

THE FIBRE INDUSTRY.

Conditions in Hawaii at the Present Day.

Ramie.

Ramie, more generally known as China Grass or Nettle Fibre, is unquestionably the best vegetable textile material known. Its advantages over all others are so pronounced that the advocacy of its qualities by those who have carefully investigated its properties has been so enthusiastic that the very pre-eminence of this wonderful fibre has probably been as responsible for past failures to popularize it, as the ignorance and prejudice with which it has been associated. Not only has careful investigation led to a better understanding of the value of Ramie, but the improvement of manufacturing methods, conducted over many years, has produced machinery adapted to the peculiar difficulties of the fibre, so that its cultivation in suitable localities may now be undertaken with every assurance of success.

In compiling this paper reference has been had to the most authoritative sources of information on this subject available at the present day. The object aimed at has been not only to present systematically an account of the general cultivation and manufacture of Ramie, but more especially to carefully investigate the question as to whether the introduction of the industry to these Islands can be advocated as a thoroughly practical and remunerative undertaking.

It will be well to first briefly enumerate the most characteristic properties of Ramie and also to refer to the detrimental influences which have opposed its success, before proceeding to a description of the production of the fibre and the adaptability of its manufacture to Hawaii.

The qualities of Ramie may be summarized as follows:

1. *Strength.* Ramie has been proved by actual experiment independently conducted, not only in Europe, etc., but also in these Islands, to be approximately three times as strong as hemp, four times as strong as flax, and many times stronger than either silk or cotton. The relative strengths may be

expressed as follows: Ramie, 100; Hemp, 40; Flax, 25; Silk, 20; Cotton 15.

2. *Length:* The length of the separate filaments varies from 2 or 3 to 15 inches. Those of flax from .2 to 2.5 inches. Long staple cotton from 1 to 1.5 inches.

3. *Lustre:* The remarkable gloss of ramie is equal to all but the better grades of silk. This quality in conjunction with others, permits it to be used with advantage to the durability and strength of the fabric in admixture with silk.

4. *Dyeing:* Ramie may be dyed to any desirable shade of color, and in this quality is only equalled by silk.

5. *Texture:* It is remarkable for its pliancy and softness.

6. *Durability:* a. Ramie is impervious to moisture and is therefore not subject to rot. For this reason it is invaluable for the manufacture of sails, nets, ropes and also for bank notes and document paper.

b. Its wearing qualities are vastly superior to cotton goods, rendering it a splendid material for uniforms, etc.

c. It is free from the attack of moths.

7. *Non-Elasticity:* It does not stretch and is therefore a good material for machinery belting and measuring tapes.

8. *Hygiene:* Its suitability for body clothing is established to be at least equal to that of other fabrics.

9. *Use:* The possibilities of its manufacturing uses are almost unlimited. Whatever has been made from cotton, flax and manila hemp can be equalled or excelled by Ramie. Its mixture with wool and silk give excellent results. The range of materials made from it includes beautiful table linen and duck, sheetings, tapestries, curtains, sail cloths, awnings and almost indestructible uniforms and riding breeches.

Among the many causes which have prevented Ramie from finding its proper place in the manufactures of the world may be mentioned:

1. The ill-advised advocacy of this fibre as a substitute for other materials.

2. Lack of adequate machinery to insure a regular supply of the fibre.

3. Ignorance of the proper method of manufacture.

4. Lack of sympathy between planter and manufacturer.

5. Company promotion.

6. Opposition of the cotton and other capitalists.

Each of the above influences has been at work to the detriment of Ramie and will be referred to briefly. The splendid superiority of Ramie warranted it an unassailable position as a textile material based solely upon its intrinsic merits. Everyone who has examined the wonderful fabrics of Oriental manufacture made from this fibre will readily acknowledge the truth of this statement. Its advocates, however, actuated either by ignorance of its true merits or by timidity, endeavored to found its reputation chiefly as a cheap substitute for other fibres to which it was infinitely superior. The unenviable reputation of an adulterant at once attached to Ramie, and it was associated in the minds of many with such materials as Jute, which is used so liberally in cheap carpets and rugs, much to their detriment. This stigma condemned Ramie to many manufacturers and a prejudice was aroused against it, which is even now only slowly being removed.

A greater obstacle to its success, however, was the absence of adequate machinery to operate upon commercial quantities of the fibre. In the Orient the preparation of China-grass cloth has been carried on from very early times and the production of fibre has been entirely by hand. To insure a place for Ramie in European and American markets it was necessary to produce a regular supply of the fibre, which could only be effected by machinery suited to its particular requirements. The difficulties to be overcome in this direction were great and the Indian government, some years ago, offered a bounty for a satisfactory machine. A host of impractical inventions was the result, often produced by men who had not even seen the plant to be treated. The general result was unsatisfactory and the offer of a bounty was afterwards withdrawn.

