Valuing tow, as it comes from the flax-dressers, at five cents per pound, (which is as low as I have known it to be sold the past year,) will make the cost of No. 1 about thirty-three cents per pound ; thus—

1,000 pounds tow (with the shives adhering,) at 5 cents per pound	$50 00
Cost of separating the shives (500 pounds net,) at 3 cents per pound	15 00
Bleaching 500 pounds clean tow	25 00
Picking and carding 300 pounds bleached tow, at 3 cents per pound	9 00
Cost of 300 pounds bleached tow, or flax cotton	99 00

Or 33 cents per pound. Numbers 2 and 3 are one-half bleached. This was done by dissolving and mixing together about equal quantities of soda ash and chloride of lime, say eight pounds each to one hundred pounds tow, and in the clear liquor steeping the tow (cleaned of shives) for three to four hours ; it must then be soured and washed, dried and picked.

Cost of 100 pounds clean tow	$13 00
Cost of bleaching materials	72
Cost of labor and picking and carding	3 35
Result, 75 pounds half bleached tow (or flax wool) costing	17 07
Or costing per pound	$22\frac{76}{100}$

Numbers 3 and 4 differ only in length of fibre—the shorter is made by passing a second time through the picker.

It is easy to reduce the fibres so that none shall exceed a given length, but, from their structure, they are liable to be more or less broken by the subsequent rough treatment to which they are necessarily subjected.

A manufacturer of woollens has used a small quantity of No. 1, carding it with wool. He reports: "It worked in every respect as well as cotton, and in the finish was fully equal, while the color it receives is undoubtedly more durable than that of cotton." I regret the cloth was sent to market without a sample being taken.

From numerous experiments I have made I am satisfied there is no saving in expense or material in using non-retted flax. The matters removed by water or dew-retting are all removed in bleaching, but at the expense of additional quantities of materials. Goods made from non-retted flax and not bleached will be "slazy" when moistened, and liable to early decay.

The cost of Nos. 1, 2, and 3 is based on the present price of tow, as it falls from the second and third knives of the flax-dresser. Owing to the large demand for flax at prices of 18 to 22 cents, fine tow, in the rough, is salable at 5 cents.

I have spent much time, and been at no inconsiderable expense in experimenting. I intend pursuing the subject as I have opportunities for so doing, in the hope of realizing valuable results.

Very respectfully, yours,

E. TOWNE.

STATEMENT.

I herewith beg to submit my treatment of converting fla[x] into a cottonized substance:

I commence by taking the flax straw gathered *when fully ripe*, either *tangled* or *straight*, after the seed has been taken off. The straw, after being air-dried, is passed through a flax breaker, of Sanford & Mallory's make. By the operation of this machine the boon, or bark, is, to a considerable extent, separated from the fibre, and the stem loses about fifty per cent. of its original weight and reduced to one-half of its original bulk. After breaking it is put through a picker and duster by which a large portion of the adherent portions of wood are removed. The fibre is now ready for boiling. The boiling consists of the following process:

To every ton of the fibre add as much water as will well cover it, and afterwards introducing into it about five per cent. of a solution of caustic soda of the specific gravity 1.50°. (The caustic soda is made by adding caustic lime to a solution of soda ash in the proportion of two parts of lime, six parts of water, and two of soda, and twelve parts of water. This is the *concentrated* liquid.) The fibre is allowed to boil three hours, and then is passed into a solution of carbonate of soda of five per cent.; then into a solution of sulphuric acid of one and a half per cent.; then into a solution of soda ash, same strength as before. It is then partially split and ready for bleaching.

The bleaching liquid is hypochloride of magnesia, made by taking one part by weight of chloride of lime to twelve parts of water ; and in a separate vessel, two parts of sulphate of magnesia to twelve parts water. Mix the two solutions together, the clear liquid is then diluted to 3° Twaddle, specific gravity 1°.015. When sufficiently bleached, is then removed to a solution of carbonate of soda, same strength as before, and left there half an hour; then passed into a solution of sulphuric acid, same strength as before, and allowed to remain there as long as any disengagement of gas is visible; then wash the fibre in a weak solution of oil soap. It is then dried by passing through a wringer and passed over heated copper cylinders to the picker and duster. It is then carded on a Dundee card, and is finished by passing through a 48-inch wool card. The time occupied in the operation of boiling and steeping process to the state ready for carding is six hours.

The expense of converting one ton of flax straw into flax-cotton is as follows:

One ton of flax straw	$10 00
Breaking one ton of straw	2 50
Picking and dusting 1,000 pounds	1 00
Boiling in caustic soda 570 pounds	2 50
Labor in steeping and chemicals	16 00
Washing and drying	2 00
Picking and dusting 354 pounds	50
Dundee carding	50
Carding on wool cards 291 pounds, producing 257 pounds	5 00
Total cost	40 00

Or less than sixteen cents a pound, exclusive of rent, interest, and insurance, which the bleached flax waste will cover. It has been sold to paper-makers at four and a half cents per pound. The shives and other waste are used for fuel under boilers.

Cost of machines and vats.

Breaker	$355 00
Picker	175 00
Duster, or willow	150 00
Picker for white stuff	250 00
Dundee card	750 00
Wool card for finishing	1,100 00
One boiling iron vat	150 00
Six wooden vats	300 00
	3,230 00

The recent advance in the price of chemicals has raised the cost of production.

I adopt the Claussen process, having purchased the right for the use of his patent for the United States, having practically experimented upon it, and fully demonstrated the most favorable results. In 1854 I commenced manufacturing flax cotton at Rocky Hill, New Jersey, and produced a sufficient quantity on a commercial scale to induce a number of gentlemen to form an organized company, with a capital of $200,000; but from the low price of cotton and wool at that time, and the unfavorable state of the money market, and the prostration of the manufacturing interest, and from the prejudices of manufacturers to use a new staple, they became discouraged, and from some of the shareholders not paying their full instalments of shares, the company disposed of their property after having produced about ten tons of flax cotton. Most of it was purchased by Messrs. Lawrence & Stone for their manufactory at Lowell.

I can prove from practical experience that flax and hemp can be converted into a fibre stronger than cotton or wool, and capable of taking better color than either; can be spun and wove on the existing cotton and woollen machinery at a cost below cotton or wool at any time, there being less waste. It will mix and felt with wool, having had it mixed with wool and made into cloth and hats, and I had them worn in my family and found them much more durable than all-wool.

There has been a great deal of prejudice against some portions of Claussen's process totally unfounded and misconceived. For instance, that it was not suitable for making long flax, but rather that *all*, long and short, indiscriminately, was converted into flax cotton: the fact is the reverse. No doubt the flax cotton is the greatest novelty, a new article of commerce, and so becomes the most prominent feature in the various inventions. The long flax, however, through Claussen's process, is produced in better condition than as at present for the manufacturer, and what is indifferent and not sufficiently well grown for long flax is quite suitable for, and is converted into, flax-cotton, also common tow, and such like stuff. By this process the flax, instead of being pulled in a green state, is allowed to ripen the seed, and can be cut with a mowing machine. The farmer by this means saves the great expense of pulling, and has the seed, which alone pays for raising the crop, and by breaking the straw with a hand machine, such as Sanford & Mallory's, he can return to the land nearly one-half the weight as manure. The shives contain silica, and by feeding his cattle the refuse seed and bolls, he also obtains a rich manure. In 1854 I had an agent in Washington exhibiting specimens showing the whole of Claussen's process, from the flax straw to the finished cotton, linen, and woollen fabrics, in a bleached, unbleached, and dyed state.

Yours, respectfully,

H. McFARLANE.

NEW YORK, *September* 4, 1863,
No. 242 *West* 20*th street.*

SIR: I find in this morning's paper a notice of the meeting of the board of commissioners appointed by the Commissioner of Agriculture to consider the subject of the use of flax and hemp as a substitute for cotton.

