# THE RAMIE:

## (RHEA)

SYNONYMOUS WITH THE

## CHINA GRASS, URTICA BŒHMERIA NIVEA,

ETC.

**Its Description, Mode of Cultivation, and Method of Disintegratio and Cleaning the Fibre.**

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BY

THEOPHILE MOERMAN,
GHENT, BELGIUM.

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TRANSLATED FROM THE FRENCH BY EDMOND DURUP DE DOMBAL,
*Bengal Secretariat.*



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TED AT THE BENGAL SECRETARIAT PRESS.
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# PRECIS OF THE ESSAY.

For some years past, Europe has been annually importing tolerably large quantities of the fibre of the white nettle, known under the names of ramie, rhea, or China-grass. Botanists, to begin with Linné, have designated the ramie, *Urtica Nivea*, or, in French, *Ortie blanche sans dards de la Chine*, seeing that it really belongs to the large family of nettles (*Orties*,) and its cultivation mainly to the south of China.

Dr. Roxburgh, who was deputed at the beginning of the present century to make experiments in India with certain textile plants, devoted great attention to this remarkable plant, and designated it *Urtica tenacissima*, because he found that its fibres were the strongest of those he had experimented upon. Gaudichaud, having regard to the convenience of distinguishing, by a distinct name, the varieties of the perpetual and prickless nettle (*Orties perpetualles et sans dards*) from the other annual nettles (*Orties annuelles*), gave to this textile plant, the name of *Bœhmeria*, so that now the real botanical name of the ramie or rhea is *Urtica Bœhmeria Nivea*.

The *Urtica Bœhmeria Nivea* is of Chinese origin, and the back of its leaf is perfectly white, that is to say, white with green veins, and the leaves and the stalks are very robust and strong. When the stalk comes to maturity, it assumes a reddish-brown hue, somewhat of the colour of blood. Haskrall carefully distinguishes it from the different varieties known at Java, and designates the best species of Chinese origin by the name of *Bœhmeria sanguinea* in contra-distinction from the *Bœhmeria candicans*. The stalks of this second species, when mature, are not of the same deep blood-red colour as the *Sanguinea*. The species called *Bœhmeria candicans* is held in high estimation in Java, of which country it seems to be a native. That which distinguishes *Bœhmeria candicans* from the *Bœhmeria Nivea*, or *Tenacissima*, or *Sanguinea* is, that the leaves of the *Nivea* are all white, with green veins; while the leaves of the *Bœhmeria candicans* are green, lightly veined with white, or precisely the opposite style to the *Nivea*.

In commerce, the two species are generally confounded, and are known under one single general name, either as *Ortie blanche*, or ramie, or, as in British India, rhea, or, as in England, by the whimsical name of China-grass, although it is a plant of high wood, having at least as much stalk, and growing as high as the hemp plant. Which of the two varieties produces the finer and the greater quantity of fibre is not yet determined. The author is inclined to believe that there is little or no difference in the merits of these two species, and botanists confound the two, and frequently speak of both as one and the same plant.

The fibre, when properly and thoroughly disintegrated, is longer, stronger, finer, and more glossy than the finest flax; has all the brilliancy of silk; is finer than the beautiful Sea Island cotton; and can be bleached and dyed more easily and more satisfactorily than all other textile fibres. It is in very truth the queen of fibres.

Messrs. Blume, Fortune, Belastier, Forbes, and Leclanker, concurring with the modern *savans* Benito, Roezl, and J. Bruckner, affirm:—

(1.) That the fibre of the ramie is stronger and more resisting than the best European hemp.

(2.) That the fibre of the ramie is 50 per cent. stronger than the best Belgian flax of the Lys.

(3.) That the fibre of the ramie can be spun to a finer quality than flax, and that it wears better and is more durable.

(4.) That the plant grows more easily and produces fibres more abundantly than any other textile plant.

Roxburgh established the fact that, notwithstanding their fineness and brilliancy, the fibres of the white nettle excel all others in strength. Royle declares that—

| | |
|---|---|
| If the strength of hemp is represented by ... | 160 |
| The strength of aloes will be ... ... | 190 |
| And of the white nettle ... ... ... | 280 |

The following results have been obtained by experiment with fibres not twisted:—

| | |
|---|---|
| Strength of the hemp of St. Peterburgh ... | 160 |
| Ditto fibres of Yakka ... ... | 175 |
| Ditto „ Yerkum ... ... | 190 |
| Ditto „ of the white nettle of China... | 250 |
| Ditto „ „ „ of Assam | 310 |
| Ditto Assam (wild) ... ... ... | 343 |

The fibres can be bleached as well and as rapidly as flax and cotton, while they have in addition a brilliancy and a lustre which will be vainly sought for in flax or cotton. The tissues of China-grass in this respect surpass by far the silk called *organsin*.

The fibre of the white nettle, or China-grass, or rhea, has long been used in India as material for weaving. So early as in the reign of Queen Elizabeth in England, Lobel, the botanist, relates that in Calcutta the people manufactured from the fibres of a species of nettle a very fine and delicate tissue. Later on, these fine cloths were imported into Europe. The importation was principally from Java to the Netherlands, where the cloth was in great vogue under the name of Neteldoek to indicate its origin. In fact *netel* means nettle, and *dock* tissue. From that time attempts have been made, and with success, to imitate with fine flax the beautiful tissue of the ramie, of which it is but a counterfeit. But the counterfeit never had the lustre nor the body of rhea cloth. To maintain the counterfeit, the name of Neteldoek was preserved for the flax cloth, and this name has been perpetuated for the delicate tissues of flax which are manufactured in Belgium and Holland.

The Chinese and the Japanese manufactures of beautiful piece-goods with the fibre of the ramie, are known by every one.



Shanghai and Hankow are the ports of exportation. The Chinese use the fibre to manufacture a cloth extremely light and fine, which they wear during summer. It is principally manufactured in the south of China.

The exportation of China-grass, during the last few years from Shanghai has generally resulted in loss to the exporters, but continental manufacturers have begun to find a special use for this staple, and to import large quantities. According to the report of the Belgian Consul at Shanghai, the fibre, which is despatched in its raw state from China, is divided into two classes, the raw white China-grass, and the raw green China-grass. The average prices paid in Shanghai in 1863, 1864, and 1865, were from 8 to 14 *taels* per *pecul* for the white kind, and from 6 to 9 *taels* per *pecul* for the green kind. A *pecul* is equal to 135 pounds avoirdupois, or 100 *catty*, and a *catty* is equal to 1 pound and 40 ounces.

The white China-grass is the same as the green, but the white is a little better retted, which is the only difference. The accounts rendered by the Belgian Consul at Shanghai fix the price of the material at £80 per ton, delivered in London. In England, chiefly in Bedford and Wakefield, China-grass is spun on machines for spinning wool, corresponding in fineness to Nos. 100, 150, and 200 of flax fibre. It is complained that the thread has a little too much down on it, which detracts from the beauty of the tissue manufactured with it in imitation of silk. Material for dress-making is manufactured at Bedford, with the warp of cotton and the woof of China-grass. This stuff is made of all colours and shades, and of various designs. Monsieur Duesberg, the ex-director of the flax factories, Brussels, has discovered the means of spinning the fibre on flax frames, with cold water as readily as the best flax.

According to Roxburgh, the first three bales of ramie fibre imported to England were shipped from Sumatra, in 1810, where the first experiments were made. At the London exhibition of 1851, there were several specimens of fine tissues made from the fibre of this nettle; indeed the tissues were so remarkable that several of the contributors obtained medals. Marshall's filature, Leeds, received some of these fibres for experimental spinning, and at that time estimated their value at £48 to £50 per ton raw. Marshall at times has spun the fibre of the ramie up to 1,200 twists at once. Other filatures also spin this fibre; at Wakefield, Halifax, Leeds, Lisle, Rouen, and other English and continental towns.

The fibres of the nettle have been utilized from very ancient date in the Himalaya mountains, as is proved by passages in the ancient poetry of Ramayana and in the verses of Kalidas, where mention is often made of the nettle-cloth, which is praised in these passages for its beauty and fineness. The ramie is a perpetual plant. Contrary to hemp and flax, which must be sown annually, the roots of the ramie never perish, but become year by year stronger, and more productive. The ramie throws out rapidly tufts of stalks, which grow from 3 to 14 feet high, according to the climate and soil. The stalks greatly resemble those of the hemp, but with this difference, that each stalk of the hemp is an entire plant of itself, whereas each root of the ramie throws out several stalks, forming a bush or tuft, which grows all together. The stalks of the ramie grow to a height of 13 feet in the Punjab, and in Bengal along the banks of the Ganges? they also grow well to a height of four-and-a-half feet near Ghent, but the plant does not flower in the north of Europe. The cultivation of the ramie requires less care and labor than that of cotton or flax, while, at the same time, it can resist great variations in the temperature of the seasons. It is only necessary to cut its stalks down to the ground when being perpetual, it grows again like the water willow.

The ramie propagates itself in meridional Asia. It can be propagated by seedlings and by cuttings, but more generally and preferentially by dividing its roots (which form and multiply each year), which produces the most robust and profitable plants. In inter-tropical countries, the ramie yields on an average from three to five crops yearly, obtained by simply cutting the stalks down to about four inches from the ground, whenever they attain the height of from three-and-a-half to four feet. The plants immediately throw out new stalks, more vigorous, and in larger numbers than those first cut. Experience has established the fact that the fibre of the second cutting is superior to that of the first, and that it is preferable to cut the stalks before the plant flowers, to obtain a finer and softer fibre.

The plant is never destroyed or attacked by caterpillars, or other insects, owing to the quantity of tannin which the bark contains; as tannin slightly concentrated, is poison to nearly all small vermin of the inferior parasite kingdom. The plants hold good for years, their roots becoming stronger yearly, their stalks stouter and more robust. The ramie does not suffer during the rainy season. It survives equally long droughts, without suffering appreciably. Snow alone harms it. Blume, the botanist, observes that it grows best on lands well ploughed or dug up, in damp soil, and in the shade, and more luxuriantly in valleys than on hills. Land suited for prairies, or for the cultivation of flax, are also best suited for the cultivation of the ramie. It is certain that the ramie grows more readily in light and sandy soil, well worked and sufficiently shady; but according to Mr. Bruckner, the plant will grow anywhere and everywhere.

The annual yield of fibre which the ramie produces per acre is five or six times greater than the quantity which the cotton-plant produces in the best seasons and in the most favorable climates. Mr. J. Bruckner, of New Orleans, estimates, that each cut of the ramie, after the plant has attained the height of from three to four feet, produces 600 to 800 pounds of retted-disintegrated fibre per acre, when the retting and disintegration is carried on skillfully.

This would be a very good return even in countries where only one crop could be obtained, considering that even this return exceeds the average return which the flax-plant yields in fibre for each crop. But Mr. Bruckner adds that in the fertile soils of Louisiana, of the Mississippi, of Alabama, Texas, in Georgia, and of South Carolina, the ramie can easily be made to yield three or four crops in the year. Now, this far exceeds the production of cotton or any other description of textile plant; and Mr. Edouard Nicolle of Jersey affirms that in his ramie plantations he obtains annually at Jersey



three crops, or a total produce of 11,250 pounds of raw fibre, or bark separated from the centre wood of the stalks; and in addition to this 6,750 pounds of dried leaves, which are very fibrous and an excellent material for paper making. The value of the leaves, he says, covers the expense of cultivation. According to Mr. Nicolle, 11,250 pounds of raw and dried fibres produce about from 5,000 to 7,875 pounds of fine fibre ready to be combed out and used in filatures.

After confirmatory experiments which the author has made in this matter, he is of opinion that it may be estimated that when the ramie plant produces 5,000 pounds of raw or half retted and dried bark yearly per acre, it will lose, after a first thorough retting, about 30 per cent. in weight, and will return about 3,500 pounds of fibrous bark pretty well cleaned by a first operation, that is to say, cleaner than is sold in the commercial marts, and better disintegrated than in the state in which it is imported from China.

This bark, retted only for the first time, is, it is asserted, worth about four-pence per pound, and is sold in commerce at six-pence per pound. After a second thorough retting, the bark loses again 10 to 20 per cent. in weight, and as much in the bleaching, combing, and softening processes which are indispensable. Five thousand pounds of raw fibre per acre will, therefore, after the first retting, produce about 3,500 pounds of fibre; after a second retting will leave about 3,000 pounds, which, after bleaching, will leave about 2,500 pounds. Thus 5,000 pounds of the raw bark produced on an acre of ground loses about 50 per cent. in the process of preparation for the loom.

The fibrous bark half retted and sold at three-pence per pound only, would return about £60 sterling per acre. This is a much larger return than is yielded by the cultivation of flax or hemp in the most favorable seasons.

The cleaned fibre, bleached and ready for the loom, would cost four-pence per pound, plus the cost of retting and bleaching, which would come to about two-pence per pound, so that the total cost of the fibre would be six-pence per pound; and in this state the fibre is superior to the best flax of Lys which is sold at one shilling per pound. China-grass, prepared and bleached, sells at three shillings to three shillings and six-pence per pound.

According to Dr. T. Tornidge, an analysis of the fibre of the ramie shows it to be composed of the following parts:—

| | |
|---|---|
| Potash ... ... ... | 32·37 |
| Soda ... ... ... | 16·33 |
| Lime ... ... ... | 8·50 |
| Magnesia ... ... ... | 5·39 |
| Oxyde of iron ... ... ... | ...... |
| Chloride of sodium ... ... | 9·13 |
| Phosphorus ... ... ... | 9·60 |
| Sulphur ... ... ... | 3·11 |
| Carbon ... ... ... | 8·90 |
| Alumina and silica ... ... | 6·60 |
| Total in parts ... | 100·00 |

From this analysis we might foretell with certainty that it is a plant which exhausts the fertility of the soil, like the hemp and flax; and to obtain an equally abundant crop each year on the same soil, it is necessary to restore to the soil by way of manure what its cultvation has taken away.

Nitrate of soda, or *natron*, sea-salt and lime, will be the elements which must, in preference, be introduced into the soil in ramie plantations, as the most appropriate to this cultivation. The land intended for ramie plantations, should be a light and well-manured soil, and well ploughed. It is, moreover, indispensable that the land should have a good sub-soil, because the ramie throws its roots downwards, like the flax, to a depth of 12 or 14 inches. The lands best suited to the cultivation of flax, will also be the lands best suited for the extensive cultivation of ramie.

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## RETTING AND GRINDING.

Dr. Henly, who devoted much time and attention in India to the means of developing the cultivation of China-grass, declared that the people were apathetic, and confined themselves, to the cultivation of jute which is a textile plant of little value, and which cannot outlive the smallest continued action of water. The cause of this, he said, is explained by their ignorance of processes for disintegrating the fibre of the ramie. An Indian can daily turn out about 112 pounds of jute fibre, whereas the same man would not find it possible to turn out more than three pounds of ramie.

The fibre of the ramie is analogous to that of the flax and hemp; the fibres are similarly attached to the wood of the stalks, and adhere to one another with a gummy-resinous and albuminous pith or sap, resembling *caoutchouc*, which can only be dissolved completely by means of fermentation when the process is performed in the manner the author describes.

Dr. Jules Lemaire has proved that fermentation is not a chemical reaction arising from a simple molecular attraction, but on the coutrary, that alcoholic, acetic, or putrid fermentation, no matter at what stage, is produced by the vital action of infinitely small insects, quite visible with the solar microscope which he calls "ferments."

These insects cannot live or multiply except at the temperature at which other insects exist.

To obtain fermentation, it is necessary to have—

(1). A fermentescible nitrogenous matter, such as gluten, which exists in all vegetable saps.
(2). Water in sufficient quantity.
(3). Contact with air.
(4). A suitable temperature.

In the retting of fibres, the only one which is useful, is acetic fermentation.

But the contact with air and the large quantity of gluten and of nitrogenous gum contained in the sap, causes the ordinary acetic fermentation to degenerate into putrid fermentation, owing to the causes above indicated. This last fermentation is superfluous, and has the disadvantage of emitting a very offensive odour from the escape of ammonia and hydrosulhuretted acid.



After numerous experiments the author has been able, on principle, to establish the fact that carbon, sulphur, and clay, or, in lieu of the latter, alkaline salts such as chalk, used in proportionate quantities, possess the property of maintaining the action of retting to acetic fermentation, and of avoiding putrid fermentation and the offensive odours which empiric retting emits.

To arrive at this result in practical experiments, it is necessary to guard against the loss of the chemical agents used in the operation, which would inevitably occur if the operation were carried on in running streams.

It is, therefore, necessary to carry on the operation in reservoirs or in masonry vats, in which the fibrous matter can be retted. If these vats can be covered with planks, or folding doors, so as to prevent the direct contact of air in the bath, so much the better.

Pulverized sulphur should be boiled with soda, clay, or lime in a vat by means of a serpentine tube in order to obtain alkaline polysulphurets. A small quantity of this alkaline polysulphuret (about ½ to 1 per cent. of the weight of the stalks to be retted) should be put into the retting bath. An equal quantity of finely powdered charcoal should be added. By these means at comparatively trifling cost and with less water than otherwise, retting succeeds even with water not of the very best, as the salts which it contains are neutralized by the agents employed. To ret rapidly it is only necessary to keep the temperature of the bath at 25 degrees by means of tubes heated with steam or with any apparatus for heating water.

The ingredients, which are added to the bath, cause the retting to progress rapidly, and as the alkaline sulphurets, absorb the products arising from fermentation, the water remains comparatively cleaner, and fermentation progresses regularly and without inconvenience. To carry on the operation on a large scale, the simplest way would be to construct the vats one after the other, in a long rectangle divided into compartments of about six feet square, and six feet deep.

This mode of retting has the double advantage of furnishing manure for the soil with the water used for retting, which has little or no stench; and will restore to the soil a large proportion of the elements withdrawn from it by the plants.

The water from the vats has a slightly sour smell, the natural result of acetic fermentation, but it is not disagreeable. To reduce it to poudrette, it is only necessary to allow the water to run out into cisterns, and to add a little lime which will precipitate the metallic salts

It would then remain to pump or draw out the water from the top after 24 hours standing, and collect the poudrette from the bottom. The natives of Java are absolutely ignorant of the manner of destroying by fermentation the gluten by which the fibres adhere to each other as in hemp. After dividing the stalks into two parts by a cut, they remove the bark from which they remove the epidermis and adhesive portions by scraping the bark with a knife until the fibrous pellicles begin to appear. This substance is white, with a slight shade of green. They content themselves with washing this substance several times in water and then dry it: but this manipulation is not sufficient to remove the glutinous matter which adheres to the fibres, and which in the ramie is similar to *caoutchouc* and to the resinous matter of the flax.

The new Belgian grinder can turn out from 2,000 to 3.000 pounds of ground flax per diem. The bruising and grinding are so th roughly performed that the flax in being turned out is three-fourths separated from its husk, by which it loses upwards of half its raw weight which falls to the ground in the shape of pounded straw. It is then necessary only, to administer a few strokes with a mallet to remove from the fibre the last remnants of straw which still adhere to it. But this is not all. The bruising of the stalk destroys also the gummy substance which causes the fibres to adhere to each other, and renders the quality of the flax finer and of greater value. The fibre thus worked becomes soft and silky without losing any part of its strength.

# PREFACE.

AMONG the numerous plants which Providence has sown liberally over the surface of the universe, there are divers textile plants of so much usefulness and so many social resources, that they deserve to be examined and mentioned separately.

Of this category there is reason, I think, to place at the head, the White Nettle (*Ortie Blanche*), about which I write in this pamphlet. Let us once more recall the truth that the study of these plants shows incontestably the Divine kindness towards man, His privileged creature; because it is for the benefit of mankind that all these marvellous productions were created. Their delicate and splendid structure, their peculiar vitality, and the regular organization which distinguishes them, as well as their varied products, are well calculated to increase our admiration for and our profound gratitude to the Creator who has placed these gifts at the disposal of man during his short exile here below.

Let us then endeavour to extract the best we can from these plants, which are so productive and so useful.

THE AUTHOR.

# INTRODUCTION.

For some years past Europe has been annually importing tolerably large quantities of the fibre of the white nettle, known under the names of Ramie, Rhea, or China grass. Now this alone would prove to us at once that there exists an outlet for this fine and glossy textile fibre. It will not therefore be unprofitable to study and explain the qualities of the plant which so plentifully produces this beautiful fibre, superior in its merits to the finest flax when it has been separated from its stock in a proper manner. This robust and productive textile plant, which is grown and manipulated into fibre so easily, may be cultivated with facility in all localities to a greater or lesser extent. In fact, it is reared and manipulated somewhat like the flax, and without any serious difficulties. It produces a magnificent fibre in abundance, and its culture can yield the finest results in agriculture as well as in industry, as I shall explain further.