The common ignorance which has prevailed on the peculiar methods involved in the preparation of Ramie fibre has also contributed greatly to retard the industry. Prominent among these may be mentioned the fact that many "ramie" machines have been put forward in the past founded on the principles necessary for the treatment of flax and cotton. The machinery necessary for these latter has been perfected by a slow process of improvement, commencing at the very infancy of mechanical invention, and adapted to the peculiar requirements of those fibres. The failure of attempting to apply such methods to a fibre of entirely different nature was to be expected, and

general discouragement has followed such efforts. The difficulty of decorticating the fibrous bark from the skin of the plant had also to be encountered, although the necessity for this process has, with experience, been entirely obviated. In the case of hemp, the stalks after being cut are allowed to dry before extracting the fibre. The Ramie plant, however, possesses a resinous gum which upon drying retains the bark so tenaciously to the stem as to defy all ordinary attempts to remove it. The arrival of the dried stems at the fibre extracting machinery necessitated chemical treatment to remove the bark of so drastic a nature as to seriously impair the quality of the material. In many cases such deterioration resulted that the goods manufactured from the harsh, brittle filaments produced by these processes, quickly rotted and Ramie fell into even further disrepute. Occasionally the stalks fermented instead of drying properly and thus became worthless. Opposed to the advocates of the chemical treatment were those who aimed at decorticating the stems by mechanical means which were wasteful and destructive to the filaments. Fibre produced by this method arrived at the market so crushed and bruised as to cause still further misunderstanding and prejudice against Ramie.

It is now recognized that in order to produce the clearest fibre from most plants it is imperative to operate upon the green stalk or leaves immediately after harvesting and before the evaporation of moisture has commenced. The extraction of Ramie within a few hours of cutting the stems and before the resinous gum has hardened has rendered the harsh chemical and mechanical processes unnecessary, as at this time the bark is readily removed. The mistaken notion about decorticating was, however, not recognized till after many years of experiment.

Another fertile source of mistake was the absence of a proper accord between the planter and manufacturer. The planter grew stems of unequal quality and dried out the natural juices, making the removal of the bark difficult and the extraction of good fibre impossible. The fibre cleaner ruined his material by unsuitable treatment and supplied the spinner with harsh material either corroded with chemicals or bruised and matted by machinery. By using machinery adapted to hemp and

cotton the weaver was necessarily not a little disgusted with the product of his mills, which went forth to further increase the disrepute of the fibre. Fortunately a closer intimacy between the different operators has resulted in a better understanding and all the above causes of mistake have been removed.

Company promotion again, often on the part of the unscrupulous, has also had a bad effect upon the industry. Plantations have been commenced with large capital and have often produced the plant in great quantity without possessing proper machinery, and large losses have been entailed. Visionary projects of this nature now belong to the past, and perfected machinery has opened the road for an industry of great promise. The magnitude of the American cotton industry, which furnishes 80 per cent. of the world's consumption, has necessarily ranged the interests of an influential body of capitalists in antagonism to Ramie, and often what purports to be authoritative literature either ignores all mention of this fibre or is interested in depreciating its value. By this means wrong impressions have been sedulously disseminated to such an extent that even today the advocates of Ramie are often met in America with impatience. Most of the above misunderstandings and difficulties have now been overcome, and France and Germany in particular are in the van of a new industry. In this instance America and the English-speaking world appear to be still clinging to the old order of things, but the advance which is taking place under European initiative is clearing the way for success.

The conditions best suited to the successful cultivation of Ramie are a moist sub-tropical atmosphere, combined with a friable, porous soil which will not retain moisture. The plant is appreciably injured not only by drought but also by water retained in the earth. Although the plant will grow in situations not fulfilling the above qualities, the best and most uniform fibre is produced when the locality is carefully selected. No measure of success can be expected from gathering wild plants unless the filaments are to be prepared by hand—a process only possible in China and such countries, where time and labor are of negligible consideration. Formerly most attempts to propagate Ramie have been restricted to the culti-