Desiring to lay before the commission some facts in relation to a discovery in the mode of curing flax so as to make it useful as such a substitute, I take the liberty of addressing myself to you, sir, as the chief commissioner.

As long ago as the year 1852, while residing at the Hague, and acting in the capacity of private secretary to our minister at the court of the Netherlands, Hon. George Folsom, I made the acquaintance of a Hollander who claimed to have made a great discovery in the preparation of flax for spinning. It was much talked of at the time, and the Dutch government made a proposition to the inventor to put his new method into practical use. Similar propositions were also made to him by parties in England, France, and Belgium. I read some of the letters which he received from these parties at the time. He declined them all, giving me as a reason for so doing, that he was afraid of being deceived by them, and cheated out of the profits which he believed he would ultimately derive from his discovery. Specimens of his flax were exhibited at the World's Fair in London, in 1852, for which he received a medal, &c., from the commissioners. It was just at the time when Claussen was sounding his trumpet through the public journals about flax-cotton, and the invention of my Holland friend was overshadowed by the umbrageous fame of the since unfortunate chevalier.

I was led, by some interviews I had with the inventor, to write to a friend in Boston on the subject, enclosing samples of the flax, and asking him to consult with Mr. Lawrence (Amos or Samuel, I think the latter,) upon the matter. The result of that correspondence, after receiving Mr. Lawrence's very sanguine opinion, was, that I entered into an agreement with the inventor, and sailed for New York with the identical samples of the flax which had been exhibited at the World's Fair. After a long and stormy passage, which culminated in shipwreck, I reached New York and proceeded at once to Boston, where I learned of the death of Mr. Lawrence. I visited several of the manufacturing towns of New England, and showed my samples to different manufacturers. They were taken by surprise by the appearance of the flax, and seemed incredulous of the statement concerning the short time required to bring the staple into the state in which they saw it, and also of the cheapness with which it could be done. After some fruitless endeavors to interest them in it (they being all cotton spinners) I abandoned the whole thing.

Last summer I was induced, by the interest I saw was taking hold of the public mind in the matter of procuring a substitute for cotton, to write to the inventor on the subject, and I received a letter from him written in London, where he had been residing for several years, practicing as a dentist, and carrying on his experiments with flax, hemp, and India fibres. He sent me some new samples, more perfect than the ones I had before seen. These samples I showed to Hon. Washington Hunt last fall, whom I met at our general convention, and who is interested in a manufactory for the dressing and spinning of flax in Lockport. He acknowledged them to be finer than anything they had as yet been able to produce, and expressed the wish that I would visit Lockport and talk with him further on the subject. It was not convenient for me to do so, however. I afterwards gave the samples to a friend, who showed them to some private individuals, who authorized me to make a proposition to my friend in London to come to this country and demonstrate what he could do. In reply to my letter, he wrote that he could not entertain such a proposition; but requested the gentlemen to send out a competent person, having a practical knowledge of the culture, curing, and spinning of flax, to investigate the merits of his process, and with powers to enter into a contract with him. The parties were not willing to do this, and I have not since made any exertion to interest others: only, at the request of a friend, I have allowed my specimens to be sent to the Hon. Addison H. Laflin, of Herkimer, N. Y., who is largely interested in a new invention for the manufacture of paper from wood.

The specimens that I have are of several different kinds—some being prepared for ordinary flax machinery, and others for spinning on cotton machinery. These latter samples I have received since my interview with Governor Hunt. They closely resemble cotton, both in texture and in the length of the staple, being wholly unlike either the Lockport, Penn Yan, or any other specimens I have ever seen, and entirely different from the Claussen flax-cotton. The time required to bring the raw flax, in the straw, into its cottonized state is one day. The Lockport process takes from three to five days. By our friend's process there is less waste than by the Lockport process, and the expense is no greater.

Since I wrote last to the inventor in London, giving him the answer of the parties here to his proposition, I have received from him a London paper containing an account of a meeting of manufacturers and others, presided over by an English earl, whose name escapes me at this moment, at which a statement written by my friend was read, (relative to the invention,) and a committee appointed to test the merits of the same. Several members of the meeting pledged themselves to furnish the funds necessary for that purpose, and also for the purpose of going into the manufacture of it, if found to be as valuable as it then seemed to them to be. I am sorry I have not the paper here to refer to. I have not yet learned the result of these investigations. I do not believe, however, that the inventor will divulge the secret of his invention; or that he will enter into any contract which will shut him off from bringing the thing out in this country, in case sufficient inducement should be held out to him within a reasonable length of time.

I have been induced to write you upon this subject in the hope that it may lead to an investigation of my friend's discovery, on the part of your commission, and that our country, and not England, may reap the profits of this invention, if it should prove to be as valuable as I have every reason to believe that it is. To promote this object I will do whatever lies in my power, and which may be consistent with my clerical duties and obligations. I will only add that I would be glad to meet here any of the gentlemen of the commission who may be visiting New York, and will endeavor to have the samples referred to in this letter returned into my possession next week.

I have the honor to be, sir, your obedient servant,

E. FOLSOM BAKER,
At Church of the Annunciation, New York.

Hon. J. MOREHEAD, *Pittsburg, Pa.*

FOURTH SUBDIVISION, OR MANUFACTURING STAGE.

A leading object of the appropriation having been to test the practicability of substituting the fibres of flax for cotton, on cotton machinery, and also of mixing them instead of cotton with wool, we have directed our attention particularly to such modes of assimilating these fibres to cotton as would, in our judgment, be likely to accomplish the desired results, and to such modifications of cotton machinery (wool machinery not requiring any changes) as would best adapt it to the production of yarn from such assimilated fibres. We have not deemed it necessary to give much time to the mechanical modes of long-line flax-spinning now in general use in European countries, as the raising of marketable flax for long-line imposes too many burdens on the growers, and is produced at too great a sacrifice of seed to warrant, at present, its extensive cultivation in this country. Both the raising of flax for long-line, and its manufacture by machinery where grown, seem to be better adapted to countries of humid climates, and of comparatively small areas for cultivation, subdivided among a dense population accustomed to cheap manipulating labor. There are very few mills of this kind in the United States, and most of these are using long-line for coarse fabrics, obtained to a considerable extent in the Canadas, whence it is imported free of duty under the reciprocity treaty. A member of this commission recently visited one of these mills at Braintree, Massachusetts, and was shown the various machines and processes for making coarse, long-line yarn and cloth. It is well known that the only mill of this class in our country fully equipped for spinning and weaving fine long-line yarns, (located at Fall River, Massachusetts,) was, after a great outlay of capital and immense exertions to operate at a profit, converted into a cotton mill at a heavy loss, in consequence of an insufficient home supply, the mill being precluded from using foreign stock by a practically interdictive duty.

After the most careful consideration of various modes of growing and treating flax to obtain the best results to the farmer, and an abundant supply to the manufacturer, we are of the opinion that the crop should be planted mainly for the seed, and incidentally for the fibre; that to insure the greatest profit to the grower from both these sources, there should be sown from four to six pecks of seed to the acre; that if the crop is designed for ultimate fibre, *i. e.*, flax-cotton, it should be harvested by machine cutting in the morning after the dew is off, when the seeds are sufficiently in the glaze to be of brown color; thereby securing the greatest supply of oil and the least rigid condition of fibre; that it should be exposed to the sun through the day, cocked towards night, and treated in other respects like grass cut for hay, avoiding as much as possible exposure to rain or dew; that the seed should be threshed in the cheapest and most convenient manner regardless of the tangled condition of the straw; that the latter should, for the effectual removal of the shives, be subjected to the action of approved power brakes, (we give the preference to Mallory & Sandford's twelve-roller kind,) located either on the farms or at convenient points for the neighborhood patronage; that in this form it should be rough-baled and sold to chemical disintegrating works, to be there further divested of dirt and shives by mechanical means, and exposed to high steam in combination with mild or strong alkaline solutions for disintegration, and in this finished form sold as stock for manufacturing into fine linen fabrics on cotton machinery. Flax cotton from such stock will be reliable for uniformity of strength, and be sufficiently white without bleaching prior to its manufacture into cloth.