If, generally speaking, the public mind has yet occupied itself so little with the profitable results that might be obtained by the culture of China grass, as a substitute for silk and wool, it is simply because up to this time few persons have obtained precise information about this plant and about the practical means of utilizing it, as the little that is known on these points is most frequently erroneous, incomplete, vague, and incorrect.

In fact, as far as I am aware, there does not exist up to this time any general or complete note on this textile, or any sketch which exhibits at once the vital temperament of the plant, the rational mode of its cultivation, or any indication as to how to utilize profitably its excellent fibres. All that has yet been published on the subject is very incomplete; it remains, therefore, to collect and collate all that has been fragmentarily observed on the subject.

Within the last few years, under a colligation of peculiar circumstances, I found myself in possession of several interesting papers on this plant; some from America and others from Europe. I have grouped together these various indications, and the result is this little work, which proves by evidence, it seems to me, the great agricultural and industrial value of the white prickless nettle (*Ortie Blanche sans dards*), and the great omission we have been guilty of by neglecting up to this time to devote a much larger share of our attention to it.

The short Notice by Mr. J. Bruckner of New Orleans has, among other papers, been of unquestionable use to me, because it shows more precisely the best mode of cultivation on an extensive scale of the Ramie plant, or China grass—a point which the majority of other writers have either ignored or passed over in silence.

I believe, therefore, to be doing a useful work in publishing the present pamphlet, having regard specially to the important place which Ramie will hold, before many years pass over, I believe, in the general system of agriculture in the south of the United States of America, and perhaps even in Europe.

I have collected together here the various particulars I have obtained on this subject, and I supplement and complete this information with a few theoretical and practical observations on the steeping and retting of fibres, based on study and numerous experiments which I have made on this ungrateful matter for many years. The explanations which I append at the end of this pamphlet, specially on the subject of retting, will prove to be of some utility, I have no doubt, when I come to consider the false and chimerical ideas which most persons concurrently hold in regard to the rational means which should be employed to ret and disintegrate textile fibres.

My pamphlet will then, I hope, serve as a guide to persons who desire either to occupy themselves or to instruct others in the cultivation and rational utilization of the white prickless nettle, which, during the last few years, has drawn upon itself the attention of some botanists and distinguished manufactures who, like myself, are inclined to believe that it will perhaps some day become, to the same degree as cotton now actually is, one of the pivots of the industry of filatures and weaving in general.

Because, when the Ramie becomes more appreciated, there will perhaps be, before many years pass, a great agricultural innovation in some countries suitable for its cultivation on a large scale, and the result may be then that the white nettle will, to a great extent, be a substitute for flax and cotton. The extended cultivation of the Ramie will so much the more easily allow of this partial substitution, as its cultivation, in the first place, offers really considerable advantages, owing to the enormous return of fibre which this plant produces, and to its superior quality, besides the possibility and extreme facility of cultivating it more or less universally. (*Vide* the detailed description of the plant hereafter given.)

Botanists, to begin with Linné, have designated the Ramie *Urtica Nivea*, or, in French, *Ortie Blanche sans dards de Chine*, seeing that it really belongs to the large family of nettles (*Orties*), and that its cultivation is mainly in the south of China.

Dr. Roxburgh, who was deputed at the beginning of the present century to make experiments in India with certain textile plants, devoted great attention to this remarkable plant, and designated it *Urtica tenacissima*, because he found that its fibres were the strongest of those he had experimented upon.

Gaudichaud, having regard to the convenience of distinguishing by a distinct name the varieties of the perpetual and prickless nettle (*Orties perpetuelles et sans dards*) from the other annual nettles (*Orties annuelles*), gave, in this view, to this textile plant the name of *Bœhmeria*, so that now the real botanical name of the Ramie is *Urtica Bœhmeria Nivea.*



*Urtica Bœhmeria Nivea* is of Chinese origin, and the back of its leaf is perfectly white, that is to say white with green veins, and the leaves and the stocks are very robust and strong. When the stock comes to maturity, it assumes a reddish brown hue, somewhat of the colour of blood.

Haskrall carefully distinguishes it from the different varieties known at Java, as the most precious among the prickless nettles (*Orties sans dards*) which produce such excellent fibre. It is for this reason that he designates the best species of Chinese origin by the name of *Bœhmeria Sanguinea* in contradistinction from another species of this plant of Indian origin which is called *Bœhmeria Candicans* (the word *candicans* in Latin signifies whitening). The stalks of the second species when mature are not of the same deep blood-red colour as the *Sanguinea*.

Moreover, the species called *Bœhmeria Candicans* is also held in high estimation in Java, of which country it seems to be a native. That which distinguishes the *Bœhmeria Candicans* from the *Bœhmeria Nivea* or *Tenacissima* or *Sanguinea* is, that the leaves of the *Nivea* are all white with green veins, whilst the leaves of the *Bœhmeria Candicans* are green, lightly veined with white, or precisely the opposite style to the *Nivea.*

I have at my residence two young and strong plants of the two different species, and it appears to me that the *Nivea* is the more robust and vigorous of the two in every respect.

In commerce, the two species are generally confounded, and are known under one single general name either as *Ortie Blanche* or Ramie, or, as in British India, Rhea, or, as in England, by the whimsical name of China grass, notwithstanding that this is a plant of high forest wood, a strong tree, having at least as much stalk and being as high as the hemp plant. As these two species are generally called in the localities of their production in Java, and Malay, as well as in Mexico, in New Orleans, and in the United States by the name of Rameh or Ramie, I think it well to preserve this nomenclature, which, in my opinion, has the advantage of being the shortest among all other synonymous names used. The more so because it is the Indian name, and the one already used in countries where its cultivation has for the present the greater chance of becoming before long extended to a considerable degree.

The Ramie or China grass is a textile plant greatly spread and much estimated throughout Asia, but less generally known in America. And yet within the last few years its cultivation has been to a small extent introduced everywhere. Latterly the *Urtica Bœhmeria Candicans* species of Java was introduced into Mexico as a cultivation by Don Benito Roezl, of Santo Comopan, in Mexico; and into the United States by M. J. Bruckner, of New Orleans. At Melle, near Ghent, it has been cultivated for upwards of ten years in fields in the establishment of the Messrs. Josephites.

Mr. Charles Blume son of the celebrated botanist, inspector of forests in Java, has written to me saying that he proposes to form at

Java a company for the cultivation on a large scale of this textile plant and to export to Europe the prepared fibres for the filatures. Dr. Herman Grothe, at Berlin, and M. F. J. Rief, at Prague, have also written to me that their attention is specially engaged in spreading the cultivation of Ramie in Europe. The same may be said of Mr. Edouard Nicolle, a retired French officer, who resides in the Isle of Jersey, where he has an extensive cultivation of the white nettle (*Ortie Blanche*).

## GENERAL DESCRIPTION AND THE USAGES OF THE FIBRES OF THE RAMIE.

THE stalks of the Ramie, just like the stalks of flax and hemp, contain in their bark large quantities of fine and strong textile fibres of great length. These fibres, when properly and thoroughly disintegrated, are longer, stronger, finer, and more glossy than the finest flax; they have the brilliancy of silk; are finer than the beautiful Sea Island cotton; and, moreover, the fibres of the Ramie can be bleached and dyed more easily and more satisfactorily than all other textile fibres.

It is in very truth the queen of fibres, by reason of its excellence and its numerous superior qualities. The Ramie, or *Ortie Blanche sans dards*, is a perpetual plant; that is to say, contrary to hemp and flax, which must be sown annually, the roots of the Ramie never perish, but become year by year stronger and stronger, and more productive. The Ramie throws out rapidly tufts of stalks which grow from three to 14 feet high, according to the climate and soil. The stalks greatly resemble those of the hemp, but with this difference only, that each stalk of the hemp is an entire plant of itself, whereas each root of the Ramie throws out several stalks, forming a bush or tuft which grows all together.

The Ramie belongs to one of the tribes of the large family of *Urticeæ*. It is a plant with upright stalks and alternate leaves.

Its leaves bear three principal ribs; the two lateral ones are marginal in the lower part, and strong and smooth at the top, but below are covered with a thin down of a grey colour.

The flowers of the Ramie are unisexual; that is to say, they contain the organs of only one sex: they are also monœcius; that is to say, on each plant there are, at the same time, flowers that are each distinctly male and distinctly female.

In hot climates, of which place the Ramie is a native, it blossoms in September and October. The flowers are greenish, having small globular heads, which group together in axillary panicles.

The male flowers have a calyx containing four or five divisions in monopetalous corollas bearing staminæ in varying numbers. The female flowers have a single ovary, with a single cell containing a simple stigma closed in an involucrum; the fruit and seed separate, and the embryo closed in an endosperm.

The stalks of the Ramie, which grow to a height of 13 feet in the Punjab and in Bengal along the banks of the Ganges, also grow perfectly well every year to a height of four and a half feet in the garden of the Messrs. Josephites in Mello near Ghent, but the Ramie does not flower in the north of Europe.

Flowering, however, is not an indispensable condition for the cultivation of the Ramie, or for the beauty of its fibres. On the contrary, wherever the Ramie is grown for its fibres, it is advisable to cut the stalks before the plant produces flowers. The cultivation of the Ramie requires less care and labor than the cultivation of cotton or flax, while at the same time it can resist variations in the temperature of the seasons. It is a plant which is not sown yearly; on the contrary, it is only necessary to cut its flower stalks down to the ground, and being perpetual, it grows again like the water willow; that is to say, like the water willow when its stalks are cut, it throws out fresh stalks in larger numbers.

The stalks of the Ramie have, in every respect, at first sight, a great resemblance to the stalks of the hemp, but the latter is a plant which must be sown every year, whereas the Ramie is perpetual, and when its stalks are cut, fresh stalks grow at once in larger numbers; this is not the case with the hemp or flax plants.

The Ramie propagates itself in its native countries in meridianal Asia. It can be propagated by seedlings and by cuttings, but more generally and preferentially by dividing its roots (which form and multiply each year), which produces the most robust and profitable plants.

In intertropical countries the Ramie yields on an average from three to five crops yearly. Crops are obtained by simply cutting the stalks down to about four inches from the ground whenever they attain the height of from three and half to four feet. The plants immediately throw out new stalks, more vigorous, and in larger numbers than those first cut.

Experience has enabled us to establish the fact that the fibre of the second cutting is superior to that of the first, and that in every instance it is preferable to cut the stalks before the plant flowers and before it is completely mature in order to obtain a finer and softer fibre.

The Ramie is never destroyed or attacked by caterpillars or other insects, owing to the quantity of tannin which the bark contains. Now tannin, slightly concentrated, is poison for nearly all small vermin of the order of the inferior parasite kingdom. It is for this reason that the bark of the oak is more respected and shunned by insects of of all known kinds. This existence of superabundance of tannin in the bark of the Ramie, the oak and hemp, &c., is such as to drive away all caterpillars and other vermin from the neighbouring plants. It is even alleged that a few grains of the oak seed sown at intervals of three or four feet among vines suffices to destroy insects, as the smell alone of the tannin is a poison for the animalculæ which produce, promote, and develop the disease of *oidium*.

The annual yield of fibre which the Ramie produces per acre is five or six times greater than the quantity which the cotton plant produces in the best seasons and in the most favorable climates.

The Ramie, says Mr. J. Bruckner, will therefore powerfully contribute to increase prosperity to a greater degree in South America, where the soil is so marvellously fertile and so well suited to this great



cultivation. Already, he adds, the Ramie which has only been introduced a short time ago in New Orleans, is giving birth to a hope that it will, in a few years, be exported as profitably as cotton.

The Ramie once planted, has, like the water willow, the advantage (I have pleasure in repeating) of not requiring to be replanted each year. The plants hold good for years, and their roots becoming stronger and stronger yearly, their stalks grow stouter and more robust. The Ramie does not suffer during the rainy season. It survives equally long droughts without suffering appreciably; snow alone harms it.

The Ramie, which has been known and utilized throughout Asia for centuries, has been recently acclimatized in Louisiana and the country along the Mississippi. Its cultivation henceforth seems certain and assured in all countries in which cotton is cultivated, and where the people are given to the cultivation of textile plants.

Blume, the botanist, observes that this plant grows best on lands well ploughed or dug up, in damp soil and in the shade, and consequently is more luxuriant in valleys than on hills. Lands suited for prairies or for the cultivation of flax are also best suited for the cultivation of the Ramie. In a further chapter will be found copy of a manuscript memoir which this *savant* offered some years ago to several Governments in Europe, but which has unfortunately remained a dead-letter.

The Ramie is propagated chiefly by cutting from the older plants the young lateral shoots with their roots. These young shoots are then planted to a depth of 3 inches in ploughed or dug soil at convenient distances one from the other, as will be indicated more precisely further on.

The propagation of the Ramie can also be carried on as rapidly by means of layering, which is done by laying in the ground at a depth of three inches young stalks or branches which are fixed in the ground by means of small wooden hooks, and covered with earth at intervals, care being taken to strip off the leaves from the parts which will go under ground, and to straighten the parts which remain above.

The parts covered with earth soon take root, and then each portion which has taken root may be cut into sections, by separating the parent stalk from it as well as from the adjacent plants by means of a thin knife. Thus, a number of new plants are obtained all along these sections. By proceeding with care and skill each plant may be multiplied annually a hundred-fold at pleasure just as rapidly as by sowing.

The Ramie can also be propagated by the most simple means of cuttings, which consists of dividing branches having several knots or eyes into small stumps, and laying them under ground to take root. This operation can be performed after the cessation of snow, and at any time in spring or summer, but preferentially in June or July, as the young plants are most sentitive to the cold, which causes them to perish rapidly. Another mode of propagating is by sticking into the ground cuttings or fragments of stalks; only in this case, care must be taken to water them every day with rain-water to facilitate the formation of roots, and to provide against the cuttings drying up and withering for want of humidity before the roots are formed.

In the course of fifteen days these cuttings develop rapidly, especially if the weather is favorable and warm. It is advisable to plant these cuttings in heather lands, covering them with a glass dome at night, or in a hot-house in the shade until the roots are formed, and the cuttings have turned into plants, and have become therefore stronger and more capable of weathering out the unforeseen inclemencies of the seasons. Frequently these cuttings, like the seeds, have the misfortune of not producing strong plants in the very first year, and it is for this reason that the division and distribution of the roots as well as the layering of new shoots are, and will remain, the best mode of propagation, and the most sure to produce immediate and productive results without involving great labor.

The Ramie, when it has completely taken root, does not suffer from moderate falls of snow in winters following, but in countries where the winter is intense and the snow severe, it is absolutely indispensable that the roots of the plants should be secured against the action of the snow; and this operation is so much the more easy as the roots of the Ramie naturally grow from 12 to 14 inches deep, especially when the soil has been well ploughed. At this depth the roots are already sufficiently secure from the intense cold; and this security is enhanced and completed by means of planting the plants in rows at regular distances, as it then becomes easy to cover them by the end of autumn, that is, before winter, with a few inches of earth, as is done in the case of hops.

The number of times the stalks can be cut each year naturally varies according to the climate and soil. Only one or two crops can be had in the north of Europe, two or three in Italy and in the south of France, four or five in Algeria and south America, &c. It is evident that a well cared for and properly manured soil would have a great influence over the development and production of this plant.

Mr. J. Bruckner of New Orleans estimates, according to his own personal experience, that each cut of the Ramie, after the plant has attained the height of from three to four feet, produces 600 to 800 pounds of retted-disintegrated fibre per acre, when, of course, the retting and disintegration is carried on skillfully.

This would be a very good return even in countries where only one crop could be obtained, considering that even this return equals and exceeds an average return which the flax-plant yields in fibre for each crop. But Mr. Bruckner adds that in the fertile soils of Louisiana, of the Mississippi, of Alabama, Texas, in Georgia, and of south Carolina, the Ramie can easily be made to yield three or four crops in the year. Now this far exceeds the production of cotton or any other description of textile plant; and Mr. Edouard Nicolle of Jersey affirms that in his Ramie plantations he obtains annually at Jersey three crops, or a total produce of 11,250 pounds of raw fibre or bark separated from the centre wood of the stalks; and in addition to this 6,750 pounds of dried leaves, which are very fibrous and an excellent material for paper-making. The value of the leaves he says, covers the expense of cultivation. According to Mr. Nicolle, 11,250 pounds of raw and dried fibres produce about from 5000 to 7,875 pounds of fine fibre ready to be combed out and used in filatures.

It is certain that the Ramie grows the more readily in light and sandy soil, well worked and sufficiently shady; but according to



Mr. Bruckner, this plant is so vigorous that it will grow anywhere and everywhere.

When the stalks of the Ramie have been sufficiently retted the fibres are perfectly white, soft, fine, and lustrous like silk. Moreover, it can be combed out just like flax or wool, that is to say, with the same implements.

The Ramie, or *Urtica Bœhmeria* or *Ortie Blanche*, belongs, as its name *Bœhmeria* indicates, to the family of perpetual prickless nettles. As a plant, and to the view, it resembles, as I have stated before, the hemp plant, which also belongs to the family of nettles.

The Ramie grows in upright stalks like the hemp, and of the same thickness; it attains a height of three to four and a half feet, according to the climate and soil in which it is cultivated.

Cattle are very fond of the green leaves of the Ramie, which are extremely nutritious, and their nutritive properties are increased three-fold and more by allowing them to ferment in a closed vat containing yeast and water; while again, the leaves when dried serve to make paper of excellent quality.

The bark of the stalks is greenish during the growth of the plant, but it becomes brown, harsh, hard, and ribbed in ripening.

The Ramie has a number of synonymous names in the different countries of which it is a native, and where it grows wild. It will suffice here to note the principal names.

Sir George Stanton, Dr. Ulliek, and Sir William Hooker, all three affirm that the plant which has been called by Linné *Urtica Nivea*, is very certainly the same as that called in China *Schou* or *Schu*, from whence is derived the word *Schou-Ma*, which means fibre of the *Schou*. In Japan it is called by divers synonymous terms, such as *Tija*, *Siri*, *So*, or *Mao*, or *Karao*, or *Akaso*. In Siam and Sumatra it is called *Klooi* or *Caloee* or *Ghoni*.

In the Malayan Islands it is called *Rameh* or *Rami;* in Java the species of Chinese origin is specially designated *Rami Sanguinea* by reason of the brown shade of dried blood which the bark assumes when mature; and the other species of Indian origin is called *Rameh Candicans*. In the Marian Islands, East Indies, the name given is *Sidziafi;* at Bonoa, *Inan;* in Nepal, *Poah;* in the Celebes Island, in Gambia, and in Bengal, it is called *Kankhora* and *Gâmb*. In the province of Assam it is called *Rhea;* in the island of *Sound* its name is *Keperit* or *Kapierit;* in the Réunion and in the Martinico it is known under the name of *Urtica Sinuata*.

Decaisne, like other authors who have written about this plant, affirms that there are two principal species of the Ramie, or *Urtica Bœhmeria*, or China grass: the first is a native of Java and of the East Indies, the back of the leaves of which are of a greyish green with white veins, and which seems to be the species known in Java under the name of *Urtica Candicans;* while the other species is of Chinese origin, that is to say, the *Nivea*, the back of the leaves of which are perfectly white with green veins.

This is the general difference at once perceptible between the two species (*vide* note at end), which are held in equally high estimation.

Experience and comparative experiments will decide for the future which of the two varieties offers the greater advantages in cultivation, and produces the finer and the greater quantity of fibre. I am, however, inclined to believe that there is little or no difference in the merits of these two species, and what strengthens and supports my belief is that almost all botanists confound the two, and most frequently speak of both as one and the same plant. Nevertheless, according to Hasskarl and Junghuhn, the best and principal species of Ramie is the native of China; that is to say, the *Nivea*, known by the Javanese under the name of *Urtica Bœhmeria Sanguinea*, the back of the leaves of which are white with green veins. Now, this plant is really the same as that described by Blume as *Bœhmeria Utilis* or *Urtica Nivea*; while William Hooker, who has equally given his attention to this subject, confines himself to assert that the *Urtica Bœhmeria Nivea* is most positively the species cultivated and so highly valued in China, and that it was introduced from Ningpo into Calcutta by Doctor MacGowan. There are several healthy plants of these two principal species in the Botanical Gardens at Ghent, but it is not known from whence they were imported.

The species of which the leaves are of a greyish green with white veins, and which is a native of Java, *i.e.*, the *Urtica Candicans*, is that species the cultivation of which has been introduced in Jersey, Melle, near Ghent, Mexico, New Orleans, &c.

It may also be observed that there are several other species of the Ramie or white nettle which produce fibres, more or less fine and abundant. But after the foregoing remarks, there is every reason to place above all other species:—first the typical Ramie, or *Bœhmeria Nivea* of China, and in the second place the *Bœhmeria Candicans* to which I have alluded above, that is to say, the native of Java, and of which Royle speaks. It was described by Rumphius under the name of *Raminum majus*.