vation of cuttings—10,000 of which if reserved only for the production of others, will in eighteen months stock a plantation of 500 acres. If fibre be the end desired, two crops may be obtained from cuttings the first year. The best results are said to be obtained from seed—a method till lately neglected on account of a belief that it was not practicable. Great care is necessary to germinate the seed, but the few rules to be observed are simple, and success is said to be certain if they are closely followed. A light sandy soil should be selected, and the surface thoroughly disintegrated and lightly fertilized. After pressing the surface of the bed well down and moderately watering it, the seeds, mixed with damp soil, are strewn—uncovered by any other earth. A matting roof, to be moistened if necessary, must be erected. No water should be applied directly to the plants until the seminal leaves appear, when a light sprinkling from a fine rose may be beneficial. When two inches high the seedlings may be transplanted, care being taken to retain as much soil round the root as possible. The plants are best set about three inches apart and the first crop should be ready one year after sowing. As Ramie is a perennial, replanting is not necessary for some years, and from two to five crops may be taken annually. The best and most economical method is to produce a succession of crops in order that harvesting and extraction of the fibre may be continued throughout the year. If preferred, the seeds may be germinated in boxes of finely pulverized loam, protected as described by a matting roof.

The plants are now set much more closely than formerly, to produce better fibre through the prevention of branching. In a warm climate, such as the Hawaiian, a quick growth results, and the stems contain plenty of sap, which assists in the cleaning of the fibre. Generous artificial fertilization would be necessary for continuous cropping, as Ramie is said to deplete the ground more than many other plants.

After harvesting the stems it is essential that they be operated upon by machinery immediately, to extract the fibre before evaporation has commenced. The filaments are found underlying the bark and separating this from the wood of the stem. Ramie fibre therefore belongs to the important *bast* or cortical division of fibres together with true hemp, as distin-

guished from the *foliaceous* or structural fibres of which sisal and manila hemp are typical examples.

Five chief requisites are imperative to a satisfactory Ramie fibre machine:

1. It must remove all woody matter.
2. It must entirely remove the bark,—thus obviating the necessity of the former destructive chemical or mechanical decorticating processes.
3. It must extract as much as possible of the gummy juice contained in the stem to render the degumming process simple.
4. It must produce separate filaments and not “ribbons.”
5. It must be capable of operating upon large quantities of stems and of producing fibre in commercial quantity.

Machines claiming to fulfil some or all of these requirements have occasionally been put upon the market, but have not given entire satisfaction in the past. Several Ramie machines are now obtainable which are credited with giving satisfactory results. Of these the “Faure” has been thoroughly tested before a representative gathering of well-known planters, weavers and merchants, by whom it has been pronounced as thoroughly satisfactory, and as possessing all of the above enumerated qualities. In the following description this machine is more particularly alluded to, not only that it is probably the best, but also that more detailed particulars of its construction are available. The prices and means of procuring this and other machines will be appended to this article.

The Faure machine is the invention of a French gentleman of that name, and is the result of many years of experiment conducted upon his own plantation. The first model has been slowly improved upon and difficulties have been overcome till now the Ramie grower can manipulate his own machinery and market his product as readily as the planter of sisal—the fibre being extracted from the green stems at one operation. The machine weighs about one thousand pounds and is simple and strong in construction. It consists, briefly, of a frame, gear, decorticating drum and feed table. Of these the latter only needs special description. It is of unusual form, consisting of three parts, a convex or upward curve, a horizontal plane, and a concave or downward curve. The whole table is also ren-

dered "elastic" by the support of springs, which impart rapid vibration to the bed. The stems are fed into the machine butt first about ten at a time, and after passing in a few inches are withdrawn and the stems again presented leaf first. The convex part of the table over which the stalks first pass breaks up and partially removes the woody parts; the horizontal plane removes the outer skin from the strip by scraping and beating and at the downward curve of the table the filaments are freed of adherent bark, wood and gummy matter, which are thrown out by centrifugal force from the drum beater which travels at the rate of five hundred revolutions per minute. When the fibre has reached the end of the table, a return is effected and it is withdrawn. The machine is operated by one-horse power and could be attended by native or Japanese labor—two men being required to each; 360 lbs. of green stems, producing about 4 per cent. of fibre, may be operated upon in an hour, and from 140 to 180 lbs. of fibre may be obtained in one day of 10 hours. After extraction, the fibre may be at once dried, but a beneficial effect is produced by immersing it in boiling water containing 1 per cent. of carbonate of soda. This treatment removes much of the gum and thus assists the process of degumming at a later period of preparation. When dry the fibre is baled and shipped to market.