But if the crop is designed for short stock to be manufactured on modified cotton machinery into coarse linen goods without chemical disintegration, we recommend retting the straw, and that on taking the flax from the brakes it be subjected to the further action of power disintegrating, shortening and cleaning machinery, to be located at convenient centres in flax-growing districts, and there be baled for the market.

We are aware there is an impression that unretted straw cannot be successfully divested of its shives by mechanical means. This impression is probably based upon the imperfect mode hitherto practiced in harvesting the crop. The straw, even if intended to be left in an unretted state, is generally permitted to lie more or less exposed to dew or showers a few days after cutting. This partial wetting and drying appears to have a tendency to crystallize the gluten or cellulose between the filaments and woody portion, which makes it more adhesive and harder to separate; but if the straw is harvested and dried without exposure to moisture, the crystallizing process not being developed, we think the shives will, under the action of properly constructed brakes, readily separate from the fibres. We have seen unretted, tangled, as well as straight straw, quite thoroughly divested of shives after passing twice through a single head of Mallory & Sanford's brake, with the horizontal, rotating and vibrating rolls, placed in sets one above another.

It is estimated that retted straw shrinks in weight about fifteen per cent., while the fibre loses very little of its weight. This is caused by the partial decomposition of the shives and a portion of the gluten or intercellulose; so that if the straw crop is sold in an unretted state a proportional allowance should be made for its extra weight, less the value of the unretted shives for cattle-feeding, which is said to be considerable, as their oleaginous properties make them quite nutritious. A ton of retted straw in good condition produces about 450 pounds of flax, while a ton of unretted produces only about 380 pounds. Good retted straw in ordinary times is worth, in flax districts, say eleven dollars per ton of 2,000 pounds, equal to 2½ cents per pound for the flax. This gives a proportional value of nine dollars per ton for unretted straw, equal to 2½ cents per pound for each kind of flax. The cost of labor, supplies, power, supervision and use of machinery and buildings for converting the straw into flax, is also about 2½ cents per pound; making the entire cost of the flax at the brake machines five cents per pound. This, if sold at seven cents, in ordinary times would give a liberal profit to the proprietors of such machines; but flax in this form will, of course, be subject to a diminution in weight when further divested of its glutinous substance, straggling shives and seed-ends, by the action of preliminary machinery for converting it into filaments and fibres of the requisite fineness and length to be spun into coarse yarn, which with the loss of short fibre in manufacturing, and tare of the bags and ropes, will be fully equal to twenty per cent. of its weight, thereby adding two cents per pound to the first cost; to which must also be added 1½ cent per pound for railroad and mill transportation and other expenses, making the entire cost of the stock in ordinary times at the consuming mills about 10½ cents per pound.

The same stock sold from the brake machines at seven cents per pound to the proprietors of mechanical and chemical disintegrating works, to be "cottonized" for yarn suitable to weave into print-cloths or shirtings, would be subject to a loss in the respective processes of about forty-five per cent. of its weight, thereby adding about 6½ cents per pound to the cost; to which must also be added 1½ cent per pound for railroad and works transportation and other expenses, making the cost at the works thus far fifteen cents per pound. The cost of cottonizing, including the preliminary mechanical operations at the works, will be about four cents per pound net weight, making the entire cost at the works in ordinary times, exclusive of any charge for profit, about nineteen cents per pound.

If any of the manufacturing trade should be apprehensive under this estimate that the difference in value between flax-cotton and cotton in ordinary times would discourage the use of the former, no matter how perfect the stock may be prepared, we would remind such, that if linen goods continue to maintain their supremacy in the market, print-cloths or shirtings made of flax-cotton would probably command a price that would leave a larger difference in favor of the manufacturer than the difference of cost between the two kinds of stock.

In the early stage of the effort to cottonize, there was a general belief among experts (including the Chevalier Claussen, and also Mr. Sands Olcott, of Pennsylvania, the pioneer in this country of flax-cotton, and who patented a flax-straw cutting machine in 1840) that it would be necessary to cut the straw into lengths comparing favorably with the length of cotton; but a critical and microscopic analysis of the constituent parts of the fibrous covering of the straw revealed the fact that the filaments of which it was composed were subdivided into cells or individual tubular fibres, of nearly uniform fineness, and somewhat variable lengths, cemented longitudinally by intercellulose, or gluten, which, while it would to a great extent resist the disintegrating power of machinery, could not maintain its cohesion against the liberating and dissolving power of tepid-water soaking, followed by long-continued boiling in mild alkaline solutions and subsequent exposure for a short time to high steam; or by boiling at a temperature of 280° Fahrenheit, with soda-ash or caustic solution, without any preliminary processes.

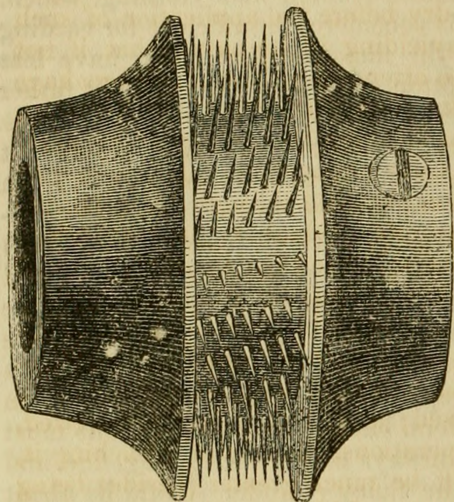
It then became a question to what degree of fineness and maximum and minimum lengths of fibre can flax be safely reduced by mechanical means only; and in what way can the product of such means be successfully spun into coarse yarn on cotton machinery? These questions have been met by the owners of a number of cotton mills in various parts of the country that have heretofore been employed in manufacturing the lower and coarse grades of cotton goods. Some of these mills, especially those that are located in flax-growing regions, began with tangled straw, and carried it successfully through draught-roller brakes, dusters, and wool and cotton pickers, thereby preparing their own stock; while others situated remotely from such districts have preferred purchasing their supply in bales, of parties residing there who have made the preparation of such stock a special business. The latter mode of obtaining it, besides being in accordance with the views of the commission, seems best adapted to encourage the alteration of this class of cotton mills into flax mills; and also for supplying flax disintegrating works with material to be transformed into flax-cotton for use by a higher class of cotton mills in the production of fine linen goods.

In determining the question of length of stock by means of preparatory machinery, it has been found impracticable to obtain, by any combination of machines yet employed, maximum lengths of fibre less than about three inches, without reducing the minimum lengths shorter than the fibres of cotton; and hence it became necessary to depend for the further reduction of the maximum lengths upon modifications of the machinery at the mills as arranged for cotton. To this branch of the subject the commission has given much attention, but as a report of our investigations is expected in time for distribution soon after the closing of the present Congress, we have reluctantly suspended our labors without obtaining as full results as the magnitude of the inquiry calls for, or as the light already obtained promises. We did not think it desirable at the commencement of our labors, while the manufacturers of both flax and cotton as well as ourselves were in a comparatively undeveloped state, to use the appropriation in crude experiments, or expenditures that might result only in loss. We preferred, as far as possible, to avail ourselves of the incipient efforts of those whom patriotism or hope of securing monopolies had stimulated to attempt the solution of the cottonizing problem. To this end, two of our commission visited in the past autumn nearly all the points in the western and eastern portion of the country, and in the Canadas, where particular attention had been given either to the growth or manufacture of flax. From these visitations and conferences, to which have since been added our own experiments, we have reached conclusions both in regard to the most promising modes of using flax cotton prepared exclusively by mechanical means for the manufacture of coarse goods, and by combined mechanical and chemical means for the manufacture of fine goods on cotton machinery, which we will now proceed to delineate, premising that if the unexpended balance of the appropriation is devoted to further discoveries by this or a new commission, the results might be given in a supplementary report at the first session of the next Congress. We think this course preferable to a lapse by "non-user" of the unexpended part, and much more likely to result in a larger contribution of valuable knowledge to the public upon this highly national investigation than a distribution of it in small sums to the many enterprising parties in different sections of the country who have so courteously responded to our call for information, and who have so generously sent specimens of their various productions for the museum of the Department.