There is also another, but inferior, species in Java known as *Rameh Goenong* or the Ramie of the mountains; while on the Asiatic continent, in Indian countries, there are several inferior species of Ramie, of which the most known and most abundant is the species called *Bœhmeria Puya*, or *Frutescens*, which abounds in a wild state all over Bengal, in the immense valleys of Nepal, and throughout the plains which border the great streams of the Ganges and Brahmapootra.

It is most remarkable that the natives of Nepal, where almost all species of the Ramie abound, absolutely neglect its cultivation by reason of their profound ignorance of the art of extracting its fibres, while at the same time they confine themselves to the extended cultivation of jute and cotton as textiles, rice and torie as comestibles.

The Torie, it is pretended, is a plant the voluminous roots of which are extremely nutritious, and which is little or not at all known in Europe.



But if what is said is true, it is to be hoped that, as Parmentier has enlightened us about the potato of Peru, some other public benefactor will make us a similar present some day in regard to the Torie; and this would be the more desirable if it is true, as authors pretend that this root is superior to the common potato in quality and yield.

Meanwhile let us assume that besides the abovenamed species of fibrous nettles so justly held in high estimation, there are also other common kinds, the fibres of which are used to a lesser degree in certain countries. These other species of nettles are described by botanists under the following names:—

1. Urtica Heterophylla.
2. Ditto Cannabila (hemp).
3. Ditto Pulcherrima.
4. Ditto Urens.
5. Ditto Dioica.
6. Urtica Tuberosa.
7. Ditto Crenulata.
8. Ditto Virulenta.
9. Ditto Gogliado.

The hop, the fig, and several other plants also belong to the botanical family of *Urticeæ*.

According to J. Delachamp, Pliny, Dioscordes, Hippocrates, and Jahr, the majority of the *Urticeæ* have well-defined medicinal properties, which these authors describe. An experiment was made in Prussia to extract the fibres from the nettle known as *Urtica Urens*. But Dr. Herman Grothe of Berlin assures us that this plant did not produce good results as a fibrous plant. He ascribes the failure to the plant being an annual, and to its growing to a height of one foot only; and, moreover, to the stalks throwing out lateral branches, which inevitably make the fibres short and bad. On the other hand, he says that the other species of common nettle called *Urtica Dioica* produced satisfactory results. This latter is a strong plant which grows to a height of six feet; it grows rapidly and without throwing out lateral branches. He adds, it is retted and manipulated like the hemp and flax. 100 pounds of green stalks, says M. Herman Grothe, will yield 46 pounds of dried stalks; which when reduced to fibre, will produce 32 pounds of coarse fibre or 20 pounds of clean fibre, combed out. After this digression let us revert to the subject of the *Urtica Bœhmeria*, or Ramie.

Attempts have been made for centuries to acclimatize to some extent everywhere the Ramie, which is so highly appreciated, in China, Java, and throughout the Indian Archipelago. These measures might bring about in Europe in a few years hence, changes analogous to those which were spontaneously brought about first by the rapid development of the potato cultivation, then by the introduction of cotton, and lastly by the cultivation of the beet-root, a most precious root, which has liberated us from the necessity of importing sugar from the Western Archipelagoes.

It is well to call to mind that cotton was almost unknown to our ancestors. Now, in a few years, it has assumed a formidable extension in cultivation and consumption.

There is just as much reason to believe that at some time or other the cultivation and consumption of the Ramie will assume a greater and much more rapid extension.

According to Dr. T. Tornidge, China grass, or the fibre of the Ramie, is composed of the following parts:—

| | |
|---|---|
| Potash ... ... ... | 32·37 |
| Soda ... ... ... | 16·33 |
| Lime ... ... ... | 8·50 |
| Magnesia ... ... ... | 5·39 |
| Oxyde of iron ... ... ... | 0·0 |
| Chloride of sodium ... ... | 9·13 |
| Phosphorus ... ... ... | 9·60 |
| Sulphur ... ... ... | 3·11 |
| Carbon ... ... ... | 8·90 |
| Alumina and silica ... ... | 6·60 |
| Total in parts ... | 100·00 |

From the above chemical analysis of the composition of the Ramie, we might foretell with assurance and certainty that it is a plant which exhausts the fertility of the soil, like the hemp and flax. But this is no inconvenience for the educated mind; because to obtain an equally abundant crop each year on the same soil, it is only necessary to restore to the soil by way of manure the component parts of the Ramie which its cultivation has taken away. This is a process followed, among others, in the cultivation of hops.

We can see, then, that manure in general, but more especially nitrate of soda, or *natron*, sea-salt, and lime, will be the elements which must in preference be introduced into the soil in Ramie plantations, because these things are by their constitutive nature the most appropriate to this cultivation, and those that will infallibly yield the most magnificent and fruitful results.

It is asserted that the mode of preparing and enriching the soil for the cultivation of the Ramie, as done in China, was published in France by M. Stanislaus Julien, who resided for a long time in China. I am sorry I have not seen this useful publication. Anyhow, it seems to have been translated into English in the 4th volume of the "Journal of the Horticultural Society of London."

I am, however, eager to give some information here in order to facilitate the enquiries of those who interest themselves in the subject.

Interesting information on the Ramie might equally be found in the review entitled "*Nieuw Tijdschrift gewijd aan alle takken van volksvlijt*," volume II, published in 1860, at Rotterdam, by Professor S. Bleekrode.

It also furnishes some particulars on jute, or *Corchorus Capsularis*, Badoorie or Madar, or the *Calotropis Gigantea* of Madras, &c., &c.

The work on textile plants published by Mr. Decaaus, and printed at Rouen in 1867 by H. Boisel, may also be read with advantage.

According to Mr. Bruckner of New Orleans, in order to produce the Ramie by sowings, the seed must be sown on mild and light soil, and only a little covered over with earth because of the tenuity of the seedlings.

The young seedlings which are thus produced can only be transplanted in the second year. They are then planted out in rows and



spaced out in fields at equal distances of at least 16 inches apart; it will be beneficial to keep the field well aired and cool, and this is done by a second tilthing or light digging during summer, care being taken to remove from time to time the rank vegetation.

The fibre of the white nettle, or China grass, or Rhea, has long been used in India as material for weaving. So early as in the reign of Queen Elizabeth in England, Lobel, the botanist, relates that in Calcutta in the East Indies the people manufactured from the fibres of a species of nettle a very fine and delicate tissue. Later, these fine cloths were imported into Europe. The importation was principally from Java to the Netherlands, where this cloth was in great vogue under the name of Neteldoek to indicate its origin. In fact *netel* means nettle and *doek* means tissue.

It is from that time that attempts have been made, and with success, to imitate with fine flax fibre this beautiful and fine tissue of the Ramie, of which after all it is but a counterfeit. But this counterfeit of flax never had the lustre nor the body of the Ramie cloth. And to maintain the pride of the counterfeit, the name of Neteldoek was preserved for the flax cloth, and this usurped name has been perpetuated up to our days for the fine and delicate tissues of flax which are largely manufactured in Belgium and Holland.

But this sham Neteldoek or cambric made of the flax fibre, still remains a weak counterfeit of the real Neteldoek of the white nettle, because, as I repeat, the fibres of the Ramie are very much stronger, finer, more silky, and more lustrous than the flax fibre.

To prove this, it is only necessary to remember that a sample of the Ramie fibre was sent by Dr. Buchanan to the East India Company in 1811. The Court of Directors sent the fibre to one of the London houses for the purpose of being spun into thread. A cord spun from the Ramie supported a weight of 252 pounds, whereas a cord of the Russian hemp of the same thickness broke or parted with a weight of 82 pounds; and this proves the excessive strength of this incomparable fibre [*vide* the *Technologist*, 1863, page 128].

Moreover, it is sufficiently well known in our days that the Chinese and the Japanese manufacture very beautiful piece-goods with the abundant fibre of the *Urtica Nivea* or Ramie.

This stuff is called in the dialect of Canton *A-pou* (for *Hia-pou* which means summer cloth). It is manufactured in tolerably large quantities in the provinces of Hoonan and Houpe, five or six days' journey from Hankow, as well as on the borders of the lake of Poyang in the vicinity of Kin Kiang.

Shanghai and Hankow are the ports of exportation to Europe. The Chinese use this fibre to manufacture a cloth extremely light and fine which they wear during summer. It is principally manufactured in the south of China.

The exportation of China grass, during the last few years from Shanghai to London as a speculation, has generally resulted in loss to the Chinese exporters, but the continental manufacturers begin to find a regular and special use for this staple. Consequently they import every year very large quantities to Europe. According to the report of the Belgian Consul at Shanghai, this textile, which is despatched in its raw state from China, is divided into two classes, the raw white China grass

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The exportation of China grass, during the last few years from Shanghai to London as a speculation, has generally resulted in loss to the Chinese exporters, but the continental manufacturers begin to find a regular and special use for this staple. Consequently they import every year very large quantities to Europe. According to the report of the Belgian Consul at Shanghai, this textile, which is despatched in its raw state from China, is divided into two classes, the raw white China grass and the raw green China grass. The average prices paid in Shanghai have been in 1863, 1864, and 1865 from 8 to 14 *taels* per *pecul* for the white kind, and from 6 to 9 *taels* per *pecul* for the green kind.

The exportation from Shanghai progressed as follows:—

| | | 1863. | 1864. | 1865. |
|---|---|---|---|---|
| White China grass, *peculs* | ... | 28,784 | 33,026 | 38,453 |
| Green ditto | ... | 4,481 | 16,439 | 19,022 |
| Total | ... | 33,265 | 49,485 | 57,475 |

The white China grass is the same as the green, but the white is a little better retted, which is the only difference. The accounts rendered by the Belgian Consul at Shanghai fixes the price of this raw material at £80 per ton, delivered in London, which is too dear by half to import with profit.

A *pecul* is equal to 135 pounds avoirdupois, or 100 *catty*, and a *catty* is equal to 1 pound and $4\frac{1}{3}$ ounces. The exportation from Shanghai represented in tons would therefore be as follows in round numbers.

| | | Peculs. | Tons. |
|---|---|---|---|
| In 1863 | ... ... ... | 33,265 | 2,000 |
| „ 1864 | ... ... ... | 49,485 | 3,000 |
| „ 1865 | ... ... ... | 57,475 | 3,500 |

We must understand that a great part of the exportation was through the Indian Archipelago, because the importation into London during these years was about 500 tons per annum.

It must be understood that these figures refer to the raw bark of the Ramie not completely disintegrated from the stocks.

In the meridional parts of China, the cloth of the Ramie or China grass is as much valued as silk on account of its coolness and durability.

Now owing to the great value in which the Chinese hold this fibre and the different cloths manufactured therefrom and to the important uses to which they put this produce, I think it improbable that this fibre can ever be imported at cheap rates from China to Europe, and for this reason it is desirable that its cultivation should also be introduced elsewhere than in China and India.

Moreover, the high value and estimation which the Chinese attach to the tissue of the *Tchou-ma*, or Ramie, is only reasonable and legitimate if we are to judge from all that has been said in its favor, and which has been confirmed by different writers.

To cite only one instance, I shall here relate what has been said by the talented and venerable Father Voisin, one of the Superiors of the Seminary of Foreign Missions at Paris. He lived in China for 12 years as a missionary, and one day he showed one of my friends, M. Theodore Mareau DeLaval, a former representative of France, a vestment woven and made in China from the fibre of *Tchou*, Ramie, or China grass; M. Mareau writes to me saying it was a beautiful tissue, very even, of the colour of a crow, manufactured and dyed in China. Father Voisin declared to M. Mareau that this tissue was so strong that frequently, when by constant wear the colour faded, it could



be redyed and worn again. This operation is not performed only once, but is repeated every three or four years, as the cloth is almost indestructible. And this remark is the more striking, because it is well known that the dyes used in China for cloths are of a remarkably durable nature. Indeed Father Voisin adds, that shirts made of the cloth of the *Urtica* or Ramie are so cool that they become inconvenient at certain seasons, whereas, as summer wear, if it can be stated that wool is warmer than cotton, and cotton warmer than flax, I may add that flax is warmer than the Ramie.

This last bit of information is useful, inasmuch as it indicates by what mixture certain cloths can be made to suit special uses.

The Ramie cloth rivals silk for making dresses and other light and shining wearing apparel while costing 50 per cent. less, and being much stronger and more durable.

In the travels of Pallas, volume I, page 690, it is stated that the inhabitants of Kamschatka make their fishing nets with the fibres of a nettle plant which bears leaves like the hemp plant, and which is a native of Siberia and a species of *Urtica Cannabina.* The women of the *Baskers* spin thread and weave cloth from this fibre. They cut the stalks in autumn, dry and ret them and separate the centre wooden or ligunous portions with their hands, a course of operation which gives us a right to infer that, contrary to popular opinion, this species of Urtica is also really without thorns or pricks. The above remarks conclude with the indication that the women of the *Baskers* crush, in wooden mortars, the stalks of which the central wood has been previously taken out. This pounding in the mortar has the effect of disintegrating more thoroughly the fibres from the woody portions which may still adhere to them after the first operation. Does it not therefore seem probable that these remarks have reference to some one species of perpetual *Urticeœ* without thorns, and perhaps analogous to the *Urtica Nivea*, unless of course it is purely the hemp, and nothing more or less?

It would be most interesting to obtain more complete information about this species of the perpetual *Urtica* of Siberia.

Let us hope that travellers in that country will bring back with them some live plants or seedlings of this fibrous plant so much valued by the *Baskers*, which, after all, might be simply the common hemp, but might well also be a robust species of the *Bœhmeria* or perpetual *Urtica.*

However, there is no doubt that pending an extended and special cultivation of the Ramie, varied according to the climate, efforts might be made to acclimatize everywhere a number of plants, as is done with the potato, hop, &c.

To arrive at such results, it is necessary to study primarily the different modes of cultivation which must be adopted, and which naturally must vary according to climate.

But to return to our subject. Let us cite the extraordinary fact that in former times the fibres of the Ramie exchanged hands as national conventional money value in the meridianal countries of Sumatra (Patanby).

Besides, during the reign of the Sultans of Sumatra, land-taxes were paid in fibres of Rameh or Ramie. (The *Technologist*, 1863,

p. 128); and this proves the high value which the people attached to this fibre, and the great respect which they had for it.

M. Edouard Nicolle gives the following particulars of the Ramie fibre as coming within his experience:—

(1.) That M. Leheer at Lyons has succeeded to weave *Moires* and other tissues, the appearance and quality of which resemble those of floss silk.

(2.) That M. Farel at Montpellier has cultivated the white nettle, or China grass, in his garden since 1815; and that this plant has bravely stood the cold of winter and the heat of summer.

(3.) That M. E. Nicolle himself has cultivated and propagated this plant at Jersey for many years; that he has established by experiments the fact that the Ramie, or China grass, is a strong and vivacious plant which returns as many crops as the Lucerne grass (Burgundian hay); that the 20 or 30 stalks which each plant yields every year, grow habitually to the height of from four to six feet at Jersey. In places other than Jersey, M. Nicolle has obtained three crops annually which produced the following results:—

(*a*). At the rate of three crops a year, he has obtained a total annual return of 5,625 pounds of dried stalks per acre, that is, after separating the stalks, or straw layer which exists under the bark of this plant. Now this is an enormous return, which will admit of no comparison with other products. These 5,625 pounds of raw fibre are equal to a minimum of 3,375 pounds of well retted, and thoroughly cleaned fibre ready for use at filatures, and this is the result obtained at Jersey. Moreover, besides the bark or fibre, there were the leaves, equivalent to five-elevenths of the whole crop, that is about 2,557 pounds of dried leaves per acre for the total yield of three crops per year.

(*b*). That these leaves are replete with very fine fibres, which are an excellent material for paper-making, and the value of which covers all costs of cultivation and manual labor, the more readily so as the cultivation requires very little manual labor.

(*c*). That he has made several plantations of the Ramie in various climates and different soils; for instance, in the department of *la Manche* almost on the sands on the sea-coast, as well as in the department of Dordogne.

(*d*). Thanks to the plantations made by M. Edouard Nicolle, he assures us that he will soon be able to supply some hundreds of thousands of young plants to the public, and to supply them at moderate prices.

(*e*). That agriculturists desirous of trying this cultivation may apply to him at Jersey, and to M. Martin in the colony of St. Foie (Dordogne).

It appears that M. Vergnioul, Inspector of Forests at Nimes, also cultivates the exotic Ramie.

In Spain the Ramie flourishes and bears seed, particularly in the province of Murcia.

I wish also to point out here, that both species of the Ramie, *i.e.*, the native of China, and the native of India, of which I have before described the difference in leaves (the *Urtica Bœhmeria Nivea* or *Sanguinea* and the *Urtica Bœhmeria Candicans*), have both been equally cultivated for many years in open fields, and with complete success, by M. Bernardin, Professor of Sciences at the Institution of Melle, near Ghent. These plants have been thriving for the last ten years in the Botanical Gardens of this establishment without any other care than covering them with leaves during winter.



Why should not others in Belgium be able to do on a large scale what M. Bernardin has taken the initiative to begin on a small scale in view to assure us that this plant will thrive in Belgium? He has had, on a small scale, crops of magnificent stalks, and it is therefore probable that by adopting the special mode of cultivation laid down in this pamphlet we might be able rapidly, and without expense, to multiply this plant *ad infinitum*, and obtain results far superior to those to be had by the cultivation of flax. In winter the plants might be protected from the cold by a covering of leaves or with a layer of earth, as is done in the case of hops, in order to avoid their destruction from snow. Without this precaution the plants will certainly perish.

I hasten, then, to announce these facts to all intelligent agriculturists who have the courage to try experiments, in order to further the progress of agriculture and industry in the country.

I can add as supplementary testimony of the vigour of this plant, that I myself have a few young plants in my garden, obtained from small cuttings of stalks which I received from M. Bernardin. I put these cuttings, or heads of stalks cut in June, into the ground, and they immediately took root, as easily and as rapidly as cuttings of the water-willow. I contented myself simply in keeping them always cool during the first 15 days to facilitate the development of the young roots; and in this case the old adage, which prescribes that for most things only a beginning is wanted, is truly applicable. But may it not be also here the case to exclaim with Mr. Alphonse Cordier, that if good things are not rapidly propagated, the reason is that generally all attempts made outside the stereotyped style of old usages are most frequently stigmatized by a crowd of ignorant men as folly.

Indeed the history of all ages and nations chronicles the fact that all innovations are the more retarded and kept back, because they have against them the prejudices of false *savants*, besides having to combat against the opposition of blinded interests which ignore the advantages that might be brought about for them by new inventions and proposed innovations.

For such people we must prove their error not by speaking of the creations of genius or the works of superior men, whose meditations and studies have disclosed some secret of nature, like Papen for instance; but let us speak of more simple matters.

At the time that Achard the chemist conceived the idea of extracting sugar from the beet-root, was there any one who foresaw the future prospects of this idea or of this invention?

When Jumel sowed the first seeds of the cotton on the borders of the Nile, who could have predicted that some day Egypt would owe him a heavy debt, and Europe a much heavier one?

When Parmentier fought against popular prejudices, and against the beliefs of the erudites of his day who pretended that eating potatoes would produce leprosy and other diseases, who would then have thought that this vegetable would soon become the universal, and, after bread, the principle food of the people? And yet to attain this end, it was necessary that the monks of St. Pierre, at Ghent, should force their people to pay their tithes in potatoes, in order to be able to propagate this useful and precious tubercle in the extensive cultivations of Flanders.

There would be hundreds of instances to cite from history, but let us confine ourselves to the above.

It is sufficient for our purpose to attract a few willing men bravely to attempt the extraction of the first fibres of the white nettle, and to attempt everywhere, even in Belgium, a rational and methodical cultivation of this textile plant which is so vigorous and so fruitful, besides being, among other things, superior to the fibres of all known vegetable textiles.

To bring home to our readers the more forcibly some of the principle qualities of the Ramie, I subjoin a *resumé* of some of its qualities recognized by botanists, amongst whom are the following :—

Messrs. Blume, Fortune, Belastier, Forbes, and Leclanker, concurring with the modern *savants* Benito Roezl and J. Bruckner, assure us—

(1.) That it is certain and beyond doubt that the fibre of the Ramie is stronger and more resisting than the very best European hemp.

(2.) That the fibre of the Ramie is 50 per cent. stronger than the very best Belgian flax of the Lys.

(3.) That the fibre of the Ramie can be spun to a much superior and finer quality than flax, and that it wears better and is more durable.

(4.) That this plant grows more easily and vigorously, and produces fibres more abundantly than any other known textile plant.

