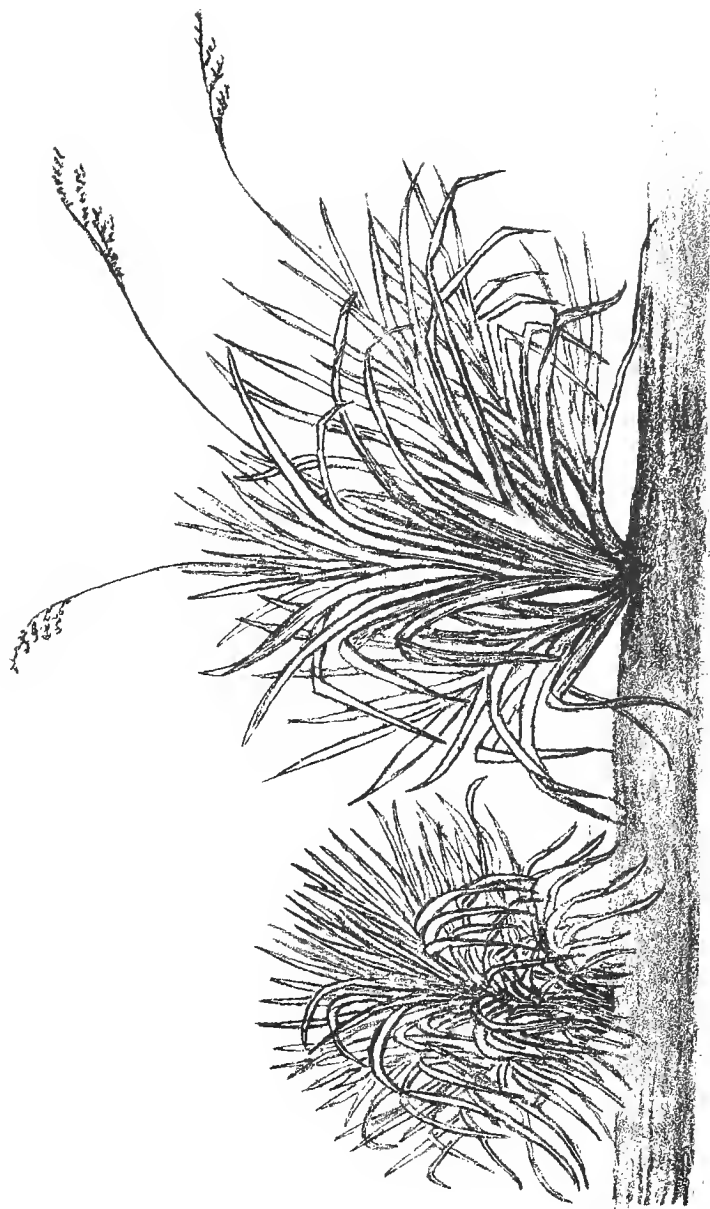


FIG. V.—PHORMIUM COLENZOI.

FIG. VI.—PHORMIUM TENAX.

“NEW ZEALAND FLAX.”