Very good short flax stock is prepared from tangled straw for coarse yarn mills by Randall's, Clemens's, Smith's, and several other series of machines, but the cleanest and finest short stock that has come under our notice is that obtained from the Davies machine, made at Dayton, Ohio. This machine is composed of an iron or wooden frame, having a series of five open aprons, fluted feed rolls that rotate in iron shells, and wooden cylinders which have diameters of a foot each, and revolve about six hundred times per minute. The surface of the cylinders is perforated for the reception of square spring-tempered No. 12 wires, square at the ends, and inserted in the apertures in spiral rows converging from the heads towards the centres, and projecting from the surface about half an inch. The flax either in the straw (if retted) or in the form of crude tow is fed on a level apron through the feed rolls to the first cylinders, from which it is thrown on an inclined apron to be carried to the second set of feed rolls and the second cylinder, and then successively over the other inclined aprons, and through the other feed rolls, and over the other cylinders, until delivered at the end of the machine in bulk, when it is collected and baled in the same manner as cotton for the market.

In this form it is carried into cotton mills and presented first to the lapper, no preliminary operations being required, as it is to a great extent free from shives, dirt, or other extraneous matter. But as this stock, notwithstanding its comparative cleanliness and the ease with which it is made into laps, is too coarse and uneven for the carding process, without modifying the lapper beaters to adapt them for shortening the long filaments and fibres and making all the fibres finer, we added to each of the beaters another set of arms, and attached at the ends in lieu of knives wooden lags two and a half inches wide. The fronts of these were covered with strips of leather two inches wide, into which were inserted curved and pointed teeth of No. 14 wire, with their points on the same periphery as the knives on the other arms, and which, when in motion, rotate within about one-eighth of an inch of the periphery of the feed rolls. The speed of the beaters, arranged in this manner, should be about 2,000 revolutions per minute. When the beaters are so equipped, they not only distribute the grist evenly on the wire cylinders and lap rollers, but if the laps are doubled and carried through the lapper a second time, they disintegrate the filaments so thoroughly as to largely increase their number, and at the same time materially shorten those that were of too great length for the subsequent operations in the mill, without visibly shortening those that were sufficiently short in the bale. The laps so prepared are next carried to the carding machines, the carding power of which, in a great number of American mills, is in a main cylinder, doffer, and top-flats, all covered with fine chisel-pointed wire clothing, which, although well adapted for carding cotton, is considered insufficient for carding flax fibre. The insufficiency is caused by the fact that flax fibres have less elasticity and greater specific gravity than cotton, and are withal straight rather than curled like the latter, and hence do not rest easily upon the surface of the teeth, but are inclined to imbed themselves among the teeth, which makes it desirable to substitute needle-pointed clothing for chisel-pointed on the main cylinders and doffers, and also to substitute working, stripping, and fancy cylinders for the top-flats, which should likewise be covered (except the fancy) with needle-pointed clothing. This form of the teeth permits the workers and strippers, aided by the long and flexible teeth of the fancy, to act freely on the main cylinder, keeping the stock upon its surface and ready for delivery to the doffer. If the chisel-pointed clothing, however, of the main cylinders and doffers is in good condition, and the stock is well prepared, it can be used in connexion with the working, stripping, and fancy cylinders, but the two former kinds must have needle-pointed clothing. The latter is always covered with long, fine, and flexible clothing. The surface velocity of the fancy cylinder should be about twenty-five feet faster than the surface velocity of the main cylinder; the workers and strippers should run at the usual speeds; and one worker and one stripper are sufficient for one card. The cards should have screens of perforated sheet zinc under the main cylinders, and the licker-in cylinders (if there are any) about three-eighths of an inch from their surfaces, otherwise too much of the stock will be thrown off in the form of waste by the centrifugal forces developed in the rotation of these cylinders. The feed rolls should be heavily weighted, and their speed be increased about twenty-five per cent. The stock may be carded once or twice. We think once is sufficient. In either case, the fleece should first be delivered into a railway trough; and, if intended for a second carding, the product or sliver should be collected from calender rolls without being lengthened, and made into laps for the finishing cards, and from their railway should be drawn by means of a draught railhead from two and a half to three inches. This head should have three under rolls one and one-quarter inch in diameter placed about three and a half inches from centre to centre of the back and front rolls. The back and front rolls should be fluted or corrugated; the back top roll should also be fluted or corrugated, while the front top roll should be covered either with vulcanized rubber or gutta-percha, (the latter can be had at 153 Broadway, New York, of the Gutta-Percha Manufacturing Company,) and both rolls should be one and one-half inch in diameter. The middle under roll should be encircled by a spring gill, with collars at either end, rising an eighth of an inch above the points of the gill needles; the back top roll should be slightly weighted, and the front top heavily. The entire draught should be between the gill roll and the front roll. The shivers from this head should be collected in cans, and passed through either one or two heads of a drawing frame, with gills on the middle under rolls, and with top rolls fitted like the top rolls of the railhead, doubling the slivers at the draughts, which should not exceed one inch into four. From the drawing frame the stock should be made into condensed and untwisted roving on a Taunton speeder, arranged with gills on the middle roll, and with top rolls similar to the rail and drawing frame heads. The spinning frames may have either rings or flyers for twisting. As good yarn can be had from one as the other, it is indispensable that the frames should have large rings or flyers designed for coarse spinning only, as the kind of stock we are treating of cannot at present be made into finer yarn than numbers ranging from six to ten, (cotton gauge,) and it is wholly impracticable to think of spinning it on frames designed for yarn ranging between twenty and thirty-five skeins to the pound. The frames for this stock must be arranged with a draught not exceeding one inch into six inches, and should be fitted with spring gills on the middle rolls for each spindle, and with uncovered smooth

No. 1.



iron back top rolls one and a half inch in diameter without weights. The front rolls should compare with the front rolls in the preceding operations. These spinning gills consist of twenty rows of tapering needles seven-sixteenths of an inch long and one thirty-second of an inch in diameter at the base, six in a row, one-sixteenth of an inch apart, and inserted obliquely through apertures in a brass hollow cylinder one and seven-sixteenths inch in exterior diameter, and projecting through the surface four-sixteenths of an inch, making the entire diameter of the periphery of the points one and fifteen-sixteenths inch, with brass collars at their ends one and six-sixteenths inch exterior, and fourteen-sixteenths of an inch interior diameter, and flanches to the same, one and nine-sixteenths inch in diameter, fitted with steady pins and set screws for attaching the entire gill to the middle roll. The gills cost three dollars each; the needles can be purchased at $2 50 per thousand. These gills, as well as the larger kind for railheads, drawing frames, and speeders, are made by Messrs. Lanphear, Levalley & Co., at Phenix Village, Rhode Island.

The yarn spun from this stock makes excellent twine, and can be woven into crash, osnaburgs, burlaps, and sugar cloths; and, when doubled for warp, it makes very superior grain bags.

Foremost among the cotton mills that have been altered substantially in the way we have described to make some of the above fabrics, are the Hope and Penn mills, of Pittsburg, Pennsylvania, owned by James H. Childs, esq., and others. The best flax grain bags in the country are made at these mills, and at the same mills are also made very superior stock for battings and for the use of upholsterers. Too much credit cannot be given to the proprietors of these mills for their patriotic and successful efforts to disenthral the north from entire dependence on cotton for these manufactures, and for the encouragement they have given to the owners of other mills to follow their praiseworthy example. The mills at Lockport, New York, owned by ex-Governor Hunt and others, are also producing excellent brown and bleached stock for upholstery, waddings, and coarse yarns, as well as twine of a very high grade. The Medina Flax Company's Works, at Medina, New York, are likewise producing goods of a similar character of superior quality. To this list must be added the mills of Governor Smith and others, in Warwick, Rhode Island, that are making grain bags of excellent quality, besides carpet warps, twine, and rugs. There are many other successful pioneers in this branch of flax manufacture obtaining most encouraging results, so that this department of substituting flax for cotton on cotton machinery may be considered no longer problematical, but a success.