(5.) That in warm climates this plant yields regularly from three to five crops annually, and that the stalks of each crop are from 18 inches to 10 feet in height.

(6.) That each plant at first produces four stalks after the first crop; that in the second year it throws out generally from six to eight stalks; the third year it produces 10 to 12 stalks, and the fourth year from 16 to 20 stalks; that the fibres of the second, third, and fourth crops are generally finer than the fibres of the first crop Consequently to obtain a more abundant crop of finer fibre in the very first crop, it is advisable to nip off the heads of the young stalks when they grow to a height of six or eight inches; this has the effect of making the plants throw out lateral shoots in larger numbers. At the same time the heads of the stalks thus nipped off may be used as grafts, and with a little care for the first few days they will, in a few weeks, become so many young plants.

(7.) That the cultivation of the Ramie may be attempted in countries where heavy snow falls in winter, provided the precaution is taken to cover the plants with a little earth before winter, as is done in the case of hops.

(8.) That plantations may be made at any season, either in summer or in winter. But the plantations made in summer have the



vantage of allowing the young plants to spread and develop their ›ts in autumn and in winter, and the result is that the summer or :umn plants begin to throw out stalks in spring, when agriculturists about to commence their spring sowings.

Finally, according to Mr J. Bruckner it would be advisable in the ensive cultivation of the Ramie, to adopt the following mode which erience has justified and sanctioned.

## RATIONAL MODE OF CULTIVATING AND PROPAGATING THE RAMIE, AND OF UTILIZING THE ABUNDANCE OF BEAUTIFUL FIBRE IT PRODUCES.

THE land intended for Ramie plantations should be a light and well-manured soil, that is to say, manured and well-ploughed. It is, moreover, indispensably necessary that the land selected should possess a good sub-soil, because the Ramie throws its roots downwards like the flax to a depth of 12 or 14 inches, in search of its nutritive sap; this, of course, would be impossible in lands with a bad sub-soil, and consequently in that case the plants would not thrive. The lands best suited to the cultivation of flax, which also throws its roots downwards and deep, will also be the lands best suited for the extensive cultivation of Ramie.

It is desirable, also, for this cultivation, to begin by ploughing the lands to some depth, and then to till lightly in order to remove the superficial rank vegetation.

In fields thus prepared, furrows or small trenches are made with the plough or other implement at distances of at least three feet apart, that is to say, just as is done in the case of potato plantations, except that for the Ramie the furrows are at greater distances, as will be shown hereafter. This being done the sowing is commenced in these trenches in rows, to a depth of three inches, (1) either with seedlings of the previous year or with cuttings; (2) with strong shoots, or with the divided roots of older plants, which increase rapidly as in the case of hops.

These young plants are put into the ground at distances of at least 16 inches apart, as in the case of hops. In a few days they begin to grow.

Each plant yields on an average three or four stalks, and soon the plantation assumes the appearance of a small forest. If then it is desired to continue solely the multiplication and propagation of the plant, the following course should be adopted:—

As soon as the stalks of the plants of the new sowings have attained a height of eight to ten inches, they should be laid down on the ground and covered with earth at intervals, so that only the heads of the stalks can be seen.

In four or five weeks all these young stalks thus laid on the ground will have thrown out new roots. The new plants can then at once be separated from the parent plants and transplanted. In the meantime the parent plant will have thrown out fresh stalks in larger numbers than at first. When multiplication and propagation is the



only object, the new plants produced each time may be successively treated in the same way as the first plants. By this means we may have within a few months and from a single parent plant, thousands of young plants, indeed, sufficient in three years to plant out an area of 50 acres, and this proves the fecundity and extreme facility of propagating the Ramie.

Another simple means of propagation is, not to lay the stalks in the ground, but to cut or nip off the heads of the first plants when they attain a height of 10 to 15 inches, and to plant these cuttings immediately; this process will also cause the decapitated parent plant to throw out lateral shoots three times as numerous as at first, and to increase the quantity and enhance the fineness of the fibre; while at the same time the heads nipped off can be planted as cuttings, and will become fine plants by the next season. It is only necessary to keep the new plants damp and secure from the north wind for the first 15 days until they have taken root, after which no further attention is required except to cut the stalks, and cover the plants before winter.

During the first year the cultivation of the Ramie demands a little care, as it is necessary to weed out the rank vegetation; but from and after the second year this operation becomes superfluous, because by this time the Ramie will have thrown out such strong and wide-spread roots, that there will be no room for the growth of rank vegetation or other parasitic plants in the same field.

With an intelligent cultivator, the produce of the lands sown with Ramie will increase year by year.

But to attain this end, it is necessary to till the land yearly at the end of autumn, after having thrown into it as much manure as possible. There is no fear of adding too much manure to the soil especially of the kind above indicated. The expenditure and labor on this account will be repaid a hundred fold by the abundant yield of fibre, and the rapid growth and multiplication of stalks or crops every year. In fact this is the case for the Ramie as well as for all other crops where manuring and ploughing are not sparingly doled out.

According to M. E. Nicolle, of Jersey, it would be almost an advantage to pull out the roots from the ground every autumn and to divide and replant them. This process would involve some labor but it has the following advantages:—

(1.) It is the most natural period for dividing the roots of the plant, which process, according to M. Nicolle, is the best mode of propagating this plant, as it is the mode by which strong plants are at once obtained, yielding fibre from the very first year

(2.) It is a good opportunity to manure the soil into which to replant the divided roots at once. The roots may be replanted in spring, care being taken to preserve them during the winter against the effects of snow, by keeping them in trenches covered over with straw and earth, or in ridges. But they must be well protected against all effects of cold up to the end of May, or the least snow will destroy the precious tubercles which are reserved for plantation in the following spring, either in the beginning of June or the end of May.

The Ramie plants grow rapidly, and their stalks can be cut down very time they attain a height of four to six feet, when they can be cut down to three or four inches from the ground, for the purpose of disintegrating the bark which contains the fibre. In order to be the better able to separate the bark from the stalks, it is necessary to ret the latter first of all, precisely in the same manner as is practised in the case of hemp and flax.

A few days after the first crop the plants throw out fresh stalks more numerous and stronger than the first. By this means several crops are obtained annually, according as the climate and season are favorable or not, and especially according to the degree in which the soil has been manured.

The fibres of the Ramie actually imported from Asia to Europe are either little or not at all retted.

These fibres therefore present a rude and rough appearance, and adhere to each other like badly retted hemp. It is therefore necessary, before spinning with these fibres, to subject them to a proper course of retting, if not to a course of thorough boiling at high pressure heat, in order to dissolve the gummy-resinous pith or sap incrusted in the fibres, which causes them to adhere to each other; then to follow up the course of retting, after drying, with a course of harling and softening on the pallet or other implement used to free the hemp from its straw. It is therefore necessary to carry the raw fibre through these processes in order to obtain a clean fibre of a silky, and brilliant appearance, such as it is desirable to have in fibre prepared for spinning purposes. In Java, the retting of the Ramie stocks is carried on in the same manner as in India, on a primitive and slow system. It is almost unnecessary to enter into the details of this system, especially as there are other more rational modes known and practised elsewhere.

The following is an account of the system of retting the Ramie or China grass stalks generally adopted in China, Borneo, and Sumatra.

The stalks are cut and collected into bundles, and are then thrown into still pools and kept there for several days until the process of retting, so as to cause the bark to separate from the wooden parts, is sufficiently advanced.

As soon as this separation is perceptible, the bundles of stalks are removed from the water, and all the cortical bark or raw fibre is immediately collected. To do this the wooden stalks are split up the centre. Two fingers or the thumb are inserted between the wood and the bark and slipped along the whole length of the stalk between the wood and the bark, which has the effect of bringing out the fibre in two strips or ribbons. These strips are spread out on fields to complete and finish off the process of retting by exposure to the dew; but those who are more skilful collect these strips of bark into bundles, and again for a second time throw them into water to effect a cleansing by a fresh and more complete process of retting.

By this second steeping another fermentation and decomposition is brought about of the sap or pith incrusted in the fibres which causes them to adhere to one another. This process completes more thoroughly the retting, which is not effected by the simple exposure to the dew.



After this second retting, it only remains to work up and comb out the fibre, and thus prepare it to be spun to any quality of fineness.

But for the latter manipulation, the machinery is much behindhand in the pagan countries, where, as a natural consequence, civilization is little spread.

And this is, and will remain for a long time, the greatest obstacle to the development and extension of the cultivation of the Ramie in countries with climates so favorable for carrying on profitably, and on a large scale, this beautiful cultivation.

But meanwhile why should not efforts be made to introduce this cultivation in the more civilized countries of Europe and America.

Dr. Henly, who devoted much time and attention in British India to the means of developing the cultivation of the Ramie or China grass, recognized and declared that the East Indians neglected this easy and precious cultivation; that they were apathetic, and confined themselves, in preference to the cultivation of jute which is a textile plant of little value, and which cannot outlive even the smallest continued action of water. The sole cause of this, he said, is explained and justified by their gross ignorance of good processes for disintegrating the fibre of the Ramie or China grass, and their lack of machinery to obtain the profits rapidly. Their ignorance in this respect is demonstrated by the fact, that an Indian can daily turn out about 112 pounds of the jute fibre, which is easily and without much trouble separated from its stocks; whereas the same man would not find it possible to turn out more than three pounds of the Ramie fibre. The education of the Indians in this direction has yet to be begun.

But the case is not quite analogous in China, Sumatra, and in Borneo, where the people are more skilful than in India.

Now the Ramie, being the most valuable textile plant which, proportionately to all other textile plants that can be cultivated on the Asiatic continent, yields larger returns, it is evidently clear that the Indians would find in its cultivation a source of great prosperity as soon as they learnt to extract the profitable portions properly; that is to say, by cultivation and disintegration according to approved methods.

"Really," says Alcan, who is competent to form an opinion, "the tissue which is obtainable from the excellent fibre of this plant, rivals in whiteness and beauty the *batiste*, and in gloss and brilliancy silk."

For those who wish to occupy themselves seriously in the introduction of this plant, it is sufficient for me to say that the fibre of the Ramie is analogous in nature to the flax and hemp; that the fibres are similarly attached to the wood of the stalks, and adhere to one another with the gummy-resinous and albuminous pith or sap which can be dissolved completely by means of fermentation in water or retting, when the process is performed methodically and rationally in the manner I have laid down in a subsequent chapter.

But this process of retting can, if necessary, be changed for another operation, more rapid but involving more expense by saponification of the resinous gum. The packets of raw strips or bands of the China grass are washed in a bath containing ten per cent. of caustic soda, super-heated, to which is added a little oil. This washing is performed at a pressure heat of eight atmospheres, during at least five or six hours; in this latter case it is desirable to carry on the work in large iron pans, which may be rendered air-tight by means of bolted covers, constructed so as to have a continuous circulation of the bath. This alkaline bath would produce little or no effect at the degree of temperature of boiling water, but super-heated to eight atmospheres or more, the separation of the fibres goes on admirably with the help of caustic soda.

This latter procedure by means of a bath of caustic soda heated to high pressure, is that which has been used during the last 30 years for washing thread, cloths, &c., as well as for dissolving the resinous gum which incrusts the lignuous fibres of straw intended for paper manufacture.

Indeed, this caustic bath dissolves the woody substance and saponifies it, and leaves the fibres separated. The reason why this action of the caustic bath on the ligneous bark differs so much in effect in proportion to the small or great degree of heat, may be found in the fact that the quantity of ammonia which is generated by the organic matter heated to a temperature of two to eight atmospheres is very large, provided a little caustic alkali is added to the bath while at the simple heat of boiling-water there is little or no generation of ammonia.

Ammonia, more than soda and potash, is an excellent solvent of gummy-resinous matter, which incrusts vegetable textile fibres, and causes them to adhere to one another.

In fact, chemistry teaches us that ammonia is artificially produced in a general manner at every time that organic matters undergo a change of equilibrium in their constitution, either by the disorganizing process of fermentation, or by the application of great heat, and especially when the action of heat is supplemented and developed by the powerful aid, and not less powerful reaction, which caustic alkali exercises in these cases.

Large quantities of ammonia are made by simply dissolving with lime, in large cylinders, animal matter of little value, such as the residues of the washings of wool, bones, the entrails of slaughtered animals, &c.

I think it well to explain as follows the great production of ammonia in such cases:—

(1.) There naturally exists a great affinity or attraction between hydrogen and nitrogen, which have a tendency to unite wherever they come in contact in their nascent state, and to form by their union a binary compound, a new body which is nothing but ammonia, or according to the formula in chemistry $NH3$.

(2.) All animal bodies, as well as almost all vegetable saps, contain large quantities of nitrogenous substances, such as gelatine, albumen, gluten, &c.

(3.) Now according to M. Mulder of Rotterdam, these nitrogenous substances are not only of an analogous composition almost identically the same, but they have besides a common base called *Proteine;* moreover, the only distinction between them seems to consist in variable proportions of sulphur and phosphorous, *plus* some other salts in very small and almost inappreciable quantities.



*Proteine* is composed of—

| | | | | |
|---|---|---|---|---|
| Carbon | ... | ... | ... | 55·29 |
| Hydrogen | ... | ... | ... | 7·00 |
| Oxygen | ... | ... | ... | 21·70 |
| Nitrogen | ... | ... | ... | 16·01 |
| | | Total | ... | 100 00 |

Hence arises the formula $C^{40}$, $H^{31}$, $N^{5}$, $O^{12}$.

(4.) Under the effects of fermentation either of weakened acids or alkali intensified by the action of heat, *proteine*, or the glutinous substance of feculæ, or sap of vegetable matter (as well as the salts which co-exist in infinitesimal proportions), tends to decomposition and becomes divided into two parts, at the same time that a portion of the water which has dissolved the *proteine* also decomposes.

As soon as the decomposition, that is to say that division and separation of normal parts of the substances takes place, these elements immediately, according to the natural laws of affinity, form new combinations, which result in the formation of new and more elementary bodies, principally ammonia in large quantities, and fatty acids.

(5.) When gelatine, albumen, gluten, or pectase, or the simple base of nitrogenous bodies, are boiled with potash or soda or quicklime, ammonia is formed, and in quantities varying according as the temperature is raised.

This is easily explained by the fact of the great affinity these alkali have for oxygen, which it removes from these substances as well as from the water by the process of decomposition.

But while these alkali have little or no affinity for nitrogen or hydrogen in an isolated state, those two gases have, on the other hand, a great affinity for each other. The result is that as soon as they are separated by the decomposition of pectase or vegetable gluten, the two gases unite at once and form ammonia.

On the other hand, at the same time a small quantity of carbonic acid is formed and escapes. which as it is gradually formed is al absorbed by the alkaline caustics, and by the ammonia which is formed and dissolved.

Owing to the well-known affinity between alkaline substances and acids, alkaline carbonates must be formed during the second stage of discombination. In the meantime the fatty acids, such as oleic, margaric, and stearic acids of the resinous gum are liberated and combined with the alkali forming soaps, since soaps are nothing else but alkaline oleates, margarates, and stearites.

The resinous gum is thus decomposed and transformed into carbonates, and alkaline soaps.

The textile fibres are by this process thoroughly separated.

With these preliminary notions it becomes easy to understand the reaction obtained in nitro-animal matters, such as hides. the refuse of the washings of wool, &c. These animal remains contain besides a quantity of gelatine and alkaline salts which are naturally inherent to them. Consequently with the aid of water and heat, everything is separated in the cylinder in which the distillation is going on, even when no addition of alkaline lixivium takes place, and thus is produced ammonia, which is first dissolved and is then volatilized and distilled when the temperature is increased. The addition of a little lime causes the operation to progress better.

The case is not the same with straw or flax or China grass, which has to be separated. Boiling water only, even at a very high temperature, is not sufficient to decompose and divide albuminous gums or the resinous sap.

Indeed, the action of water alone will not produce such a reaction or decomposition as that described above, because the agents of reaction either acids or alkali, are to be found in too small proportions in the gummy, resinous sap. Water alone will not therefore produce a sufficiently strong double decomposition. Retting, by means of slow and continuous fermentation, can alone produce this result by the action of ferments. Consequently, in order to decompose rapidly, and to divide the gluten or pectase or resinous gum from these vegetable matters, and to transform their *proteine* into ammonia, it is necessary while boiling them in water to a very high temperature, to add caustic alkaline lixivium, which with the aid of the great heat produces the remarkable result already described, of converting the *proteine* into ammonia, &c., at the same time dissolving a small quantity of fibre which varies in proportion to the quantity of alkali used. The action of potash and other alkali on starch and cellulose, always extracts from them a little oxalic acid and ulmic acid, which being saturated with alkali, forms an oxalate and an ulminate, both of which facilitate the double decomposition, and the reduction of metallic salts which exist in the gummy, resinous sap.

At any rate, the generation of oxalic and ulmic acids by means of the caustic alkali, being always produced to the detriment of the textile fibres, there is always a greater loss in fibres than the loss sustained by my process of scientific and methodical retting, which I have explained in a subsequent chapter.

I should therefore declare that the disintegration of the Ramie, like that of flax and other similar textiles, can be performed ten times more economically and is more within the reach of all by the simple steeping in water than by the use of caustic baths. It is true that a thorough retting is not obtainable in all places without inconvenience, if we confine ourselves to performing it by stereotyped modes dependent more or less on chance, as practised by long custom. But by applying to this the new process of retting which I have invented, and which I describe briefly further on, we may succeed in retting thoroughly everywhere without any inconvenience.

By this new process of retting, the resinous gum is dissolved and decomposed entirely by the action of acetic fermentation, while at the same time I have discovered the means of entirely preventing putrid fermentation which ordinarily and always interposes and complicates the operation of retting as it is ordinarily practised by routinists, by the simple immersion in water of textile stalks without the aid of any preventing or regulating measure; whereas by my rational process which is justified by theory and experience, the separation of the fibre is better performed. The fibres do not lose their natural strength, and the water used is not rendered odious.



This process is, moreover, as economical as it is simple, and easy of application everywhere. It will be found described further on.

For the present, let us confine ourselves to pointing out that after the crop, that is after the stalks of the Ramie have been cut and suitably retted and disintegrated, the bark or fibre may easily be removed by the process I have described above, either after the Chinese fashion or like those who cultivate hemp in our own country.

But the process might be carried on very much more rapidly by grinding the stalks first retted and dried between two or four cylinders of a breaker with differential or alternate movement, which makes an excellent bruise, breaks up and throws out to a great extent the woody portion, while at the same time it separates and softens the fibres. A light stripping with Merton's stripping machine will remove the remaining portion of the wood from the fibres.

There is nothing to prevent these fibres thus prepared being subjected to another, and in some cases even to a third course of retting. The whole is completed, after retting and drying, by giving the fibre again a slight pass under the breaker, followed by the softening process either in Merton's machine or by means of a few strokes of the comb, or with the wooden mallets of a mill for breaking flax.

It only then remains to wash and bleach these fibres. When the washing and bleaching is completed, this beautiful fibre should be combed out and it is ready to be spun. It should be slightly lubricated before the process of combing.

The fibre of the Ramie by its great length, its fineness, and its own peculiar nature, resembles more closely flax than cotton. It is desirable, therefore, to spin it preferentially on the frames for flax or wool. It is a grievous blunder to reduce this fibre into small lengths in order to spin it on cotton frames. This is just as absurd as cutting up flax fibres.

Monsieur Duesberg, the ex-director of flax factories, Brussels, has discovered the means of spinning this fibre on the flax frames with cold water as readily as the best flax. He has given me some fine specimens of the Ramie cloth woven with the fibre I supplied him with.

Amateur cultivators of China grass will no doubt learn with pleasure that Mr. J. Bruckner, who resides in New Orleans (*No.* 104, *Gravier Street*), announces that plants or seedlings of the Indian species, the China grass, *Bœhmeria Candicans*, may be obtained from him to any extent required. But this should not withhold cultivators from procuring other species also from their native countries, such as China, Java, &c.

## REVIEW OF SOME OF THE FIBROUS PLANTS.

There still exists in Asia and in the Antilles numerous textile plants which are useful but yet little known, and which are of as much interest although of less importance than the Ramie or China grass.

Subjoined is a list of the names of some of these textile plants.