It will be of interest to shortly mention the operation connected with the subsequent manufacture of Ramie goods. The bales are opened at the mill, and the fibre is sorted by female labor, according to length and color. It is then steeped in the degumming vats to thoroughly free it from any remaining resin. This process is quite simple and is accomplished by the copious use of steam, water and chemicals of such weak solution as not to affect the beauty and quality of the fabric. After leaving the degumming vats the fibre is dried and subjected to bleaching similar to that employed with flax or cotton. It then undergoes the process of Preparing and Softening to render it smooth and ductile. The combing machines sort the various qualities and lengths, and after passing the drawing frames it is converted into rovings, which are manufactured by the spinning frames into yarn.

The best yarns are used to produce brocades, damasks, tapestries, curtains, dress goods and table cloths, which in their finest

grades, surpass even the best linen. It is also used to improve the strength and durability of some silk goods by admixture with the latter. The finest yarn is spun 50,000 yards to one pound and may be used to produce an excellent fabric of which Ramie forms the warp and silk the woof.

Medium qualities of Ramie yarn are used in the manufacture of handkerchiefs, sewing threads, duck, medium table cloths, engine hose, and belting. It is also used with satisfactory results mixed with wool.

Coarser grades of the fibre are used for towelling, canvas, sail-cloth, uniforms and cordage.

There is little doubt now that the reputation of Ramie is vindicated and the obstacles to its manufacture removed, that the industry is on the eve of a great development. For reasons which have been considered, previous attempts have been premature, but the opportunity of the present is full of promise. In the development of this new enterprise Hawaii would do well to take the initiative, as not only are these Islands far better suited for the growth of the plant than countries with a cold winter, but our perennial summer affords conditions which will return a continual harvest, permitting the operations of field and mill to be conducted the year round. Fibre produced in sub-tropical countries is also reputed more highly than that of colder latitudes.

Probably the best results would be produced by Ramie growing in comparatively small plantations. The success of the industry in Hawaii has as yet not been practically demonstrated, and for this reason alone it does not seem advisable to recommend its attention to those who have not at hand a separate source of livelihood. To the man of small capital, however, who can afford to wait till the marketing of his crop, Ramie offers a field of exceptional promise. One hundred acres planted from seed would produce one crop the first year and probably three the second. About eighty tons of fibre should be produced annually under normal conditions when the plantation is in good running order. This quantity could be operated by four machines run by native or Asiatic labor. The cultivation of the crop, due to the preparation of the ground and the close setting of the plants, would be appreciably more expensive than that of sisal, but this would be outweighed by the quick return of fibre and also by its market value. In the case of sisal the expenses of field opera-

tion must be maintained for from four to five years before the plants are ready for the mill. With a Ramie plantation as that described, and taking the cost in Hawaii per ton at \$45 and the present market value of the partially degummed fibre at \$125—a moderate estimate—the possibilities may be easily realized. The cost of production in other countries is variously estimated at from \$24 to \$35 per ton. With better knowledge of the qualities of Ramie and a more regular supply of uniform quality, the market is steadily increasing.

A feature of importance, to be considered in a country in which the insect-balance has been so distributed as in Hawaii, is that the proportion of tannin in Ramie renders it immune from these pests. Another interesting fact, is that the wonderful tenacity of the gum permeating the stalks is attracting experiment, and it is hoped to make this a valuable by-product to the cultivation of Ramie.

In conclusion, it appears certain that the possibilities awaiting this fibre are nearly illimitable and there is every prospect of Ramie eventually forcing itself into a leading place in the world's markets, above all other competitors. With our splendid climate, the availability of efficient machinery and a ready market, the opportunity offered to Hawaii will not long be neglected. The extensive cultivation of Ramie, together with undertakings of like nature, should build up a substantial agricultural population and assure to Hawaii that permanent prosperity and stability which dependence upon a single industry must always render precarious.

PARTICULARS OF MACHINERY.

Faure's Ramie Fibre Decorticator. For the production of fibre (not strips or ribbons). Net weight about 1000 lbs. Production about 140 lbs. per day. Price, £36.0.0. (\$180.00). F. O. B. Liverpool, 7½% extra. Two men required to operate each machine. A set of 10 machines require 12 men. Each set is furnished with automatic apparatus for the removal of waste from below the machines, and also for conveying the fibre to a central place in the mill. Faure's machines were sent last year to the East Indies, Egypt, Tonquin and other countries.

Lehmann's Rhea or China Grass Decorticator No. A 2. Furnished with strong iron framing, feed lattice sheet, and specially constructed feed rollers. Power required 2¼ h. p. Gross weight, 2400 lbs. Production, 800 lbs. in 12 hours. Price, £85.0.0 (425.00) f. o. b. Liverpool.