Having thus portrayed what we conceive to be the best mechanical mode of disintegrating, shortening, and otherwise preparing flax for coarse yarn stock, and the best mode of carrying such stock through the various processes into yarn on cotton machinery for the manufacture of coarse linen goods, we will next present the results of our efforts, and the efforts of others as observed by us, to cottonize flax by combined mechanical and chemical means to the requisite fineness, evenness, and strength for being manufactured into print cloths, shirtings, or sheetings, on cotton machinery, either by an admixture of from fifty to seventy-five per cent. of the fibres with cotton, or by their exclusive use as flax-cotton. It is wholly impracticable to disintegrate flax into its ultimate fibre or cells without the intervention of a solvent for the intercellulose or gluten, as previously indicated. And we think it is equally impracticable to rely upon mere mechanical forces to separate the fibres after such disintegration, if they are allowed to become entirely dry before the application of such means. The undecomposed gluten is so unyielding in its nature that, if not partially wet, the separation will inevitably be attended with so much breakage of the fibres as to materially injure the stock. But if they are slightly moist, they readily slide apart into ultimate lengths through the agency of properly constructed pickers that will blow them into a dry atmosphere. It is also just as important, as we have shown, that flax-cotton obtained through chemical disintegration should be prepared exclusively from unretted stock. Some persons say that the filaments of unretted stock are more brittle than those from retted stock, and therefore more liable to abrasion in the preliminary mechanical operations of cottonizing. This, if true, would be incomparably less injurious to the fibre than over-retting, a fault of every-day occurrence in retted straw. Unretted stock will endure soaking, boiling, and steaming without injury, while retted, if over-retted, will be easily decomposed; and if it is not over-retted, and is not injured in passing through these operations, the cost of bleaching it, either before or after it is manufactured, will be much greater (besides being attended with more danger of injury) than the cost of bleaching unretted stock. Hence we recommend the discontinuance of further experiments on retted stock for flax-cotton intended for the manufacture of goods, for bleaching or printing, or goods that require the element of durability. We also recommend the postponement of bleaching unretted flax-cotton until it is manufactured into fabrics.

Specimens of bleached and unbleached flax-cotton, hemp-cotton, asclepias cotton, and China-grass cotton, have been sent by divers persons to the commission, some of them very nicely disintegrated; but three only of all the contributors who have responded to our call have accompanied their specimens with any explanation of the mode of cottonizing, viz: Mr. H. McFarlane, of Rocky Hill, New Jersey, who uses the Claussen process; Mr. Hugh Burgess, of Royer's Ford, Pennsylvania, and Messrs. Fuller & Upham, of Claremont, New Hampshire. Mr. Burgess has not experimented so extensively as the latter gentlemen, but the specimens of both are well disintegrated and separated, or cottonized. The contributions of Mr. Burgess were cottonized from flax of unretted, tangled straw dressed on Mallory & Sanford's 12-roller brake, in the presence of two of the commission, and also from flax of retted straw dressed and cleaned in his neighborhood. His process for short stock consists, after further cleaning by a suitable mechanical apparatus, in submitting it to the action of soda ash (or its equivalent in potash) in caustic solution, for an hour, in an iron boiler, (Keen's patent boiler preferred,) at a temperature of about 280° Fahrenheit, the boiler to be heated in any convenient manner, and the mass of flax to be kept under the solution while boiling. The quantity of alkali used is from one-quarter to three-quarters of a pound of dry soda ash to one pound of flax, according to the condition of the latter. After boiling, the mass is blown through the manhole under pressure into a tank, and then the solution is drained off, evaporated, and burned for repeated use. About eighty per cent. of the alkali is saved. The stock, after draining, is washed with hot water until all traces of the alkali disappear. It is then bleached by the use of bleaching liquid percolated through the mass, after which it is washed, squeezed, and dried. If long stock is used, it is formed into hanks and put into wire cylinders, which are then placed in the boiler, and, when boiled sufficiently in the solution, the latter is gradually drawn through an opening in the bottom of the boiler, and evaporated and burned as before. The hanks in the cylinders, on being taken from the boiler, are washed, bleached, and dried. After drying, both kinds of stock are to be separated by machinery. He has not yet constructed machinery (except models) for reducing the disintegrated fibres or cells to uniformity of length, or for separating them longitudinally, but is experimenting in that direction, and expects soon to accomplish the desired result. His process and product were patented in January, 1864.

The contributions of Messrs. Fuller & Upham were also cottonized from unretted, tangled straw (which they much prefer to retted,) dressed by one passage through Mallory & Sanford's brake. This brake, Fuller & Upham say, removes about ninety per cent. of the shives. These gentlemen, instead of depending on flax-disintegrating, shortening, and cleaning machinery located in flax-growing districts, take the stock from the brake and pass it through a shive-cleaning machine of their own invention, which consists of a series of card cylinders placed in a frame over each other. The stock is fed upon an apron at the bottom, and is carried from the first cylinder to the others successively to the top, where it is delivered from the machine. These cylinders act upon each other as workers and strippers. They are in a screen of zinc placed within three-sixteenths of an inch of the card teeth, having apertures for the discharge of the remaining shives and dirt by the centrifugal force of the cylinders. The latter are all enclosed in a case reaching below the cylinders that receives the waste, which is removed at the bottom. The stock is then placed in a vat with water kept at 90° Fahrenheit for twenty-four hours. The water is then drawn through a grate bottom, and the vat is again filled with water containing one barrel of soap to one thousand pounds of dry fibre, and boiled twelve hours by steam at 212° Fahrenheit, when the water is again drawn as before, and pure water is percolated through the mass the remaining twelve hours. There are two of these vats, that the soaking may be done one day, and the boiling and washing the next, in the same vat, without removing the flax until it is ready for the steaming process. The stock is next transferred in rail cars from the vat to a horizontal iron cylinder having an adjustable head and a perforated movable piston operated by a screw and gears. It also has a large escape-valve at the rear head near the top, and is supplied with steam from a boiler through pipes. It likewise has a pipe to draw off the water and extractive matter. The flax being placed in the cylinder, and the head screwed on, steam at ninety pounds pressure is let on for twenty minutes, when the perforated piston is run towards the head of the boiler, squeezing the stock into a compact "cheese." The water-pipe is then opened, and the water with the glutinous matter in solution, that has been pressed through the perforated piston, is blown off. The pipe is then closed, the piston is drawn back, and the escape-valve opened, which permits the steam to escape through the apertures in the piston, and out of the cylinder. Instantly this valve is opened, the steam in the fibres expands, overcoming the cohesion of the softened intercellulose, and filling the cylinder with disintegrated ultimate fibre or cells of the flax. The explosion is recommended to be only sufficiently powerful to disrupt the fibres and leave them measurably in parallel lines; for if they are entirely separated, many of them would be broken, and become, like immature cotton, too short to be profitably spun into yarn. The fibre is then taken from the cylinder, and, when partially cooled, is passed through a compound wringer, consisting of a cylinder eighteen inches in diameter and twelve inches in length, having several rubber rolls that revolve, with the flax passing between them and the cylinder. In connexion with the wringer there is a series of differently speeded drawing rolls that passes the stock between them, drawing it into a thin sheet to facilitate drying and to equalize the lengths of the filaments and fibres. The stock is then put into a box with a grate bottom, under which is a coil of heated steam-pipes. A rotary fan forces the air into the bottom under the pipes, and through the flax, thereby rapidly removing the moisture. When it is sufficiently dried by this arrangement to allow the fibres to slide apart without sticking to each other, it is passed through an opener which consists of a horizontal cylinder covered with needle-pointed card clothing, with workers covered in the same manner, and placed under the main cylinder, which makes about one thousand and four hundred revolutions a minute, and throws the stock into an adjoining room. The flax is then carried through ordinary gambril cards, and taken off by a railhead with large and strong-corrugated iron rolls, held together by rubber springs, to pull apart any remaining long filaments. It is then passed through a lapper and a fine gambril card, and baled for the market. The mode of preparing this stock, the steaming cylinder, and a considerable portion of the machinery used, are patented, and the entire apparatus is built by the patentees and their partner, Mr. Rice, at Claremont. The price of the apparatus (at present cost of labor and materials) for one thousand pounds of fibre per day is about fifteen thousand dollars. Parties who may desire to embark in the manufacture of linen goods from stock prepared under the patents of these gentlemen would probably do better, in the beginning, to buy their stock from the owners of disintegrating works.