(1). *Papyrus* (*Cyperaceæ*).
(2). *Phormium tenax* (*Liliaceæ*), or New Zealand flax.
(3). *Lacoua* (*Pandaneæ*).
(4). *Abaca* (*Musaceæ*), or Manilla hemp.
(5). *Pinguin* (*Bromeliaceæ*).
(6). *Palm*, which generally yields highly-coloured fibres, such as coir or khair (fibres of the cocoa-nut tree).
(7). The dark vegetable coir of Gomonth, a species of the *Madura* palm.
(8). *Caragate*, or Spanish Barb, another species of vegetable hair.
(9). *Papyrus*, or paper tree.
(10). Several species of the brown hemp of Antilles.
(11.) The *Dyass* of Arabia.
(12). The *Esparto*, one of the ancient *Spartums* or *Sparteri*, and the vegetable hair of Africa contained in the dwarf palm.
(13). The *Alfa Grass*, another species which grows in Algeria.
(14). *Zoskera Maritima*, of the coast of Africa, or *Zea Grass*.
(15). *Abutilon* of Algeria, a species of hemp.
(16). *Corchorus capsularis*, or Indian jute, in Malay, *Rami*, *Tsjina*.
(17). *Agave* or Aloes, a species of *Abaca*.
(18). *Hibiscus Textilis* (or *Mahot*, with pink flowers) of French Guiana and other intertropical countries; a species of beech with fibrous bark, of which is made ribbons of an orange yellow colour, used to tie bundles of cigars.
(19). *Crotolaria Capensis*, or the Bombay and Jubbulpore hemp, or Sunn.
(20). *Asclepias gigantica*, of Sierra Leone, or the plant-producing silk called also *Badoerie*, and in the north of British India, *Mudor* or *Madar*; in Madras, *Yercum*; and in Scinde, *Ak* or *Uk*. This species of the *Asclepias* is a beautiful plant, with straight stocks resembling the Banana; its ligneous bark of calf-skin colour contains a beautiful fibre which is disintegrated in the same manner as the fibres of the China grass. Moreover, the plant bears fruit, a kind of pod, which also yields fine silk of short lengths, whereas the silk from the bark is long and fine, and more beautiful still than that of the Ramie.



The pods are divided into two parts, and they open out when ripe to allow the short silk which they contain to come out. But the great value of this plant is in the magnificent fibre or silk which is extracted from the bark by retting and disintegrating in the manner described above.

The fibres of the bark of the *Asclepias* are of a beautiful golden yellow, silky, fine, and very lustrous, without oakum, and of equal lengths. This beautiful vegetable silk of the *Asclepias* has a slight natural curliness. I saw beautiful specimens at the second exhibition in London.

It would be desirable to procure a few parent plants, in order to study how and in what countries this species might be acclimatized, and how cultivated by a special treatment.

Indeed, it is worthy of remark, that each plant of the *Asclepias* can produce about seven oz of silk, and reckoning about 2,500 plants per acre the yield would be about 1,400 lbs. Moreover, this is a perpetual plant which need not be sown annually. M. Jeannison, Junior, of Tartary, has fabricated cloth with the fibre of the *Asclepias* of Senegal (*Asclepias gigantica*) (Paris Exhibition 1857, French Colonies, No. 255). Mr. Avril of Tartary has made embroideries (No. 258), and with the refuse, or waste cotton, coverings are made (No. 258). The vegetable silk of the *Asclepias* thoroughly allies itself with real silk, wool, and cotton.

(21.) In the family of *Asclepiadeæ*, there is in Penang the *Lynanchum ovalifolium*, which besides producing caoutchouc of an excellent quality, produces a very tenacious fibre.

Dr. Roxburgh affirms that the fibres of the *Marsdenia tenacissima*, another variety, are the strongest he knows of, and that the hillmen of the Rajmehal range use it to make strings for their bows.

According to Wight, the fibres of the *Calotropis gigantica* and *Procea*, and of the *Orthanthera Viminea*, are still stronger and are more tenacious than the preceding.

(22.) *Pakao Kidang*, a species of fern which also produces silk of a less fine quality. This plant grows wild on the Geonong Gedeh mountains in Java. Haskrall calls this plant *Belantium Chrysotricum*.

(23.) The *Girardinia*, according to Decaisne, or *Tsing-ma* of China, the *Urtica heterophylla* of Roxburgh, or as it is called in Assam *Haroe Surat*, or vegetable wool of a widespread nettle, is found in India, on the Malabar Coast, China, &c. This nettle, being prickly, is boiled to destroy the virulent action of the hairs, and to extract afterwards the vegetable wool it contains.

(24.) The *Sida rhomboidea* called in Bengal, *saffaid* or *lal burial*, and in Java *lidagori*, a species of which is cultivated in China under the name of *king-ma*, and which Roxburgh calls *Abutilon*, a textile plant analogous to the *Phormium tenax*, or New Zealand flax, producing a fibre superior to jute.

This plant is common throughout in Bengal, and might be cultivated also in Algeria.

(25.) The *Hibiscus cannabinus*, a beautiful textile plant which grows in Bengal to a height of from three to seven feet.

It is sown like the hemp, and the stalks are of the same thickness as the hemp of Bengal, but it is little known in Europe.

It is called in London a bastard jute, or Madras jute, and in the west of British India it is called *ambarie;* in Bengal *mesta* or *pat;* in Madras *palungoe;* in the Tamil language *Kongkura;* and in Guadaloupe *gomba.*

M. Bernardin, Conservator of the Museum of Melle, has compiled a synonym of familar names of over 550 kinds of these plants.

Let us stop here, and express regret that while great sacrifices are made in large industrial centres to collect wild animals which are of no well-defined practical utility, no similar measures are taken to collect nutritive and textile plants from the different parts of the globe; and this is a hiatus which we should have at heart to fill by making collections, where we might see in one view these useful plants in their special greenhouses, and side by side their produce on adjoining shelves.

It is so easy for the Governments and administrations of our days to procure through their consuls all the plants and products of the globe. By collecting, then, the most useful, in order to cultivate, propagate, and study them, and by publishing the best mode of cultivation and the special usefulness of each, a decidedly good work would be performed, the result of which would be most fruitful and profitable to the general public.

Even now, in regard to the China grass or Ramie, is it not absurd, if its cultivation can be carried on in this country, to still remain indebted for the staple to foreigners in China, Cochin, and India, where the Ramie abounds as naturally as the potato in Peru; because in reality the people who possess the raw material of their industry are doubly rich?

In the magnificent, commercial, and industrial museum of Melle near Ghent, which partly fills the hiatus complained of above, we can see stalks of the Ramie collected from the crops of the garden belonging to the establishment, as well as the raw and clean fibre and the spun and dyed threads, and also magnificent paper manufactured from the leaves of this plant. In the garden there actually grows a field of vivacious and strong plants of the Ramie. This being the case, all controversy ends, and I enquire again why attempts are not made to cultivate this plant on an extended scale, by devoting the care required and prescribed.

In truth, it seems to me that this would not be now more difficult than it has been to acclimatize in all parts of Europe the potato. This staple, now become indispensable as a commestible, must be a native of a sufficiently warm country for it to grow in a wild state; whereas in Europe it is only necessary to replant it every year to ensure its successful cultivation. We must first, therefore, seek a different and appropriate mode of cultivation. The example I have just cited is conclusive, and suffices to demonstrate the temerity of the assertions of those who pretend without just grounds, and contrary to the facts related above, that even with a rational and special mode of cultivation the Ramie will not prove a success in Europe. Now the Ramie is a much stronger and more vigorous plant than the potato. The latter suffers from snow, and spoils rapidly; but by adopting a special mode of treatment its cultivation has been finally carried on with success, even in the north of Europe.



In the industrial museum of Melle there are also specimens of various other textile plants, and amongst others the silk obtained from the pods of the *Asclepias,* but not the superior silk of greater value extracted from the bark of this plant.

I have also there seen hemp-stalks 9 or 10 feet in height, obtained from seeds of the Tuscany hemp sown in Belgium, and this proves that if farmers were to use only the seed of this species of hemp, they would obtain a finer and longer fibre than is habitually produced by using the indigenous hemp-seed.

Already farmers have taken to sowing flax each year with the Russian seed. Why, then, should not they equally use the Tuscany or Piedmontese hemp-seed, since its greater advantages are obvious?

If we were seriously to set ourselves to work, we might probably discover the means to improve and enhance to a greater degree the quantity, volume, and return of several of our various agricultural products, by making a comparative analysis of the different species, and in growing them.

Societies should be established for this purpose, and they should publish annually in a review, *ad hoc,* the results obtained, and the methods which should be widely made known to facilitate the sowing or the cultivation of the best and most productive species, as well as those which are the strongest and therefore the best able to resist the inclemencies of the seasons.

## GENERAL SUMMARY.

After confirmatory experiments which I have made in this matter, I am of opinion that it may be estimated that when the Ramie plant produces, as it does in Jersey, as declared by Mr. Edouard Nicolle, 5,000 pounds of raw or half retted and dried bark yearly per acre, it will lose, after a first thorough retting, about 30 per cent in weight, and will return about 3,500 pounds of fibrous bark pretty well cleaned by a first operation, that is to say, cleaner than is sold in the commercial marts, and better disintegrated than in the state it is imported from China, &c.

This is a comparative calculation, which may serve as a base and starting point.

This bark, retted only for the first time, is, in my opinion, worth about fourpence per pound, and is sold in commerce at sixpence per pound, and even more.

After a second thorough retting, the bark loses again 10 to 20 per cent. in weight, and as much again in the bleaching, combing, and softening processes which are subsequently indispensable. 5,000 pounds of raw fibre per acre will therefore, after the first retting, produce about 3,500 pounds of fibre; after a second retting it will leave about 3,000 pounds, which after bleaching, softening, &c., will leave about 2,500 pounds, so that 5,000 pounds of the raw bark produced on an acre of ground loses about 50 per cent. in the process of preparation for the loom.

If the fibrous bark half retted were sold at threepence per pound only, cultivators would obtain a return of about £60 sterling per acre. This is a much larger return than yielded by the cultivation of flax or hemp in the most favorable seasons.

As stated above, the cleaned fibre, bleached and ready for the loom, would cost fourpence per pound, plus the cost of retting, bleaching, &c., &c., which would come to about twopence per pound, or the total cost of the fibre would be sixpence per pound; and in this state this fibre is superior to the best flax of Lys, which is actually sold at one shilling per pound. Now China grass, prepared and bleached, is actually sold at three shillings to three shillings sixpence per pound. If the price could be reduced to half, all the flax and wool filatures might spin more extensively with the China grass. Under these conditions the spinners could make a better profit than by spinning with flax, and the cultivator would also gain more than by the cultivation of flax, and the merchant cent. per cent.

What is then necessary to realize this beautiful prospect, which is not a dream, but pure truth? Nothing more is necessary than to



propagate in suitable localities the cultivation of this useful plant, and to diffuse the knowledge of the rational mode of cultivation and disintegration of fibre.

I would add that in England, and chiefly in Badford and Wakefield, China grass is already spun on machines for spinning wool corresponding in fineness to Nos. 100, 150, and 200 of flax fibre. In my opinion this thread has a little too much down on it, which slightly detracts the beauty of the tissue manufactured with it in imitation of silk.

From the fibre of China grass, material for dress-making is manufactured at Badford, having the warp of cotton and the woof of China grass. This stuff is made of all colours and shades and of various designs. I have seen hundreds of specimens. I find occasion to remark that the cotton portions do not give sufficient body to the cloth.

I prefer the experiments made in France and in Belgium to spin the China grass by the cold water process on wool machines. The thread is then very even and without down. If the process of spinning with cold water causes it to lose a little of its lustre, it regains this loss in being passed through the roller for tissues. I believe the best tissues will be obtained by having the warp of flax and the woof of China grass. I consider it desirable to select the design so as to have to weave it as far as possible with several treadles, in order that the woof may cover the tissue in various little patterns, such as are called *piqué or satiné*, and thus render the warp almost invisible. It is beautifull brilliant, and lustrous, especially after being passed through the roller. The tissue has then the appearance of real silk. With a warp of flax the tissue has naturally more body than with a cotton warp. It is then rendered stronger, more beautiful, and of greater commercial value.

In weaving with China grass only, it will be necessary before beginning, to impart to the warp a good strong sizing of dextrine, otherwise the fibres will untwist or separate, because they are so silky that they slip away and separate from one another notwithstanding the twisting, which is not sufficient to cause them to adhere, or to resist the action to which the warp is subjected to in course of weaving. A strong starching or sizing of the warp will remedy this evil.

Let us therefore cherish a hope that this beautiful cultivation and this admirable industry will rapidly spread, and be a source of large profit to all who undertake the business seriously.

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Let us therefore cherish a hope that this beautiful cultivation and this admirable industry will rapidly spread, and be a source of large profit to all who undertake the business seriously.

## CROSSING OF SEVERAL TEXTILE PLANTS, IN VIEW TO OBTAIN SUB-SPECIES MORE ROBUST AND MORE SUITABLE FOR CULTIVATION IN COLD CLIMATES.

To facilitate the analysis of the question whether such crossing is possible, it is necessary to bear in mind, first and foremost, the elementary principles known and admitted in botany fixing and deciding how the natural multiplication and propagation of these plants is carried on.

With this object let us call to mind as a preamble that all plants which belong to the large family of *Urticeæ* bear unisexual flowers.

By unisexual is meant flowers which contain the organs of one sex only, so that these plants are monœcious, or diœcious; that is to say, among the various plants belonging to the large family of *Urticeæ*, some species bear on one and the same plant flowers of both sexes, but each flower either wholly male or wholly female. Such species as bear unisexual flowers on the one plant, but distinct and either wholly male or wholly female flowers, are called in botany monœcious plants, and to this category the white nettle belongs. Other varieties of this plant, which form the minority of the family, are those which bear flowers of one sex only on each plant, either male or female. This latter group of plants with unisexual flowers, but each plant bearing flowers of one sex only, are known by the distinctive name of unisexual and diœcious plants, and to this diœcian class the hemp among others belongs.

Monœcious and diœcious plants have therefore both equally unisexual flowers, and this feature distinguishes them completely from plants bearing hermaphrodite flowers, that is to say, flowers containing organs of both sexes in each flower, the pistil or female organ and the stamen or male organ. The large majority of plants bear hermaphrodite flowers. In unisexual plants, such as the Ramie, hemp, &c., the male flowers are easily distinguishable from the female flowers, as the male flowers have a calyx with four or five sepals bearing stamens in the interior in considerable and variable numbers. These stamens contain the pollen intended to fecundate the female flowers. On the other hand, the female flowers have a calyx or involucre which assumes divers shapes, and in the centre of which at the base is a single free ovary which is one-celled and uniovulate. The ovary is surmounted with a pistil which has at the apex either one single aperture in the interior funnel, called single stigma, or two openings or stigmas, generally of some length, which lead to the style or canal which terminates at the ovary. Besides, in the family of *Urticeæ* the seeds are separate and distinct, that is to say, that each embryo of the seed is enclosed in an endosperm, with one single ovule between two cotyledons Nevertheless the embryo, or germ of the seed, always developes in the ovary of all flowers generally. But it must be remembered that the embryo alone sometimes exists in the ovary, and sometimes also in its development, is accompanied by spermatic lobes called cotyledons or seminal leaves. The embryo of the seeds of plants, according to their species, is therefore contained singly in the ovary, or is attached to a single lobe, or is placed between two lobes. Botanists have decided that analogous plants, or plants of the same family, are recognized with precision by the analogy that exists in the disposition of their organs of fructification, that is to say, in the organs of reproduction and generation.



The celebrated Jussieu was the first to divide plants into three classes :—

(1) Acotyledonous plants, in which the embryo is not accompanied with cotyledons;
(2) Monocotyledonous plants, in which the embryo is accompanied with one single cotyledon; and
(3) Dicotyledonous plants, in which the embryo is placed between two cotyledons.

*Urticeæ* are for the most part tetrandric, that is to say, their male flowers have four stamens inserted on the calyx. This position of their stamens places them in the category of perigynous plants.

The general disposition of the stamens in plants is the second and more constant and unvarying index which establishes their analogy. Hence arises the three new classical divisions, essentially distinct, and comprising—

(1) Plants with epigynous stamens, *i.e.*, plants in which the stamens are inserted on the pistil itself.
(2) Plants with hypogynous stamens, *i.e.*, plants in which the stamens are placed below the pistil.
(3) Plants with perigynous stamens, *i.e.*, plants in which the stamens are inserted on the calyx which surround them, rather above the base of the pistil.

These three divisions are again sub-divided, but we may confine ourselves to the above principal and essential distinctions which form the distinctive and invariable rule by which may be recognized easily plants having some analogy, and consequently such as are susceptible or not to crossing. Let us examine, then, how germination takes place, in order to adduce our conclusions as to the mode of obtaining a cross between plants.

At the time of the expansion of the flowers, it will be observed that the pollen is at the summit of the stamens inside the anthers, which having come to maturity, open and diffuse their pollen on the stigma of the pistil. The latter retains this powder, or pollenic semina, in the papilla of which it is composed. As soon as the germs of the pollen come in contact with the stigma, they undergo gradually a sort of germination and emit long fibres or roots called pollenic tubes, which penetrate within the style from whence they follow the central canal and reach the ovary, where they fecundate the ovules.

The omniscience of Providence is manifested in plants as in all other things of creation Thus, for instance, in monœcious plants, *i.e.*, plants which bear unisexual flowers of both sexes on each plant, almost all the male flowers blossom a little higher than, and above the female flowers, so that having reached maturity, the pollen of the male flowers falls more easily into the female flowers, and, assisted by its dynamic affinity, penetrates into the stigma or upper opening of the pistil of the female flowers; this has the subsequent effect of fecundating by its contact, the ovules which lie in the ovary at the base of the pistil.

Without this fecundation the ovules of the female flowers would remain sterile and would not be transformed into seed, susceptible to ultimate germination.

As regards diœcious plants, *i.e.*, plants, each stalk of which bears flowers of one sex only, it is a most remarkable fact that male plants grow in the same localities as female plants; this arises from the fact that the seeds from which these plants are produced contain the germs of male and female plants in almost equal numbers. Male plants all bear flowers in abundance. The quantity of pollen secreted therein is therefore large, and the pollen having arrived at maturity is carried away by attraction and dynamic affinity, assisted by its lightness and the breeze, on to the stigmata of female flowers which it impregnates.

This being the case, does it not stand to reason that if we place on the stigma of a female flower the pollen of a male flower of another species, but of the same family, that is to say, having in the structure of its organs of generation much analogy with those which distinguish the species of the female plant, it is probable, and almost certain, that we should obtain by this cross the seed of a new and composite plant, that is say, a hybrid plant, which will participate in the form and qualities of both the different species which have furnished the elements for its formation.

Indeed, this mode of crossing is well-known and practised by horticulturists, who daily put into practice this process of artificial fecundation to facilitate the obtaining of new hybrid plants of a composite nature. They arrive at this result by transmitting the pollen of one species on to the stigma of the pistil of another species, of which they have cut the stamens before maturity, *i. e.*, before the opening of the pollenic anthers. As a consequence of this cross a large number of hybrid plants are produced in gardens which offer us numerous new and beautiful flowers and ornamental plants.

It is by acting thus by analogy, though also according to other rules to be observed in regard to the animal kingdom, that we have obtained, and may obtain whenever we want, by the cross-breed of the hare and the rabbit, a new hybrid species called leporine.

The leporine increase and multiply *ad infinitum*, and form a new species of themselves. This is not a rare occurrence, and I have seen instances in the establishments of several amateurs of the leporine who rear them in large numbers. They are all obtained from one single cross-breeding, and their offspring increase and multiply to any extent.

But once again, it is desirable to observe that this indefinite increase of this new species cannot be obtained, either among animals or among



plants, unless great care is taken to effect the cross only between animals or plants very analogous and similar.

It is by observing this fundamental rule that we have succeeded in improving certain breeds of horses by well selected crosses. The same rules apply to cattle—cows, sheep, &c. The same again to fruit-trees, so far as regards crosses between pears and apples.

As soon as the analogy lessens between the two elements which form the couple, the offspring of their cross are no longer reproductive after the second generation, or perhaps the cross fails and remains sterile.

But in addition to this general rule, it should be borne in mind that while observing its principles, it is of much importance to make good selections of the subjects with which we intend to experiment, either in regard to animals or plants. Indeed, no one can ignore how much the physical qualities of the male exercise influence over the nature and constitution of the female ovum which it impregnates and modifies to some degree by introducing therein the germs which contain the essence of its own physical qualities.

Indeed, this fact is sufficiently proved by daily experience. It is for this reason that strong and well proportioned stallions are so carefully selected for studs, and that agriculturists value so highly strong and fine bulls.

One among the most striking instances of this kind within my knowledge, and one which I have seen and witnessed frequently, is the great modification of breed and of physical qualities resulting from a cross between the ewe of the North Holland provinces with the English ram with long and fine wool. These rams, which are superb and select animals, are purchased at very high prices, even at 10 or 20 times the value of a ewe. The sheep produced by this cross-breed are considerably superior in value to those of the aboriginal race. Indeed, the new or mongrel race produced by this cross is much stronger, more solid in flesh, and produce a longer, and finer wool in more abundant quantities. They subsequently increase and multiply to a greater extent.