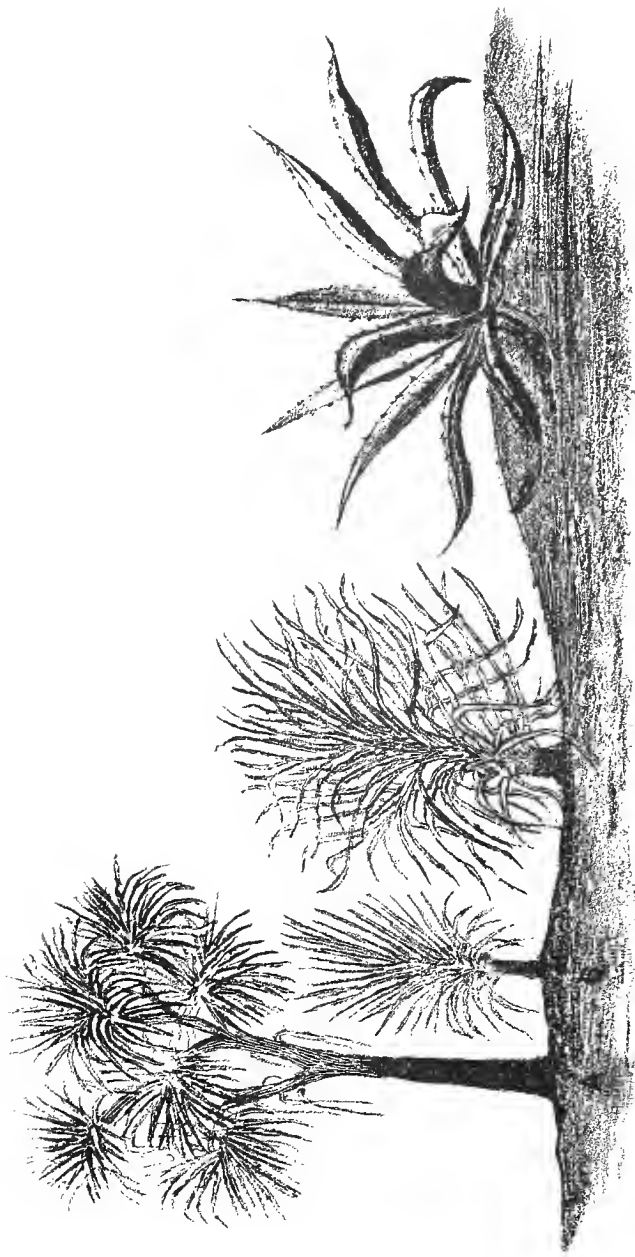


FIG. VII.—CORDYLINE AUSTRALIS. FIG. VIII.—CORDYLINE BANKSI.
(A OLD PLANT. B YOUNG PLANT.)

FIG. IX.—AGAVE SALMIANA.

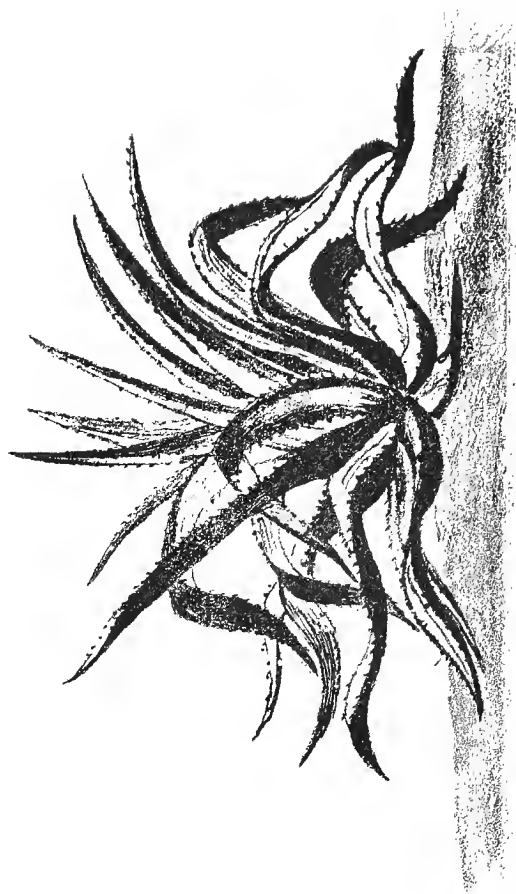


FIG. X.—AGAVE AMERICANA. "PITA HEMP" OR "AMERICAN ALOE."

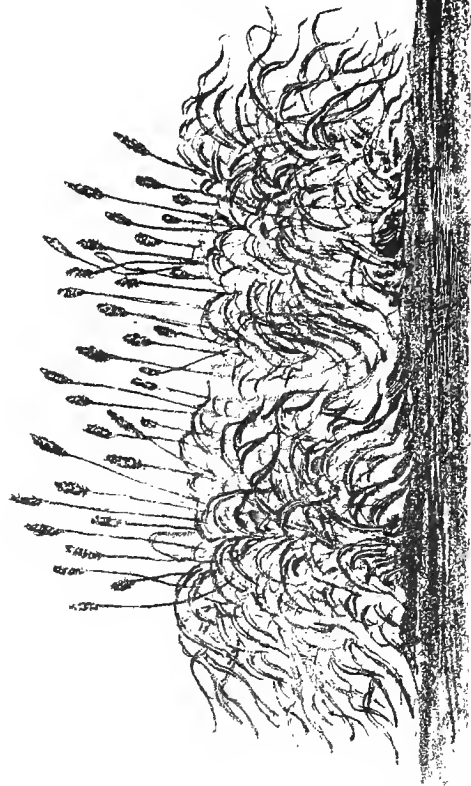


FIG. XII.—KNIPHOFIA (TRITOMA) GRANDIFLORA.
(TORCH LILY.)

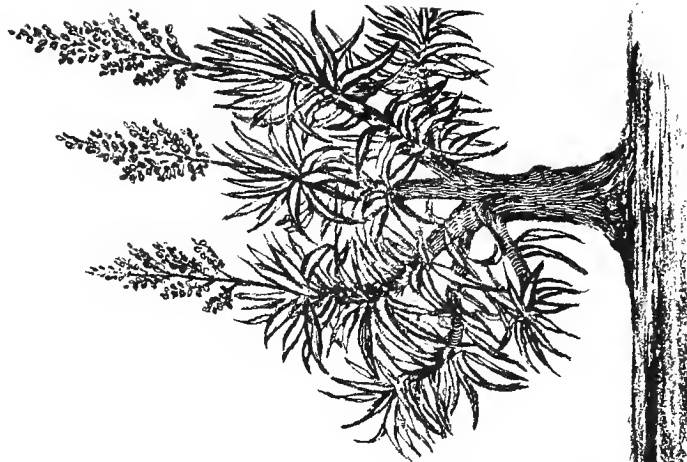


FIG. XI.—YUCCA GLORIOSA.
(PETRE HEMP OR MOUND LILY.)