There is a difference of opinion among those who have made microscopic examinations of the texture of flax fibres as to their composition. While all agree that they are cellular, and have transverse lines at variable distances, some think the lines are pores through which the interior moisture is evaporated in drying, and that the cellulose structure differs sufficiently from the structure of the intercellulose to allow the decomposition of the latter without injury to the former; others that the transverse lines indicate the growth of the cells, like cane joints; and that the composition of the cells is so nearly akin to the composition of the intercellulose, that both cannot be more than partially decomposed without so materially impairing the strength of the former at the marks, and intermediately, as to render them too weak for manufacturing. It is evident to us that the union of the cellular and intercellular matter is so thorough that while the former may be relieved from the tenacious hold of the latter, there should always be left enough of the intercellulose adhering to the cellulose after disintegration to keep the cells together until they are separated, if in a moist state, by sliding them apart through the intervention of pulling rollers; or if in a dry state, by the application of a picker to break them apart. The probability is that if the decomposition of the intercellulose is complete, or nearly so, the fibre would be much injured if not destroyed. Hence the absolute necessity, in cottonizing, of using unretted flax, which always has fibre reliable for strength in any high steam process of disintegration if properly prepared.

The opinion of the commission has often been asked upon the relative durability of goods made of long-line flax, or flax-cotton, and the relative strength of goods made of the latter to goods made of cotton. From such examination as we have been able to give the inquiry, we think that goods made from sound, long-line stock, when new, will be stronger than those made of well-prepared flax-cotton, in consequence of the excess of glutinous or intercellular matter in long-line yarns; but that as flax-cotton goods will be softer and less liable to crack when new than goods of long-line, while each ultimate fibre will be as strong, there is every reason to believe that they will be more durable, besides having the advantage of flowing more gracefully when made into garments; and as the fibres of flax-cotton are much stronger than the fibres of cotton, and much more soft and silky, fabrics made from them must not only be stronger when new, but more reliable for service than cotton goods.

In addition to the probable greater durability of flax-cotton fabrics over those made of cotton, is the important fact of their superior ability to receive and hold colors. This is supposed to be caused by the difference in the shape of the fibre of the two plants. We have remarked that both are tubular; but the wall of a flax fibre being thick, its tubular form is permanently preserved, while the wall of cotton fibre being thin, its tubular form in drying becomes flat spirally, like a twisted ribbon; consequently it presents only a flattened surface to receive and retain color; and hence it is always less brilliant, even when first dyed, than a flax fibre, the tube of which excludes the air, and by its transparency reflects the color strongly, while its closed condition shields the color from the fading influence of the atmosphere.

The flax-cotton of Messrs. Fuller & Upham has been spun on cotton machinery into about No. 24, (cotton gauge,) and also woven in the form of weft into print-cloth. To spin it successfully it will be necessary to alter the lapper and cards in the manner indicated for coarse yarns, and to reduce the number and draught of the drawing heads. One head with a draught of one inch into four inches will probably answer between the rail head and speeders. The middle top rolls of the rail and drawing heads and speeders must be relieved of a portion of their weights. The middle top rolls of the spinning frames must be wholly relieved of their weights, which can be done by substituting single saddles from the front top to the back top rolls for the double saddles generally used, unless the back top rolls are of smooth iron about one and a half inch in diameter, in which case the front rolls may be weighted with a hook and lever weights, and the back rolls be left without weights.

The preparation of flax-cotton is not yet sufficiently developed to enable us to predict decidedly its ultimate success. If more time be given this commission, or a new one for further investigation, greater progress will undoubtedly be made in the present year than has been accomplished during the entire period that has been given to the subject. The commission have specimens of unretted flax-cotton recently made by Messrs. Fuller & Upham, and also specimens of yarn made from this stock, and specimens in combination with cotton to the extent of twenty-five to fifty per cent. of the latter, together with the specimens of print-cloth previously referred to, in which the filling is of flax-cotton, all giving promise of early success.

Under every aspect of the subject, we believe it will be safe to alter one or more fine cotton mills (that are now idle) to give this stock a trial if the same can be purchased at encouraging prices; at first mixed with thirty-three per cent. of cotton, and if successful, to gradually reduce the percentage of cotton until by continued success they may be enabled to withdraw entirely the admixture and thereby demonstrate to the country the practicability of spinning fine flax-cotton yarn on cotton machinery.

The encouraging reports from those who have used machine-broken and disintegrated flax-cotton as a substitute for an admixture of cotton in coarse woollen goods, relieve the commission from the necessity of elaborating this branch of the subject. As an admixture in fine woollen goods in the form of chemically disintegrated fibre, there are at present no satisfactory results. The failure to obtain such results in this direction is probably owing more to the want of a supply of good material and to the general unwillingness of manufacturers of fine woollens to mix even cotton with wool, than to any intrinsic want of adaptability of flax-cotton for admixture. On the contrary, the peculiar affinity of flax for color, (it being equal to wool in this respect,) and its indisposition to excessive fulling, would seem to make it a much more desirable admixture for fine colored woollen goods than cotton. And it is not unreasonable to expect that when there is a sufficiency of supply of well disintegrated and separated refined flax-cotton, that it will be extensively sold for this purpose.

PECULIARITIES OF FIBRES.

When we examine minutely the construction of the several materials which are so useful in the arts as textile products, we shall be astonished to find that there is a great diversity in their characters, and we are admonished carefully to examine and consider these peculiarities, lest we may be induced to recommend certain articles for applications in the arts for which they are not by nature adapted.

All fibrous substances are composed either of cells or of cell bundles which constitute filaments and fibrils. There are three several classes of cells that may be usefully applied in the preparation of textile fabrics: first, the *endogenous* cells, and the filaments formed by their union; second, the *exogenous* or the true bast cells, which also combine together in nature to form fibrils and filaments; thirdly, the *capsular* cells, which, whether simple or branched, are still simple cells, each being naturally isolated from its fellows, and generally found as hairs, more or less intimately connected with the seeds of the plants which furnish them. Prominent among these is that wonderfully useful and admirable fibre known as cotton-wool, for an analysis of which the reader is referred to articles in the agricultural portion of the United States Patent Office reports for the years 1852 and 1853, prepared by Dr. George C. Schæffer, and in which the writer has given the results of his patient and extended microscopic investigations of these fibres. In this class we also find a large number of what are called vegetable silks that are not at all equally well adapted to economic application in the arts, but which are constantly thrust forward as presenting claims for usefulness, that are at once dissipated by a knowledge of their intimate structure. Though of good and even length, and though soft and silky in their appearance, these cells, which sometimes have an incrusting matter, are too even and smooth upon their surfaces to be possessed of good spinning properties Of this class are the silk weed, thistle down, cotton-wood down, and the epilobium.