These observations being quite accurate and precise, I consider that it is reasonable to conclude that it would be rational to apply this system to the cultivation of the white nettle, in case this plant, which thrives in high temperatures, should fail in the north of Europe to produce as luxuriant a vegetation as in the middle of Europe, and consequently should be condemned as not sufficiently strong and robust to be advantageously cultivated in the north. This evil might probably be remedied by crossing this plant with another species of the same family, but of a more robust nature, and one which thrives well in the north of Europe. I refer to the beautiful Tuscany hemp, the plant of which in Belgium attains a height of about 10 feet, as may be proved by inspecting the stocks deposited in the museum of Melle, which belong to plants sown and grown in the fields of Flanders.

The Tuscany hemp, which is the finest known, has still its defects in common with all kinds of hemp, and that is that the fibres are not fine enough, nor supple enough to make a suitable substitute for fine flax; whereas the white nettle, or *Bœhmeria Nivea*, is on the contrary specially distinguished for the beauty of its fibres, which are of a fineness, strength, and lustre which surpass by far the strength and lustre of flax. A few plants of the white nettle, which do not flower except in tropical climates or in hot-houses, may be easily cultivated in well manured earth in green-houses heated to 30° centigrade. At the same time the Tuscany hemp might be sown in the same green-house, and adjoining the white nettle. At the time of the flowering of the hemp, and before the flowers are full blown, all the male flowers should be cut away. And then it would only remain to impregnate the female flowers by shaking over their stigmates the pollen of the male flowers of the white nettle, or similarly to impregnate the female flowers of the white nettle with the pollen of the male flowers of the Tuscany hemp before they are mature. From this cross we might probably obtain a mixed nettle of a more robust nature, or the seed of a new mixed or hybrid hemp. The year following the experiment, the newly obtained seed may be sown to increase and multiply this new species to any extent. We might thus obtain a hemp plant, producing finer and more valuable fibres, which might supplant and replace flax, and with advantage too, as the hemp is more robust than the flax, and, moreover, hemp suffers less than flax from the inclemencies and variations of the seasons, while the yield in fibre of the hemp plant is ordinarily double the yield obtained from the flax plant. I trust that these practical reflections will find amateurs who may be in a position to make them still more conclusive and formal by well directed and fruitful experiments.

It would be more difficult to forecast by analogy whether we should succeed in finding similarly, by any system of cross, the means of improving also the productive qualities of the flax plant, and of obtaining new and hybrid species more robust and resistent to the inclemencies of seasons as well as to the attack of insects. In the first place it is not easy to find a plant thoroughly analogous and belonging to the same family as the flax plant. Because the flax plant, even if it bears some analogy to the white nettle and the hemp, nevertheless does not belong to the large family of *Urticeæ*. The flax, on the contrary, belongs to the species *Liliaceæ* of the family of *Geraniaceæ*. It is a dicotyledonous pentandrous plant, that is to say, it has five stamens with hermaphrodite flowers, *i.e.*, having in each flower stamens as well as pistils. Moreover the flowers are regular, and each flower contains five pistils and as many ovaries, and these together constitute the capsule. Each of these capsules of five ovaries or loculaments, contain two seeds, or in all twenty seeds, supplied each with a double endosperm. The endosperm is the white mucillaginous portion which partly covers the embryon or seed. The seed is composed of three distinct parts, the cotyledonous body; the female nutritive sperm of the roots; and the plumule at the time of generation. The cotyledonous body performs the same functions in regard to seeds and plants as the albumen or white of an egg does for the egg which contains it. It nourishes the young chicken which is being formed and developed. The female nutritive sperm of the roots at the time of generation forms the roots; and the plumule at the same period serves to form the stocks, leaves, &c.

Moreover, the flower is formed of a monosepalous calyx; that is to say, having the five leaves or sepals of the calyx as if soldered together and not separate.



These five divisions of the calyx of the flower are often unequal in structure and prolonged to a common base in one single spur. The corolla, or interior envelope of the calyx, is similarly divided into five equal or unequal petals. The petals are the divisions of the corolla as the sepals are the divisions of the calyx.

The sepals of the calyx are often twisted or fluted in spiral form just above the opening of the calyx. The aiglets of the petals are white. The five stamens are either free or united by their filament; moreover they are hypogynous, that is to say, placed above and around the pistils.

In short, the principal constitutional distinctions between the family of *Geraniaceæ*, to which the flax belongs, and the *Urticeæ* are the following :—

(1.) The *Urticeæ* have perigynous flowers, that is to say, that their stamens are inserted over the calyx while the *Liliaceæ* are hypogynous, that is to say, the stamens are placed below the pistils.

(2.) The flowers of the *Urticeæ* are unisexual, that is to say, that each flower contains only either the male or the female organs, and never both sexes in one flower, and they are monœcious or diœcious, that is say, that flowers of one sex only grow on one stock; while the flowers of the flax are hermaphrodite, that is, that each flower contains the organs of both sexes.

Moreover, the *Urticeæ* and the *Liliaceæ*, both belong to the great division of dicotyledonous plants. It cannot, therefore, be formally asserted *à priori*, that the constitutional difference between these two families is so marked as to render any cross between them impossible.

To make certain, the shortest way would be to try the experiment. For this purpose the blossoming of the flax, which takes place in June, should be artificially retarded, by sowing later in hot-houses, so that the blossoms may not show themselves till July, the time when the hemp and the white nettle blossom. If this first difficulty is surmounted, so as to obtain flowers on both plants simultaneously, it would then be necessary at that time to cut the stamens, or only the pollenic anthers of the flax flowers as each flower opens, and then to impregnate the pistils of the flax flowers by shaking over their stigmates the pollen of the male flowers of another textile plant, for instance, the white nettle, the fibres of which are finer than the flax or hemp.

If this cross is fruitful, the seeds which are thus formed can be sown in the following year, and the fact would soon be established how far we have advanced in agriculture and industry by the multiplication of this hybrid plant.

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## RETTING FOR THE PURPOSE OF DISINTEGRATING FIBROUS STALKS, SUCH AS FLAX, HEMP, AND CHINA GRASS.

THE process of retting in still pools and in running streams is sufficiently well known and has been described by several authors, and especially by M. DeMoor d'Alost in his treatise on the cultivation of flax, edited by H. Tarlier at Brussels. It is therefore unnecessary to enter here into details on this subject.

It will be sufficient to bear in mind that in many countries still pools or running streams do not exist. In such cases it becomes necessary to provide artificial agency for retting, by constructing large masonry basins or vats. In other countries, again, retting in running streams is prohibited. And, again, it frequently happens that the water of local streams or stagnant pools is not suitable for the purpose. Sometimes the current of a river is too strong, and there would be danger of the stalks and all other materials being swept away. Or the water may be too impure, calcareous, ferruginous, and too saturated with sand and mud, and all these substances harm, impede, and at times prevent the retting from taking a suitable course.

To obtain a good result of retting of the stalks of fibrous plants, we should have to secure as far as possible a stream of moderate force, with clear and transparent water; an aluminous, clayey, or argillaceous and fatty bed will do no harm, but rather benefit the retting.

Retting cannot be carried on in frozen water, nor in water in which the temperature is above 40 degrees centigrade. The most suitable temperature of water to ret rapidly is 20 to 30 degrees centigrade, and the reason for this is that retting in its essence, and by its own nature and action constitutes, scientifically speaking, the acetic fermentation of the cortical sap which causes the fibres to adhere to each other and to the ligneous part of the stocks.

The sap of plants is like the sap or substance of seeds, composed in variable proportions of starch, vegetable gluten, and a certain proportion of nitrogenous and sticky resin.

At the temperature stated above, the vegetable gluten decomposes and is transformed by fermentation (that is to say by oxidation of the amylaceous and hydrocarburetted matter) into vinegar or acetic acid.

Dr. Jules Lemaire of Paris has proved, in his clever work on phenic acid, that fermentation in itself is not a chemical reaction, arising from a simple molecular attraction, but on the contrary, that alcoholic, acetic, or putrid fermentation, no matter at what stage, is the result produced by the vital action of infinitely small, but well formed and living insects, quite visible with the solar microscope. They are called "ferments."



These insects cannot live and multiply except at the same temperature at which other living insects exist; and this explains why retting is better performed at a temperature of 20 to 30 degrees centigrade.

To obtain fermentation it is therefore necessary to have—

(1.) A fermentescible nitrogenous matter, such as gluten, which exists in all vegetable saps.
(2.) Water in sufficient quantity.
(3.) Contact with air.
(4.) A suitable temperature.

To obtain an alcoholic fermentation, it is necessary, in the first place, that the amylaceous or hydrocarburetted matter should by maturation or saccharification have been previously hydrated and oxygenated, so that by this process only it should be rendered sufficiently rich in oxygen to undergo alcoholic fermentation.

It is thus that starch-makers, who crush and ferment the flour, without any other preparation, obtain the following results:—

(1.) The decomposition of the gluten, which is absorbed by the ferments which separate it, feeding themselves and converting it into myriads of microscopic ferments which separate themselves from the starch or amylaceous matter. Now, according to M. Pasteur, the solid particles drifted by the atmospheric air are the origin of all vegetable and animal productions which exist in fermentations. These particles, examined by the solar microscope, are really amorphous particles, constantly associated to corpuscles, of which the form, size, and structure show that they are organized like the eggs of the *infusoriæ* and sporules of the *mucedinæ*.

(2.) Solid particles of amorphous matters, drifted by the air, exist everywhere, and as soon as they meet a suitable medium for their hatching, are rapidly developed. In the feculæ, at the time of fermentation, the hatching and multiplication of ferments take place at the expense of the nitrogenous portions, or the gluten; while by the absorption of the oxygen of the air, and the decomposition of water, the ferments oxidize at the same time a portion of the starch, and transform it into acetic acid. This partial transformation of the starch causes a waste or loss of the amylaceous matter. If the starch were not subsequently washed and precipitated, in order to separate it from the ferments, these insects, in continuing to oxidize the starch, would gradually transform it before long wholly into vinegar.

Whereas starch-makers only use flour to obtain dry starch; brewers, on the contrary, use the wheat seed to dissolve the starch first, and then to obtain alcoholic fermentation, and this compels them, in order to obtain such a result, to subject the seed to two preliminary operations, *firstly*, to oxidize the gluten by transforming it into diastasis by the effect of the germination of the seed; in fact the oxidized gluten can then act as a substitute for the acids, helping thus, *secondly*, the natural saccharification of the starchy or amylaceous matter of the seeds; because, to prevent the amylaceous matter from fermenting acetically, brewers are obliged at the onset, and before the fermentation begins, to saccharify it. This process is called in slang language, and as a purely conventional term, in French "*maltager*," instead of simply calling it "saccharification" This saccharification and hydratation of the amylaceous matter is obtained by heating it in water at 60 or 70 degrees C, either with a little acid, or with diastasis. After the starch has been saccharified and rendered soluble, it can be made to undergo alcoholic fermentation as soon as the temperature is lowered to 25 degrees C; because, as soon as the diastasis or nitrogenous matter mixes with it, the ferments develop themselves and transform the diastasis into yeast, at the same time oxidizing and transforming into alcohol the farinaceous matter saccharified.

These myriads of ferments, which always live, increase, and multiply rapidly, absorb air as well as a good quantity of the hydrocarburetted compounds contained in the sap and flour. Now, in breathing they throw out the carbon in the form of carbonic acid, which is at the same time formed by the simultaneous absorption of the oxygen of the air and the carbon from the amylaceous matter. If, then, the alcoholic fermentation is not stopped at the proper time, and the liquid is not shut out from contact with the air in order to stop the process of fermentation which always still exists in a latent state, if these precautions are not taken, fermentation takes its course, and continuing its work it transforms gradually the liquid of the alcoholic bath into acetic fermentation; that is to say, if the alcoholic fermentation is not moderated or entirely stopped, the continued oxygenation which results ends by transforming it into an acetic fermentation. Moreover, if the liquids in process of acetic fermentation contain much nitrogenous and glutinous matter, the ferments increase prodigiously, and then only the neutralization of the nitrogenous substances, or the exclusion of air, can prevent the acetic fermentation from turning rapidly into putrid fermentation; because the more active the fermentation, the more rapidly does the oxygenation increase, and equally rapidly do the hydrocarburets which naturally exist in the liquid weaken and disappear in the form of carbonic acid produced by the active breathing of the myriads of ferments which exist in all processes of fermentation, and which visibly increase with surprising rapidity. This I have seen with my own eyes in drops of liquids in course of fermentation when examined with the solar microscope. As they increase and multiply, they increase the oxygenation and transform the fermentescible substances which are in the liquid.

Alcohol is composed of—

| | |
|---|---|
| Carbon ... ... ... ... | 52 |
| Hydrogen ... ... ... | 13 |
| Oxygen ... ... ... ... | 35 |
| | 100 |

Vinegar is composed of—

| | |
|---|---|
| Carbon ... ... ... ... | 48 |
| Hydrogen ... ... ... | 6 |
| Oxygen ... ... ... ... | 46 |
| | 100 |



Alcohol, therefore, as shown above, is richer in carbon and hydrogen than acetic acid, but the latter is richer in oxygen. The transformation of alcohol into vinegar by the agency of ferments is therefore a decarburation and at the same time an oxygenation of alcohol.

When putrid fermentation occurs, it is evident that the proportion of the protective hydro-carburets contained in the bath has considerably diminished, and that the equilibrium is destroyed. From that moment the ferments absorb, oxidize, and convert the remaining substances into new compounds, some volatile others stable. There then takes place a general decomposition, and ordinarily more rapid when exposed to the air. Putrid fermentation throws out, among its volatile products, a large quantity of carbonic acid, ammonia, sulphuretted hydrogen, and acetic acid. There remains ultimately only a kind of *humus* of which all the nitrogenous and fermentescible matter has successively been decomposed and has disappeared almost entirely. The deposit which remains consists (according to the substances in process of decomposition) only of some oxydes and metallic and alkaline salts and sometimes of a little ulmen or carbonaceous substances.

I have said above that the saccharification of amylaceous matters is a process of hydratation, and at the same time of oxygenation, and my statement is justified by the two following formulæ:—

The fecula of barley is composed of—

C1 H10 O5

Whereas soluble sugar or glucose, to which this fecula is transformed by the operation of saccharification, is composed of—

C12 H14 O7

The transformation of feculous and gummy matters into sugar is therefore a simple assimilation of the principles of two atoms of water absorbed by each atom of fecula or gum under the influence of a temperature of 70 degrees C, and this is done in comparatively a short space of time, from two to three hours.

It is most remarkable to what extent organic transformations modify and change their nature completely at different temperatures.

For instance fecula.

(1) At a temperature of 20 to 30 degrees C it ferments and produces vinegar or starch.
(2) At a temperature of 50 to 80 degrees, and particularly at 70 degrees, it becomes hydrated and saccharified and is transformed into sugar.
(3) At 100 degrees it will only make starch.
(4) From 150 to 200 degrees it will be transformed into transparent and fluid dextrine.

The variation in product which is obtained at different temperatures is well worthy of attention. These divers results also show that the determining action of each transformation has also a different cause for each of the divers transformations, varying according to the temperature.

I have endeavoured in a few words to explain at once (1) what fermentation in general is; (2) what distinguishes alcoholic fermentation from acetic fermentation; and again the latter from putrid fermentation.

These general outlines will suffice to make it understood that, in the retting of flax, the usual fermentation of the sap which incrusts the stalks of the flax and other fibrous plants, the first fermentation which takes place, and the only one which is useful, is acetic fermentation.

But the contact with air and the large quantity of gluten and of nitrogenous gum contained in the sap causes the acetic fermentation to degenerate partly into putrid fermentation, owing to the causes above indicated. The last fermentation is superfluous and has the disadvantage of emitting a very offensive odour, arising from the escape of ammonia and hydrosulphuretted acid. Apart from depreciating, more or less, the quality of the fibre and making it lose its strength, putrid fermentation attacks also the cellulose. I have reason to believe that I am the first who has enunciated this theory of the intimate action or process of retting, which, confined to its useful action, should only effect a decomposition of the sap or gummy-resinous substance, and destroy its gluten or vegetable albumen which makes the fibres adhere to one another. With this object, we must ferment or ret acetically, taking care to avoid the development at the same time of putrid fermentation, which always occurs in empiric retting in the open air. I have studied the manner of confining scientifically and industrially the process to its useful action, and at the same time avoiding the other inconvenience I have mentioned above.

After numerous experiments I have been able, on principle, to establish the fact that carbon, sulphur, and clay, or, in lieu of the latter, alkaline salts such as chalk, used in proportionate quantities, possess the properties of maintaining the action of retting to acetic fermentation, and of avoiding putrid fermentation and the offensive odours which empiric retting emits. This result will be easily understood if we bear in mind the following chemical principles.

(1.) Clay, or alkaline salts, absorb a large portion of the acids which are formed during the process of fermentation called retting.

(2.) Carbon, as well as certain carburetted salts, have a strong decomposing action on the ammonia and hydrosulphurets which emit such nauseous odours.

In fact, carbon seeks hydrogen and energetically decomposes ammonia and hydrosulphurets by absorbing their hydrogen with which it forms hydrocarburets. From this important decomposition, it follows that the nitrogen of the ammonia escapes without emitting offensive odours, and that the sulphur of the hydrosulphurets escaping in its nascent state forms with the alkaline salts, which are added to the bath, alkaline sulphurets which remain dissolved. These alkaline sulphurets have besides a most remarkable decomposing, discolouring, and deoxydizing action on nitrogenous, gummy, and albuminous substances, and also on metallic salts.

Sulphur, by its affinity for oxygen, decomposes the colouring or other metallic salts by absorbing their oxygen, and precipitates the colourless base, or the base of metallic salts; whilst other parts of nascent sulphur decompose the nitrogenous substances, and with them form compounds highly soluble in water, as I have before shewn in my treatise on bleaching with sulphurets.



But it is clear that, to arrive at this result in practical experiments, we must guard against the total loss of the chemical agents used in the operation, and the loss would inevitably occur if the operations were carried on in running streams or in muddy ditches.

It is, therefore, absolutely necessary to carry on the operation in reservoirs or masonry vats, in which the fibrous matter can be retted. If these reservoirs or vats can be covered with planks or folding doors, so as to prevent the direct contact of air in the bath, so much the better.

Pulverized sulphur should be boiled with soda, clay, or lime in a vat by means of a serpentine tube in order to obain alkaline polysulphurets in the manner I have indicated in my treatise on bleaching. A small quantity of this alkaline polysulphuret (about ½ to 1 per cent. of the weight of the stalks to be retted) should be put into the retting bath. An equal quantity of finely-powered charcoal should be added.

By this means it is surprising how, at comparatively trifling cost and with less water than otherwise, superior retting may be obtained without inconvenience, a really good retting rendered industrial and rational which succeeds even with water not of the very best, as the salts which it contains are neutralized by the means of the agents employed. To ret rapidly it is only necessary to keep the temperature of the bath to 25 degrees by means of tubes heated with steam having an exterior opening, or with any apparatus for heating water.

It would be an advantage if on one or other side of the reservior a little space were reserved to fix a small paddle-wheel so constructed as to revolve in the bath. It would have the effect of keeping the bath in motion by a continuous artificial current. This makes the retting more regular and uniform.

The expenditure in ingredients is trifling and insignificant when compared to the results produced. But the initial outlay in starting the establishment on this system is large. In fact the expenditure under this head may be likened to the initial expense needed to establish a filature as compared with the first outlay for spinning with the hand. The latter scarcely needs any installation, but it only produces results very inferior to spinning by machine.

I consider that this method by its rational simplicity does away with every difficulty that may exist in any other system for establishing suitable factories everywhere for cleaning fibre. It is the presence of obstacles and difficulties which have hitherto prevented the establishment of such factories everywhere.

As soon as we can find the means of retting in masonry vats with a comparatively small supply of water, we are certain to find everywhere sufficient water in wells from which we might pump whenever occasion required. The abovementioned ingredients which I have added to the bath cause the retting to progress rapidly, and the alkaline sulphurets which are a part of the bath absorb the products arising from fermentation, and the water remains comparatively cleaner, and is less surcharged and saturated with heterogeneous substances and fermentation progresses regularly and without inconvenience. To carry on the operations on a large scale, the simplest way would be to construct the vats one after the other the whole forming a long rectangle, divided into compartments of about six feet square and being also six feet deep.

The masonry walls of the vats should begin about three feet above ground in order that an opening may be left at the bottom of each to allow the foul water to run out after each operation. These openings should be fitted with wooden taps; but in case this is not possible, a portable syphon will answer the purpose of drawing out the water.

A long pipe placed above the vats with a tap fitted before each vat will serve to conduct the water from a reservoir or well. The water may be pumped up by a small windmill or a small and inexpensive vertical engine.

The fibrous stalks are kept under water by means of transverse wooden beams. These beams are held down at their extremities by means of a sort of anchor built into the walls of the vats and of which only the top rings are visible. Into these rings the ends of the beams are placed. As soon as all the stalks are properly placed, the vats are covered either with folding doors, or with planks, or straw, and then fermentation does not delay to declare itself. Putrid fermentation being stopped the danger of over-retting or rotting is not to be apprehended. In a few days the retting will have been completed. The retted stalks are then removed and dried, either in sheds on trellis-work shelves, or by placing the stalks pyramid fashion on the ground as is done by flax retters along the borders of the Lys.

A second retting is sometimes necessary when the first is considered insufficient.

After retting and drying, the stalks are ground and softened in a flax grinder and the wood of the stalks removed. A course of peeling completes the process of disintegrating this fibre. It only then remains to offer the produce to filatures for the purpose of being combed out and spun There is then we see the means of carrying on almost anywhere and everywhere the retting of textile stalks, methodically, and regularly, and without inconvenience, by following the above instructions.

This mode of retting has also a double advantage of furnishing manure for the soil with the water used for retting which has little or no stench. This manure promises to restore to the soil a large proportion of the elements withdrawn from it by the cultivation of textile plants, and thus to enter into the list of agricultural principles traced by distinguished agriculturists, among whom I may name Monsieur le Comte de Gasparin in his treatise on agriculture Vol. IV textiles, pages 323, 331, 335, 336, and especially 337 as conclusion.

The filthy water from the vats has a slightly sour smell, which is the natural result of acetic fermentation, but is not disagreeable. This water which contains in solution, the substances composing the sap or the glutinous substance rendered soluble and decomposed by fermentation is evidently an excellent manure. To reduce it to *poudrette*, it is only necessary to allow the water to run out into cisterns and to add thereto a little lime which will absorb the acids and precipitate the metallic salts.

It would then remain to pump or draw out the water from the top after 24 hours standing, and collect the fertilizing *poudrette* from the bottom of the cistern.



## NEW BELGIAN GRINDER.

*For grinding hemp, breaking and grinding stalks of the flax and other fibrous stalks of various plants after retting. Prize medal, Havre Exhibition*, 1868.

This machine excels all others hitherto constructed for the purpose. Its great weight and its solidity prevent dislocation of its parts while it works with great rapidity. The differential or backward movement which is applied to it to obtain a complete bruising of the flax is extremely simple. This system does away with the numerous pinions and wheels of all other similar machines which have the disadvantage of constantly requiring repairs by wear and tear, and by the breakage of cogs of wheels which annually involve heavy expense. In the new system, only the strictly indispensable pinions have been preserved, and the others have been replaced by perpetual screws; the bearings and cylinders can easily be removed by any workman when they require cleaning. The grease boxes of the bearings have outward openings only and this prevents the dust from going in.

This new grinder can turn out from 2,000 to 3,000 pounds of ground flax per diem. The bruising and grinding is so thoroughly performed that the flax in being turned out is three-fourths separated from its husk by which it loses upwards of half its raw weight which falls to the ground in the shape of pounded straw.

It is then necessary only to administer a few strokes with a mallet to remove from the fibre of the flax the last remnants of straw which still adhere to it.

But this is not all. This bruising of the stalks of the flax destroys also the gummy substance which causes the fibres to adhere to one another, and this process renders the quality of the flax finer and of greater value. The flax thus worked becomes soft and silky without losing any part of its strength.

The final result is, that it doubles the daily outturn of flax produced by hand-labor, while at the same time it facilitates labor and improves the quality and reduces the loss of fibre. The tow which is turned out from flax bruised in this new grinder is notably of much higher value owing to the separation it has undergone.

Flax, hemp, or Ramie stripped with this machine are also softened and the fibres cleaned without having in any degree lost their strength.

This machine is admirably well adapted to soften hemp and jute and can turn out up to 4,000 pounds of fibre per day. Price of the grinder complete 750 francs—£30. Apply to Monsr. Moerman Laubhur, at Ghent.

## MODE OF WORKING THE GRINDER.

To grind flax, the stalks are spread out in small handfuls on the able in front of the cylinders. The stalks are first gathered together u order to have their base on the same plane. To do this, a handful f stalks is taken and held up vertically, and then stamped smartly n the table two or three times, and this has the effect of bringing the ase ends on the same plane. They are then presented to the cylinder ase foremost. The small handfuls of stalks should be well spread out o as to have them separate and along side one another in parallel lines s far as possible.

In passing between the cylinders the straw of the flax is crushed nd detached from the fibre, and a large portion falls to the ground. When the flax has gone through the cylinders, the spread stalks are gain brought out in handfuls by seizing their ends and gathering them ogether. These small bundles are then made over to the flax cleaner, who completes the operation with a few strokes of the mallet.

Care must be taken in presenting the flax stalks to the cylinders, nd in receiving them after grinding not to advance the fingers too close o the machine, or they will be crushed between the cylinders during heir alternate motion. It is, however, sufficient once for all to warn he workmen of this danger in view to avoid accidents, which are to be eared in every system of machinery when careless workmen are about.

The motion of the grinder is such that the cylinders move forward certain number of cogs, and return again backward some cogs less; t is this motion that gives the crush. Besides, by this continuous orward and backward movement, the stalks which pass through the ylinders are better ground than if they passed under 25 cylinders without the backward movement.

With the adjusting screws which are over the cylinders, the ressure and degree of friction can be varied at will.



## NOTA BENE.

At the time of concluding this pamphlet, I notice a note published in the *Moniteur* to the following effect:—

HOME DEPARTMENT, *dated the* 11*th January* 1870.

1. The Government of India, after communication with various Agricultural and Horticultural Societies in India, and with persons interested in the subject, has arrived at the conclusion that the only real obstacle to the development of an extensive trade in the fibre of Rhea, or China grass, is the want of suitable machinery for separating the fibre and bark from the stem, and the fibre from the bark, the cost of effecting such separation by manual labour being great.

2. The demand for the fibre is now large, and no doubt might be extended with reduced prices, and there is a practically unlimited extent of country in India where the plant could be grown.

3. The requirements of the case appear to be some machinery or process capable of producing, with the aid of animal, water, or steam-power, a ton of fibre of a quality which shall average in value not less than £50 per ton in the English market, at a total cost, all processes of maunfacture and allowance for wear and tear included, of not more than £15 per ton. The said processes are to be understood to include all the operations performed, after the cutting and transport of the plant to the place of manufacture, to the completion of the manufacture of fibre of the quality above described. The machinery must be simple, strong, durable, and cheap, and should be suited for erection at or near the plantations, as the refuse is very useful as manure for continued cultivation.

4. To stimulate the invention or adaptation of such machinery or process, the Government of India hereby offers a prize of £5,000 for the machine and process that best fulfils all the requirements named above.

5. Rewards of moderate amount will be given for really meritorious inventions, even though failing to meet entirely all the conditions named

6. Arrangements will be made by the Government of India for the supply of carefully dried stems and specimens of fibre separated from the bark, but subjected to no other process, to mechanical firms and others desirous of competing, on application to the Secretary to the Government of India in the Home Department.

7. All machinery, &c., must be brought by the competitors at their own charge to a locality which will be notified hereafter, probably in the North-West Provinces or the Punjab, and there worked under the supervision of their own representatives for a sufficient time to enable the judges appointed by Government to determine whether all

the conditions named have been complied with. The prize machine is to be transferred, if required, to Government at 5 per cent. above cost price; the patent right in any such machine to be also transferred, if required, to Government, on the latter securing to the patentee a royalty of 5 per cent. on the cost price of all machines manufactured under the patent during its currency.

8. One year from the date of this advertisement will be allowed for the preparation of the machines and their transport to the locality named for the competition; and the trials will then be made and the decision of the judges announced. If no invention of sufficient merit is received in the above named period to obtain the prize offered, the Government will continue to allow machines to be tendered for trial till the end of two years from the same date, after which, or on the award of the prize, the offers herein made will be withdrawn.

By order of the Governor-General in Council,
E. C. Bayley,
*Secy. to the Govt of India.*

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Looking to the above dates my pamphlet will be too late for the time fixed for judging the machines unless the time be deferred to a later date, However, considering the nature of the adhesive sap of the Ramie fibres, a sap which it is necessary to destroy in order to obtain the end in view, I state, as a fact (as is besides proved by what is actually going on in this respect in China and Java and in our country in regard to flax and hemp), that no grinding machine can by itself produce the required results. Some kind of retting, either preliminary or subsequent, is indispensible. I think my pamphlet indicates precisely the way to be followed in this matter.



## ANNEXURE No. 1.

Mr. Bernardin, Professor of Sciences at Melle, Ghent, who has given much attention to exotic products, has had the kindness to favor me with a few interesting notes, which will undoubtedly prove of use as a reference, and for this reason I transcribe them below.

### Synonyms of a few Bœhmeria.

*Bœhmeria* is the generic name of all prickless nettles, and at the same time it is the synonymous term of some species according to the *Museum Botanicum Lugduw Batavum, auct.* C. L. Blume, Lugd. 1849.

The following is the opinion of some authors regarding the synonyms of the principal species of *Bœhmeria.*

### 1.—Bœhmeria Sanguinea.

The name given by Haskrall to this species of the nettle or textile plant corresponds with the name of *Margyricarpus Vimeneus* given by Wedell. It is also the *Bœhmeria ovalis* or *Pouzolzia ovalis* of Miquel, or the *Urtica Sanguinea* of Blume. It is also the same plant called in the Sond Islands by the name of *Kapierit* or *Kiepierit lumbut*, and in Java by the name of *Sarabang Rameh*, or in Malay by the names of *Rami, Verang-Veranga.* According to Blume there exists a species called *Glabrata,* which is either the *Pouzolzia Montana* of Miquel, or a variety thereof. The *Montana* of Von Siebold and Zuccari. The *Rubra* or *Minor*, that is the *Margyricrapus exasperatus* of Wedell, or a variety thereof. The *Minor* of Gaudichaud, or the *Bœhmeria microceltis* of Miquel.

### 2.—Bœhmeria Nivea.

This species has received its name from Gaudichaud, and is called in the Island of Sond by the name of *Kara Musi;* in Japan it is called *Siri-So;* in Assam it is called *Rhea;* in the Marian Islands *Sidziafi;* in Sumatra its name is *Gohni*, in Japan *Reticulata.*

### 3.—Bœhmeria Tenacissima.

Like the preceding, this species owes its name to Gaudichaud. Blume called it *Bœhmeria Utilis*, and Haskrall, *Bœhmeria Candicans.* It was also called *Bœhmeria Nivea* by Miquel, and *Urtica Candicans* by Blume; *Urtica Tenacissima* by Roxburgh; *Ramiun Majus* by Rumphius. In Malay its name is *Rame, Rami*, or *Ramai.* In the Sond Islands it has several names, and it is sometimes called *Kiparoy, Kapieriet, Haramay,* and *Lalakkie.* In Sumatra it is called *Caloee* and *Klooi.* In the Celebes Islands its names are *Juan, Amboine, Gambe*, and *Gamki.* In Assam, *Rhea*, and in Cochin China, *Cay-Gai* and *Pa-Ma.* In Burmah, *Koang-Luong, I-Idi*, or *Kot-Bo-Bo, Koang-Paw.* In China there are two kinds known under the names of *Yuen-Ma* (the nettle of the plains) and *Chau-Ma* (the nettle of the mountains). These are the two varieties of the Province of Sut-Chuen. But in the neighbouring Province of Yunan the *Yuen-Ma* is again sub-divided into two sorts, viz., *Tsing-Py-Ma*, black, and *Houang-Py-Ma*, white.

Messrs. Decaisne and Lemaout regard the *Bœhmeria Nivea* and the *Bœhmeria Tenacissima* as two different species, whereas Royle and Wedell consider them as one and the same species, *i.e.*, Hooker's and Arn's *Bœhmeria Nivea*.

Dr. Blume is of opinion that the *Bœhmeria Tenacissima* was obtained in the Island of Sond by the cultivation of *Bœhmeria Nivea*.

4.—Bœhmeria Spicata.

This species received its name from Thanberg. It is also called in Japan *Iragusa S. Aka So.* In China *Tchou-ma.* In the Island of Sond *Varanga, A-kari, Akari*, in Japan *Icajaja-ma* or *Varanga-Tenera.*

5.—Bœhmeria Longispica

Of Blume, or *Bœhmeria Grandifolia* of Wedell; *Bœhmeria Macrophylla* of Von Siebold and Zuccari; *Urtica Macrophylla* of Thunberg; *Urtica Japonica* of Linné; *Urtica Elongata* of Gmelon; *Acolypha Japonica* of Houtt. In China it is called *Thon-ma*; in Japan *Yabou*, Mawa *Soura Siro-so.*

6.—Bœhmeria Candidissima

Of Haskrall, or the *Missiessya Candidissima* of Blume, who also calls it *Touchardia Candidissima*, or the *Urtica Javanica* of Wedell, or the *Lecocuida Candidissima* of Miquel, or the *Leucosyke Javanica* of Zoll and Moritz; or the *Urtica Candidissima* of Blume, or in the Sond language *Kiluntur.* This plant grows in the mountains at altitudes of from 3,000 to 4,000 feet.

7.—Bœhmeria Salicifolia

Of which Royle speaks, and which is named in India *Tusera.*

8.—Bœhmeria Palmata

Of Hooker, and of which experimental cultivation is being carried on in the middle of France.

9.—Bœhmeria Malabarica

Of Wedell, or *Urtica Aquatica* of Moon, or the *Maha-Drya-Dool* of Ceylon.

10.—Bœhmeria Puya

Of Blume, or *Maoutia Puya*, or *Bœhmeria Frutescens.* It is called *Puya* in India and *Poouh* in Nepal.

11.—Bœhmeria Verrucosa

Of Haskrall, or *Margyricarpus longifolius* of Blume, or in the Malay language *Orang-Orang*, or in Ceylon *Gas Dool.*

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## ANNEXURE No. 2.

In the *Journal of Agriculture of Tropical Countries*, second series, volume I, Mr. Bernardin says there are four types or races of the China nettle.



(1.) The white nettle, with green leaves, having their backs of a silvery white colour, a native of China.
(2.) The same plant transplanted to a damp climate, the leaves of which are also whitish at the back, but are of a deeper grey, and more veined like marble. It is to be found in Japan, in the Phillipine Islands, and in Bengal.
(3.) The race of Netherlands India, of which the back of the leaves are of an ashy grey colour at the top.
(4.) A less common race in China analogous to the preceding, the young leaves of which are either whitish or veined at the back, but which become of a uniform ashy grey colour when the leaves grow.

In No. 1 when the stalks are mature they become of a reddish colour, and ordinarily grow to a height of one foot six inches to three feet.

In No. 4 also when the stalks are ripe they assume a dark colour but only attain a height of 18 or 20 inches.

The catalogue of the Botanical Gardens of Java indicates only—

The *Bœhmeria Candicans* of Haskrall, which in Java is called *Rameh*, and in the province of Palemberg, in Sumatra, *Kloei.*

Further on this catalogue indicates the *Bœhmeria Nivea* of Gaudichaud, named in Java *Rameh*, and in the province of Palemberg, in Sumatra, *Gohni.*

The *Bœhmeria Tenacissima*, or as it is called in Java *Rameh Gœnong.* According to this catalogue, the *Bœhmeria Tenacissima* would be a variety of the *Bœhmeria Nivea*, but this variety would not be the same as the *Bœhmeria Candicans* of Haskrall. *Rameh Gœnong* means Ramie of the mountains.

The word *Rameh* in the language of the Island of Sond, and *Rami* in Malay and Riouw, appears to mean plants bearing strings or textile bark, and even simply string. The term *Rameh* is also applied in Dutch India to the following plants:—

The *Urtica Diversifolia* of Blume.
The *Urtica Nivea* of Linné.
The *Urtica Astuans* of Blume.
The *Corchorus olitorius* of Linné (a kind of jute).
The *Urtica Rugossissima* of Reinwardt (*Rameh Coeloes*).

*Rameh* in Java is the *Bœhmeria Candicans* of Haskrall.

Synonyms of a few other Urticeæ, the fibres of which are utilized.

(1.) The *Urtica aquatica*, *vide* above, *Bœhmeria Malabarica.*
(2.) The *Urtica Argentea* of Society Islands. Experimental cultivation of this species has been tried in the middle of France.
(3.) The *Urtica Caraccasana*, used in the Sandwich Islands in making nets.
(6.) The *Urtica Dioica*, known in Sweeden, &c.; very good for paper-making.

(7.) The *Urtica Gigas* or *Laportea Gigas* of Wedell, which is the nettle tree of Australia; the *Goo, Mao-Mah,* and *Irtaie* of the aborigines; the Rangoon hemp used for the manufacture of cordage in the East Indies, and in New South Wales

(8.) The *Urtica Heterophylla*, or Neilgherry nettle, called *Gota-Kahambilya* in India, *Daon Setaun.* ditto *Koemis Badak* in theIsland of Sond, *Silma-babhur* in Tamoul, *Hoeroe-surat* in Assam, *Serpah* or *Herpah* in Bhotia, *Theng* or *Tsing-ma* in China.

(9.) The *Urtica Japonica*, see *Bœhmeria Longispica*.

(10.) The *Urtica photoniophylla*, a small leafed nettle in New North Wales.

(11.) *Pipturus velutimes. Dex.* of New Caledonia, or *Tjaumoen*, in Java.

(12.) The *Pipturus propinqans* of New South Wales.

(13.) The *Cannabis Indica*, which also belongs to the tribe of the real *Urticeœ*. The natives prepare from its leaves a fermented beverage called *Bhang*.

(14.) To the same tribe of *Urtica* the following plants also belong.

*A.*—The hemp, *Cannabis Sativa*, the cultivation of which promises to increase in Europe.

*B.*—The hop, *Humulus Lupulus.*

*C.*—The paper tree, *Murus papyriferoa*, the bark of which is used for the manufacturing China paper and pretty good cloths.

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## ANNEXURE No. 3.

*Manuscript report sent by the botanist Bhune some years ago to the Governments of France, Belgium, Italy, and Spain.*

I RECEIVED a copy of this report from his son, Mr. Charles Bhune, Inspector of Forests, Java, and I publish it below.

GENTLEMEN,

FOR some time past European industry has been busy in trying to discover in the vegetable kingdom some textile material which, while surpassing hemp in strength, can be used as flax in the manufacture of cloths and the finer tissues. Some believed to have found such a textile in the New Zealand hemp (*Pormium Tenax*), others in the fibres of the *Pitta* (different species of the *Agava*) or in the Manilla hemp (*Musa textilis*), but an impartial analysis soon demonstrated that the fibres of these vegetables would not answer at all, or at least very imperfectly, for what was desired. The New Zealand flax is perhaps not so strong as the ordinary hemp of the *Cannabis Sativa;* and the Manilla hemp and the fibres of the *Pitta* are more suited to the manufacture of cordage than to the weaving of cloths and other tissues for which they are almost of no use whatever.



During my scientific researches in the Indian Archipelago, I had proposed to myself to direct my attention above all to the vegetable products in which these countries are so rich, as these products might be of the greatest use to humanity either in their healing properties, or for the different branches of industry, or for some economic purpose. It is not therefore surprising that the species of hemp known by the natives by the name of *Ramie* attracted my attention. From time immemorial, and even to the present day, the inhabitants of the Indian Archipelago give to the textile matter of this plant a marked preference in the making of their fishing nets. Experience has taught them that nets so manufactured are much stronger, and that water has less detrimental effect on them than on the nets made with the ordinary hemp. They also make several sorts of vestments which are distinguished for their extraordinary durability; but since the the low price of European calicos has nearly swamped all indigenous industry of this kind, the *Ramie* is no longer used for this purpose.

All that the experience of the indigenous fibres had from the first led me to conjecture in regard to the high value of the Ramie for technical uses, has been fully confirmed by experiments made by distinguished men with the fibre of the *Ramie* which I was the first to bring into Europe. These experiments have furnished the following results:—

(1.) That in point of strength the fibre of the *Ramie* surpasses by more than 50 per cent. the very best flax.

(2.) That it is stronger than the best European hemp, and is less susceptible to injury when exposed to constant wet or dampness.

(3.) That it leaves much less refuse than the best European hemp.

(4.) That it can be spun to a greater fineness than the ordinary hemp and about to equal fineness as flax, so that the tissues made therefrom have twice the strength of the flax tissues and are stronger than hemp tissues.

(5.) In fine, that the *Ramie* being a more vivacious plant produces a much larger quantity of textile matter than any other plant of the kind yet known.

This induces me to offer a few remarks on this useful plant and on the mode of cultivating it.