Endogenous plants are so called from the manner of their growth. Instead of depositing annually concentric layers of woody matter, like our common timber trees, these plants are inside-growers, and the new cells are interposited among those previously formed, so that a cross section of the trunk presents a multitude of dots, but no regular concentric lines and circles like common wood. These are the ends of the filaments or cell bundles, among which all new formations have to be introduced instead of being laid on outside as with the other class of vegetation. On this account the wood of such trees may eventually become very hard, and the cells will be much compressed; but these filaments are not in so good a condition for textile purposes as the newly formed cell bundles found in the foliacious expansions, and in the leaf stalks of these plants, which parts, indeed, are the fertile sources of supply of this class of fibre. As a general rule, these bundles of cells, being often of great length and strength, are especially adapted to the preparation of ropes and cordage, or other coarse fabrics, but, if properly subdivided, some of them also furnish material for the most exquisitely fine tissues.

When we recollect that all the grasses belong to this great class of endogens we need not be surprised to learn that these strong fibres may be used without first being twisted into threads. All are familiar with the East India matting as a summer carpet for our floors; some have seen our native Indians weave strong mats with the rushes of the northern lakes, and the use of straw; and the strips of palmetto leaves in the manufacture of hats are familiar to every one; none of these are twisted. But few have observed that some very beautiful tissues made in the East Indies are composed of filaments that were separated from the plants just as they present themselves to us, and that these threads have never been twisted. In some cases, as is very apparent in the coarser tissue of the matting, the ends of the filaments have been tied together deftly so as to make a continuous woof for the weaver; in others, the ends have been brought together and agglutinated by using some adhesive substance that unites them into a continuous thread. The celebrated piña is of this character, and is composed of the fibres of the leaves of the wild pineapple, which is a native of our continent, and to be mentioned on another page.

The valuable fibres of all this class of plants are associated with other cells, particularly the pith cells interspersed between them, which must be separated and removed. This process in the hands of the native workmen is often a very simple matter, and is effected by beating, scraping, and washing, but it is slow and tedious, and as these are nitrogenous matters intimately associated with the fibres, a degree of fermentation may easily be set up to assist in the disintegration. In a hot climate it is necessary to guard this process very carefully to prevent the destruction of the valuable fibre.

In the other class of plants we find quite a different arrangement of the long fibres. In the *exogens*, or outside growers, the firm woody matter, which is composed of short and stiffer or firmer cells, is formed by the deposit of concentric layers which are successively placed upon the outside of those already formed. The bark of these plants, on the contrary, is composed of concentric layers also, but the last formed is deposited within its predecessors. Here we find the true bast cells, which are arranged in filaments that unite to form flattened ribbons of great strength, and, in many cases, of considerable length. They are very pliant, having very little ligneous matter in their composition, and they form the most valuable vegetable fibres of northern temperate regions. Many of the most remarkable fibres of this class, however, are of tropical origin.

The most valuable plants of this class, and those from which these bast fibres are most readily separated, are the annuals, because in them the woody matter is easily disposed of, and is thrown off from the fibre instead of our being obliged, as in the case of large trees, to peel the bark off from the woody matter. Flax and hemp are familiar illustrations of this, and their great value consists in the length, strength, and beauty of their fibres, which are associated with a very imperfectly developed woody tissue that is easily separated from them. There are many other plants, however, which have herbaceous stems that are as easily managed, and these will be mentioned in their appropriate place.

The ultimate cells of this class of fibres are found to vary in their lengths in different plants, and probably in different parts of the same plant; they are collected in bundles which are intimately connected with each other by intercellular matter, and by pith cells; similar foreign matters are associated with these fibrils and filaments, uniting them to one another, and this fact is one of the difficulties that attends their preparation. The ultimate cells are stated to be one twenty-five hundredths of an inch in diameter, and their length is variable. They have transverse markings, which are supposed to be pores, and these are somewhat spiral in their arrangement; still, the cells, like the fibrils, are nearly straight, and tapering towards the ends. Though often somewhat compressed and angular, they are entirely different from the cell of cotton, which, though originally cylindrical, with thin walls, on desiccation, becomes flattened irregularly. This gives it the character of a spirally twisted ribbon. Some of the cells are said to resemble a screw with several twists, and this form explains the remarkable spinning properties of this fibre.*

Dr. Ure very clearly sets forth the differences in the structure of textile fibres of cotton, silk, wool, flax, and hemp, and showed that, while the first three consisted of definite and entire filaments, not separable without decomposition, the latter were compound, and that they were further divisible after treatment with

*For very clear views upon the constitution of fibres, the reader is referred to Dr. Ure's Philosophy of Manufactures, p. 81 and seq.

alkaline solutions. He brought the microscope to his aid in this investigation, and was, perhaps, the first who demonstrated the structure of these substances satisfactorily, though he refers to the labors of others. He procured a fine instrument in Paris in 1833, made by Oberhauser, with which he made his examinations of flax and cotton and wool fibres, which he illustrated with engravings of the microscopic views; some of these have been reproduced as appropriate to this report, and giving very correct representations of the objects.

From what has been shown with regard to the peculiarities of the constitution and intimate structure of different fibres, as revealed by the microscope, it will be manifest that, how closely soever we may seem to have made the fibres of flax resemble those of cotton, there is still a radical difference between them; that, though these substances appear to be similar, they are structurally different. While the cell of a cotton fibre was originally a tubular sac when filled with moisture, upon desiccation, in the process of ripening, it becomes a spirally flattened tube with a certain amount of twist. It has a tendency, from its form, to unite with its fellows, and, when so combined and subjected to the moderate draught of the spinning machinery, it is constantly inclined to couple itself to them in unison, or in accord with the processes to which it is subjected. On the other hand, when we separate the long filament of flax, by any means in our power, into its ultimate, or nearly into its ultimate fibres, or into its original cells, we find these to be straight, without twist, or any means of making them adhere to one another. Moreover, the very walls of these cells, though similar in their ultimate elements, both being nearly pure cellulose, are very differently constituted. While the cell walls of a cotton fibre are of nearly uniform thickness, and, indeed, are quite thin, those of a cell of flax are of considerable thickness, and are formed by concentric layers deposited within the original sac. The result is, that while the cavity of the cell of cotton is relatively large, allowing it to flatten in drying, that of the flax is small, and the cell retains its plumpness and rigidity, and is only modified from its original round form by pressure against its fellows, which makes it somewhat angular and irregular on its edges. This thickening of the walls makes this fibre more rigid and less pliable, as well as more heavy, and this also accounts for the greater specific gravity and the higher conducting power of flax than of cotton. The latter property, so characteristic of flaxen tissues, will ever prove an objection to this material for wearing apparel with some delicately constituted persons, while, on the other hand, the coolness and cleanliness of these tissues, which are proverbial, commend them especially to others. The greater specific gravity of flax should be taken into the account in all calculations respecting its manufacture, to avoid errors in estimates of the cost of the materials.

Dr. Ure has bestowed great care in ascertaining the specific gravity of these substances, and the results of his researches are somewhat surprising. His process is very philosophical and simple, so that his data are probably very reliable, in view of the excellent precautions he has adopted to obviate the errors that would arise from the presence of air. After using great care, and proving his results by trial and corrections, he gives the following figures: Wool, 1.26; cotton, 1.47 to 1.50; linen, 1.50; silk, 1.30; mummy cloth, 1.50. Remarking upon these weights, he says: "As a bale of linen goods is heavier than a bale of cotton goods of the same size, it might be supposed that flax is a denser substance than cotton; but it should be considered that cotton is more elastic, and, therefore, less compact under similar pressure. It is only by weighing each matter, under immersion in a liquid, that its true density can be learned." He considers the density of cotton and linen the same, and suggests that silk and wool may also be equal, and that the vegetable fibres have equal density, and thinks that the timber fibres will be proved to have a density similar to that of flax; for he suggests that the porosity of wood causes a fallacious estimate to be made of the density of its substance.