The *Bœhmeria Utilis* of Blume is well spread in all the large islands of the Indian Archipelego where it is known under the Malayan name of *Rame* or *Ramie*. It grows in the shade on a damp and fertile soil, and both these conditions are happily to be found combined in abandoned coffee plantations which are very numerous in almost every colony where the cultivation of coffee is established on an extensive scale. This remark alone will suffice to indicate precisely in what countries the *Ramie* can be successfully cultivated.

I incline to believe, without emphatically asserting it, that with the exception of some parts of Greece, the two Sicilies and Sardinia, the whole of Europe is not suited to this cultivation which however might perhaps be successful in some countries of the Caucasus and will without doubt be successful in the tropical and subtropical, countries of both hemispheres, where both the physical conditions mentioned above are combined. I should observe at the same time that this cultivation succeeds better in hilly or mountainous countries where there is much and frequent rain, than in the plains.

My reiterated representations to convince the Dutch Government of the importance of this cultivation, have induced that Government a few years since, to try experiments at Java, but they have all turned out unsuccessful. The reason of the failure is very simple. Rice lands were selected for the plantations. Now rice lands by their open position are altogether opposed to the nature of this plant which only thrives in the shade.

The cultivation of Ramie is carried on in the most easy and simple manner, by using the roots of the plants divided in pieces. These are sown three or four feet apart, and it is only for the first few days after planting that it is necessary to dig and weed the surrounding soil. Under the favorable conditions which I have indicated above the plant very soon throws out stalks of from five to seven feet high. As soon as the epidermis of the bark assumes a dark brown hue, the stalks are cut down in view to the disintegration of their fibres. From experience it has been proved that the stalks can be cut at least four times a year; and that even in the first year, the first crop yields four stalks, the second crop gives six to eight stalks, the third crop from ten to twelve stalks, and the fourth crop from 16 to 20 stalks. The succeeding years are more productive than the first. The plants increase at a most surprising rate, like the nettle at home; but care must be taken to cut the stalks down to the roots from whence they spring. It will be desirable also, to hasten the first crop, and not to wait on this occasion for the perfect ripening of the stalks, and this is urged so much the more, as the fibre of the first crop is considered of an inferior quality to the fibres of subsequent crops; at least the natives do not turn it to any use.

As regards the preparation of the textile material (of which each stalks contains as much as a whole plant of ordinary hemp) the natives are not very adroit. The natives of Java are absolutely ignorant of the manner of destroying by fermentation the glutinous portions by which the fibres adhere to one another as in the case of the hemp. Here is how they proceed in this matter at Java. After dividing the stalks into two parts by a cut throughout the length, they remove the bark form which they then remove the epidermis and the adhesive portions by scraping it with a knife until the fibrous pelecules begin to appear. This substance is white, with a slight shade of green. They content themselves with washing this substance several times in - water, and then dry it, but this manipulation as will be easily understood is not sufficient to destroy and purge out the glutinous matter which adheres to the fibres, and which in the Ramie is of a similar nature to the *caoutchouc* and to the gummy resinous matter of the flax.

In parts of Borneo and Sumatra where the Ramie is cultivated the preparation of the textile material is carried on on a little better system. This is the procedure followed in Borneo and Sumatra, which although susceptible of improvement in many respects approaches closer to the process adopted in Europe for the preparation of hemp.



The stalks of the Ramie collected in bundles are exposed for four or five days to the action of water to destroy the epidermis of the bark. Then the cortical body (containing the fibrous textile) is taken out and dried and then exposed for several days to the dew.

There is then no doubt that this plant is amenable (like the ordinary hemp and flax) to manipulation which destroys the glutinous portions; in fact the nature of the plant and the structure of its stalks indicate this sufficiently. And yet it is possible that this manipulation may need some modification in regard to the grinding of the fibres, either by the natural force of water, or by some machine, and that in this view we should have to refer to the localities where the plant is cultivated and where the fibre is prepared for exportation.

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## ANNEXURE No. 4.

*Extract from a notice on Ramie, published by Mr. Herman Grothe at Berlin, which appeared in the review entitled " Verhandlung des vereins fur Gewerbfleisz in Preussen,"* 1869. *May number.*

The fibres of the nettle have been utilized from very ancient date in the Himalaya mountains, and this is proved by passages in the ancient poetry of the Ramayana and in the verses of Kalidas, where mention is often made of the nettle cloth which is praised in these passages for its beauty and fineness.

There is an interesting notice on the tissues of the nettle in the *Breslauer Sammlungen*, Vol. XXVI. Review of November 1873, which has been copied in the *Histoire technique des plantes de Bohmer*, Vol. II, page 544.

Several authors assert that the fibres of the *Dioica* nettle were formerly used in *Picardy* for weaving purposes.

Pallas, in the history of his travels in the interior of Russia, states (Vol. I, page 436) that the Chinese often cheat the Russians by selling to them as silk-damask stuffs made with the warp of the nettle fibre and the woof only of real silk.

Some further details on the nettle will be found in a notice by Hophner in the *Magazin Helvetique*.

Kœmpfer, in his *Amoemtates Exot*, also speaks of the nettle fibre, and specially of the nettle which is cultivated in the south of Siberia, in Kamschatka, and along the Volga; and which is utilized, he says, in Japan under the name of *Mao Tojo* and *Karao*. Thunberg has written in the same sense.

In the *Jahrbuchern* of Nestor of the year 904 it is said that the sail-cloths of the ships sailing on the Volga were almost all made of the nettle fibre.

Steller in his description of Kamschatka, page 83, indicates how these people prepared the fibres of the nettle. It was very coarsely done.

The Sweedish *savan*, Rossig, furnishes in his technology on the uses of the common nettle (*Urtica Dioica*), a few details which will be read with pleasure by all those who are interested in this branch of industry. But I think it unnecessary here to enter into details on this point considering that the *Urtica Dioica* does not offer the advantages which the white nettle and its varieties afford.

According to Roxburgh, the first three bales of the Ramie fibre imported to England were imported from Sumatra to London (India office) in 1810 where the first experiments were made. On this subject might be read Dr. Royle's work entitled "The fibrous plants of India." London, 1855.

At the London exhibition of 1851, there were several specimens of fine tissues made from the fibre of the white nettle, indeed the tissues were so remarkable that several of the contributors obtained medals.

Marshall's filature, Leeds, received some of these fibres for experimental spinning and at that time estimated their worth at £48 to £50 per ton, raw. Marshall at times has spun the fibre of the Ramie up to 1,200 twist at once. Other filatures also spin this fibre; among them may be cited the following :

| | | |
|---|---|---|
| *2nd.*—The China Grass Company limited | ... | Wakefield. |
| *3rd.*—Messrs. Jos. Wade and Sons | ... | Bradford. |
| *4th.*— „ Whitworth and Company | ... | Halifax. |
| *5th.*—Mr. Verdure ... | ... | Lisbe. |
| *6th.*— „ Hugo Lindenberg ... | .. | Crimmitzchau. |
| *7th.*— „ H. Kohlase ... | ... | Chenwitz. |
| *8th.*—The Oldenberg filature. | | |
| *9th.*— „ Vechelder Spinnerei | ... | near Brunswick. |
| *10th.*—Hargreaves ... ... | ... | Dundee. |
| *11th.*—Edwards ... ... | ... | Dundee. |
| *12th.*—Batley and Greenwood ... | ... | Leeds. |
| *13th.*—Bertel and Cordier ... | ... | Rouen. |
| *14th.*—F. Pasquay ... ... | ... | Wasselone. |
| *15th.*—Bonneau and Mallard ... | ... | Roubaix. |

Marshall of Leeds spins the Ramie fibre as fine as No. 250, which is extremely fine.

Stanislaus Julin gives a complete description of the mode of cultivating the Ramie, as it is practised in the meridional provinces of China.

Major Hannay has described the mode of cultivating the Ramie as followed in Assam. He estimates that the average price paid up to this time for the raw Ramie fibre has been £20 per ton in Calcutta, and £40 per ton in London.

The question will naturally be raised whether the cultivation of the white nettle can be carried on on a large scale in the climate of Germany? We read in a report by Dr. Campbell, Superintendent, Darjeeling, that fibrous nettles are cultivated at altitudes of 3,000 feet above the level of the sea in the mountains of Nepal and Sikhim. This circumstance may hold out hopes that means will be found to proceed with the cultivation on an extensive scale in Europe. Mr. Burnitz of Frankfort, Mr. Rief at Prague, and Mr. Groth in Berlin are devoting great attention to the subject.

If we wish to examine in still greater detail some of the qualities of the fibres of the white nettle, we can in the first place cite its great elasticity and consequently its great strength which are so much appreciated by Indians.



Roxburgh in making comparative experiments has established the fact that notwithstanding their extreme fineness and brilliancy, the fibres of the white nettle excel all others in strength.

Royle confirms these experiments and declares that—

| | | | |
|---|---|---|---|
| If the strength of hemp be represented by | | | 160 |
| The strength of aloes will be | ... | ... | 190 |
| And of the white nettle ... | ... | ... | 280 |

All experimenters agree in this respect, Huddart as well as George Aston and others.

The latter gentlemen give the following results with untwisted fibres:—

| | |
|---|---|
| Strength of the Hemp of St Peterburgh ... | 160 |
| Ditto fibres of Yakka ... ... | 175 |
| Ditto „ Yerkum ... ... | 190 |
| Ditto „ of the white nettle of China . | 250 |
| Ditto „ „ „ of Assam (cultivated) ... ... ... | 310 |
| Ditto Assam (wild) ... ... | 343 |

The fibres of the white nettle spun as well as weaved, can be bleached as well as if not better than and as rapidly as the threads and tissues of flax and cotton. But they have in addition a brilliancy and a lustre which will be vainly sought for in flax or cotton. The tissues of China grass in this respect surpass by far the silk called *organsin.*

To comb out the fibres which have been already bleached, they are previously moistened, as in the case of jute, with a liquid composed of a saponaceous wash to which is added a little oil, and this preparation facilitates the separation of the fibres.

In England, the method laid down by Jungham Culpan, Bradford, is followed for the bleaching which preceeds the combing out. The fibres are thrown into a warm contentrated bath to which is added a small quantity of oil. When the fibres are well impregnated, the water is taken out by means of a hydro-extracter. The fibres are then dried and tied into bundles, and boiled in pure water for several hours. This operation is repeated as often as is considered necessary. The bleaching is brought to an end by steeping the fibres in a bath of hypochlorate of lime, and the final result is that the fibres come out perfectly separated, fine and free from the gummy and the other adhesive substances which depreciate their value.

The tissues made of China grass can be better dyed than those made of flax, but not so well as the cotton cloths It is necessary for all colours to use a mordant if it is desired to obtain a fast colour.

Mr. Grothe has also tried experiments to extract fibre from other nettles called *Urtica Urens* and *Urtica Dioica.* But he observes that the *Urtica Urens* does not and cannot produce good results as a fibrous plant considering that it only grows to an average height of one foot, and that its stalks throw out lateral shoots which as a matter of course make the fibres short and bad.

But the experiments which he has made with the *Urtica Dioica* have given him better results. This plant is very vivacious, and attains a height of six feet; it grows rapidly in straight stalks without throwing out lateral branches.

It is retted, ground, and trimmed in the same way as flax and hemp; 100 pounds of green stalks will give 46 pounds of dried stalks, or 32 pounds of raw fibre, which is equal to 20 pounds of combed out fibre.

Perhaps, as I have indicated above, there might be a means of obtaining from the seeds of a cross of this plant with the white nettle, a hybrid or mixed species more robust and more suited for cultivation in the north of Europe. Experiments in this direction have not yet been made, and it would be desirable that those who possess large fields should try such experiments as might turn out advantageous to them.

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## ANNEXURE No. 5.

*Letter from* MR. BONSOR, *Manager (Director) of the China Grass Filature, Phœnix Works, King's Road, Wakefield.*

*Wakefield, the* 18*th May* 1870.

MONSIEUR MOERMAN LAUBHAR, GHENT.

I PURCHASE raw China grass in London, in the state it reaches the market, or I buy it at Hankow in China. I sell the China grass tow at 7½ pence per pound. The buying price of raw China grass in Hankow is actually 8½ *taels* per *picul*, so that it comes up to £70 per ton in England.

The loss in the raw material varies according to quality from 23 to 38 per cent., and by adopting the following calculation there is no risk of losing:—

| | | |
|---|---|---|
| 33 | per cent. | loss. |
| 33 | „ | hackled. |
| 33 | „ | tow. |
| 1 | „ | dust. |

I have worked up several hundred lots of the China grass which have given me on an average the following returns:—

| | | |
|---|---|---|
| 22 | per cent. | loss. |
| 42 | „ | hackled. |
| 34 | „ | tow. |
| 2 | „ | dust. |

I have obtained at times up to 44 per cent. of hackled hemp which has proved to me that it is most profitable to buy only the very best raw material. The difference in price is easily made good by the superior returns in hackled hemp.

(Sd.) C. BONSOR.

I will supplement and complete the information given in the above letter by adding that Mr. A. Morgan of Bradford, advised me on the



4th June 1868 of the following rates as being those at which China grass could be purchased on that date at Bradford:—

| | | | |
|---|---|---|---|
| No. | 20 @ 2-8 | per pound. |
| „ | 30 @ 2-9 | „ |
| „ | 40 @ 3-1 | „ |
| „ | 50 @ 3-4 | „ |
| „ | 60 @ 3-7½ | „ |

*N.B.*—There already exist in Bradford several China grass looms where tissues of all colours and designs for dressmaking are being manufactured in imitation of silk and not so expensive. I think that the firm of Mr. W. Schaub at Bradford is one of the firms which deals in tissues of the China grass.

# APPENDIX.

BY R. DE DOMBAL.

## AMENDED NOTIFICATION.

*Fort William, the 26th January* 1872.

THE Government of India, after communication with various Agricultural and Hoticultural Societies in India, and with persons interested in the subject, has arrived at the conclusion that the only real obstacle to the development of an extensive trade in the fibre of Rhea or China-grass is the want of suitable machinery for separating the fibre and bark from the stem and the fibre from the bark, the cost of effecting such separation by manual labor being great.

2. The demand for the fibre is now large, and no doubt might be extended with reduced prices, and there is a practically unlimited extent of country in India where the plant could be grown.

3. The requirements of the case appear to be some machinery or process capable of producing, with the aid of animal, water, or steam-power, a ton of fibre of a quality which shall average in value not less than £50 per ton in the English market, at a total cost, all processes of manufacture and allowance for wear and tear included, of not more than £15 per ton. The said processes are to be understood to include all the operations performed, after the cutting and transport of the plant to the place of manufacture to the completion of the manufacture of fibre of the quality above described. The machinery must be simple, strong, durable, and cheap, and should be suited for erection at or near the plantations, as the refuse is very useful as manure for continued cultivation.

4. To stimulate the invention or adaptation of such machinery or process, the Government of India hereby offers a prize of £5,000 for the machine and process that best fulfils all the requirements named above.

5. Rewards of moderate amount will be given for really meritorious inventions, even though failing to meet entirely all the conditions named.

6. Owing to the delay that has taken place in maturing the preliminary arrangements, the Government of India has decided that the competition will not be held until the 1st April 1872, thus affording a much longer time than was originally intended for the preparation of machines and their transport to the locality appointed for the competition. The Government Rhea Plantation at Saharunpore, in the North-Western Provinces, has been fixed as the place where the public competition will be held, and the Government of India will provide one or more small steam-engines to work the machines during the public competition.

7. All machinery, &c., intended for trial must be brought by the competitors at their own charge to the Saharunpore Rhea Plantation,

and kept ready, before the 1st April 1872, to be there worked under their own supervision, or under that of their representatives, for a sufficient length of time to enable the judges appointed by Government to determine whether all the conditions named have been complied with. The prize machine is to be transferred, if required, to Government at five per cent. above cost price; the patent right in any such machine to be also transferred, if required, to Government, on the latter securing to the patentee a royalty of five per cent. on the cost price of all machines manufactured under the patent during its currency.

8. Arrangements have now been completed for the supply of dried Rhea stems to intending competitors, both in this country and in Europe, to enable them to form a correct idea of the nature of the plant which their machinery will be required to deal with. Persons in Europe desirous to obtain small supplies of dried Rhea stems for the above purpose, should apply to the Secretary of State for India. Intending competitors in this country, desirous of obtaining supplies of the article, must submit applications to the Secretary to the Government of India in the Home Department, in the Form A. hereto annexed, prior to the 1st of March 1871; and those who are desirous of testing their machinery on the fresh Rhea at the Government Rhea Plantation at Saharunpore during the year 1871, must submit their applications to the same authority in the Form B. hereto annexed, prior to the 1st April 1871. The former will have to pay the expenses that may be incurred in packing and despatching the stems. The latter will have to provide all labor and motive power necessary for, and to pay all expenses connected with, their experiments, the fibre turned out by their machines during such experiments to become the property of Government.

9. In order to enable the Government to arrange for the provision of a sufficient stock of fresh Rhea stems for the purposes of the formal competition in April 1872, it is necessary to ascertain beforehand the number of machines that are likely to take part in it; and intending competitors are therefore, requested to submit, prior to the 1st May 1871, and in the From C. also hereto annexed, notices of intention to compete.

## FORM A.

### Application for dried stems of the Rhea.

*To the Secy to the Govt. of India, Home Department.*

| Name of applicant. | Profession or occupation. | Address in full. | Quantity of dried stems applied for. | Locality to which it is desired that the stems be transmitted. | Name of nearest Railway Station to locality entered in preceding column. |
|---|---|---|---|---|---|
| | | | | | |



On hearing from the Superintendent of the Government Rhea Plantation, Saharunpore, the amount of the expenses to be incurred in packing and despatching the quantity of stems above applied for, or such lesser quantity as may be allotted to me, as also the cost of carriage of such quantity to (*here insert the locality to which it is desired that the stems be forwarded*), or to the nearest Railway Station, I promise to remit the total amount so required to the said officer, and I acknowledge that the packing and transmission of such stems will be entirely at my risk.

(*Name in full.*)

(*Date*)

(*Place*)

## FORM B.

### Application for permission to make preliminary experiments for testing Machinery at the Government Rhea Plantation, Saharunpore.

*To the Secretary to the Govt. of India, Home Department.*

| Name of applicant. | Profession or occupation. | Address in full. | Brief description of machinery proposed to be tested. | Date on which applicant, if permitted, proposes to commence testing his machinery. | Approximate amount of green stem which applicant expects will be necessary for testing the machinery. |
|---|---|---|---|---|---|
| | | | | | |

I acknowledge that, if permission be granted to me to test the above-described machinery at the Government Plantation, such permission will be subject to the following conditions :—

*1st.*—I am to provide all labor and motive power necessary for, and to pay all expenses connected with, testing my machinery.

*2nd.*—I am bound to conform to such rules in regard to time and place of conducting my experiments, hours of working, and the like, as the Superintendent of the Plantation may lay down for my guidance.

*3rd.*—I shall receive only such quantities of green stem, and at such time or times as, with reference to the other claims upon him, the Superintendent may find convenient to allot me.

*4th.*—All fibre, &c., turned out by my machines during these experiments with stems furnished by Government, will be the property of Government.

(*Name in full.*)

(*Date*)

(*Place*)

## FORM C.

NOTICE OF MACHINERY INTENDED TO COMPETE FOR THE GOVERNMENT RHEA MACHINERY PRIZES, AT THE TRIALS TO BE HELD AT SAHARUNPORE IN APRIL 1872, AND SUBSEQUENT MONTHS.

| PARTIES INTENDING TO COMPETE. | | | Number of different kinds of machines which competitor desires to take part in the trials. | Brief description of each kind of machine. | Motive power required to work the machine. | Date by which the machines will be ready at Saharunpore for trial. |
|---|---|---|---|---|---|---|
| Name in full. | Profession or occupation. | Residence in full. | | | | |
| | | | | | | |

In proposing to enter the above-noted machinery for the Saharunpore competitive trails, I do so under the full understanding that—

1*st*.—I shall be bound to conform to all rules and regulations in regard to all matters in any way connected with these trials that may be laid down by Government, or by the judges appointed by Government to preside over these, and that, failing to do so, I shall forfeit all claim to any prize, reward, or recompense from Government, and entirely disqualify my machinery for the competition.

2*nd*.—All fibre, &c., turned out by my machinery during the trials with stems furnished by Government, will be the property of Government.

A. O. HUME,

*Offg. Secy. to the Govt. of India.*

# THE RAMIE:

## (RHEA)

SYNONYMOUS WITH THE

## CHINA GRASS, URTICA-BŒHMERIA NIVEA,

ETC.

**Its Description, Mode of Cultivation, and Method of Disintegration, and Cleaning the Fibre.**

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BY

THEOPHILE MOERMAN,
GHENT, BELGIUM.

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TRANSLATED FROM THE FRENCH BY EDMOND DURUP DE DOMBAL,
*Bengal Secretariat.*

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