The great impetus which has of late years been given to attempts to reduce flax to a condition similar to cotton, and the extended notoriety of the suggestions to cottonize flax, has induced many persons to think that this is a new idea, one of the characteristic events of the wonderful era of progress and invention in which we live. That the idea of cottonizing flax is not new, but that is has long occupied the human mind, will appear by referring to the history of the subject, as has been done by the very learned and intelligent jury of the great international exhibition of Great Britain, who give the following account, from which it will appear that nearly a century and a quarter ago it was proposed to convert flax into cotton by boiling in alkaline solutions. From whatever causes, all these various processes appear to have failed in the objects they attempted to subserve.

The statements with regard to the splitting and bursting of the ultimate cells, as claimed by Claussen, are not verified by microscopic investigations of the specimens presented to us.

The subjoined quotation is from the report of the jury at the international exhibition of Great Britain in 1851. An extract from the report of a later jury will also be introduced to show our progress in the arts during the intervening decade:

"Among the continental nations of Europe the northern have long been celebrated for the production of flax and its manufactures, Flanders being especially distinguished for the beauty of its fine goods, and Russia and Germany for the strength and durability of their heavy and other linens.

"It is a remarkable fact that so long as hand-spinning was the only known way of producing yarn, Great Britain and Ireland were not much noted for their manufacture of linens. The wonderful change, however, wrought by the invention of the "spinning jenny," and its application to cotton machinery, speedily led to the development of the same principle in making mill-spun yarn from flax and hemp. A numerous series of specimens were contributed by P. Claussen in illustration of his patent process of making flax-cotton. This process (patented August, 1850) consists essentially in boiling the cut and crushed stems of the flax, hemp, or other plant, in a dilute solution of caustic soda, containing about one two-thousandth part of alkali. The fibrous matter is then removed and plunged into a bath of dilute sulphuric acid, containing one five-hundredth part of acid, in which it is boiled for about an hour. It is next transferred into a solution containing about ten per cent. of carbonate of soda; and lastly, when it has remained in the latter for an hour, it is plunged into a weak solution of sulphuric acid, consisting of one part of acid to two hundred or five hundred parts of water. In this it is left for about half an hour, and the process is completed. The effect of these several processes is to divide and split up the fibre in a most remarkable manner, so as completely to alter its character. Flax thus treated is converted into a substance very nearly resembling cotton. It is probable that flax-cotton can be advantageously used in the manufacture of mixed fabrics, as it appears capable of being spun with wool, silk, and other fibres. It may, therefore, perhaps, hereafter lead to several new and important practical applications. For this ingenious process the jury awarded a prize medal.

"The idea of modifying the fibre of flax and hemp, so as to convert it into a kind of cotton, is by no means new. In 1747 Lilljikreuzes and Palmquist described a mode of converting flax into 'cotton' by boiling it for some time in a solution of caustic potash, and subsequently washing it with soap. In 1775 considerable quantities of refuse flax and hemp were converted into 'flax-cotton' by Lady Moira, with the aid of T. B. Bailey, of Hope, near Manchester. The full details of the process employed do not appear to have been published, but from Lady Moira's letters in the Transactions of the Society of Arts for 1775, it appears that the fibre was boiled in an alkaline lye, or a solution of kelp containing carbonate of soda, and subsequently scoured. The result of this was that 'the fibres seem to be set at liberty from each other,' after which it may be 'carded on cotton cards.' It appears that at this time flax-cotton was made and sold at threepence a pound, and Lady Moira states that she believes that it takes colors better than flax. It is curious to observe the fate of Lady Moira's scheme. She says: 'I have no reason to be vain of the samples I have sent you, they merely show that the material of flax-cotton, in able hands, will bear manufacturing, though it is my ill fortune to have it discredited by the artisans who work for me. I had in Dublin, with great difficulty, a gown woven for myself, and three waistcoats; but had not the person who employed a weaver for me particularly wished to oblige me, I could not have got it accomplished; and the getting spun of an ounce of this cotton in Dublin I found impracticable, and the absurd alarm that it might injure the trade of foreign cotton had gained ground, and the spinners, for what reason I cannot comprehend, declared themselves such bitter enemies to my scheme that they would not spin for me. Such is my fate that what between party in the metropolis and indolence in this place, (Ballynahynch,) I am not capable of doing my scheme justice. That it should ever injure the trade of foreign cotton is impossible.' Lady Moira states that the flax-cotton gowns which she had had made, and which were worn by the members of her own family, were exceedingly durable, and the specimens of these fibres, as well as of the flax-cotton prepared by her, which are still preserved in the Museum of the Society of Arts, and are highly remarkable for their beauty.

"Subsequently to this several attempts were made in Germany to convert flax into a fibre resembling cotton, which could be used, either alone or together, with cotton in the manufacture of cotton goods. In 1777 Baron Meidinger proposed to convert flax into a sort of cotton by the action of alkaline solutions, &c. In 1780 a factory was established at Berchtoldsdorf, near Vienna, for the practical working of this process; and similar plans were subsequently brought forward by Kreutzer in 1801, by Stadler & Haupfner in 1811, by Sokou in 1816, and by several others.

"At the factory at Berchtoldsdorf not only was flax converted into cotton, but likewise a useful cotton-like fibre was prepared from tow and refuse flax, and the same is said to have been done by Hoag near Pressburg in 1788, by Gobell in 1803, and Segalla in 1811. Whether these various plans failed from the effects of jealousy and opposition, like that which prevented Lady Moira from introducing her flax cotton, is unknown; but it does not appear that any of them were long persevered in."

In one of those excellent lectures which grew out of the international exhibition, Mr. Solly is reported to have said, "I must confess that I am not at all sanguine as to the benefits to be derived from this proposal, though I think it by no means impossible that it may hereafter lead to valuable and important improvements."*

The commission, though previously somewhat discouraged by the exhibition of many unpromising attempts to cottonize flax, now feel that they are upon the eve of realizing the valuable and important improvements suggested by this distinguished savan.

So far from flax-cotton being a new article, or prepared by a new process, Dr. Schæffer states, in his excellent article on vegetable fibre,† that a similar method has been used by the Chinese for centuries.

The method of preparing this substance, as patented by Claussen, has already been given; but we find many specimens that appear to have been prepared by other processes, and their exhibitors pretend to have secret methods which they are unwilling to divulge, or claim that they have patent processes for their modes of preparation. Many of these specimens are entirely worthless, and several of them have been ruined by the misuse of chemical substances. The expense attending some of the modes of preparation is a serious objection to them; those in which cutting the fibre is a part of the process it is apprehended will produce undue waste in spinning, and in all we find a want of such a perfect disintegration as to yield an approximate uniformity of length and thickness of the fibres. The most promising specimens are those which were prepared by hot alkaline solutions, and the bundles of cells mechanically separated from one another afterwards while still moist. These will be noticed in the chapter on manufactures.

The London jury at the international exhibition of 1862 do not appear to be even so favorably impressed, when they speak of the "empirical method which, in 1851, led a majority of the jury to award a medal to Chevalier Claussen, but which, after eleven years, is just where it was at that time—in the limbo of impracticable ideas. The so-called flax-cotton has been shown as a curiosity by its inventor, but every attempt to employ it practically has proved a failure. Flax still insists upon being treated as flax, and hemp as hemp, and nothing succeeds so well in the disintegration of the fibres as water-retting."

This sweeping clause we are not prepared to adopt at the present stage of our investigations, and with the very promising developments opening before us, as exhibited in the specimens presented by Mr. H. Burgess, of Royer's Ford, Pennsylvania, and by Mr. James B. Fuller, formerly of Claremont, New

* Lectures at the World's Fair, 1850: Professor Edw. Solly.

† United States Patent Office report for 1859, to which the reader is referred for much interesting detail.

Hampshire, but now engaged in putting his discoveries into practice at Norwich, Connecticut, we are led to anticipate the happiest results.

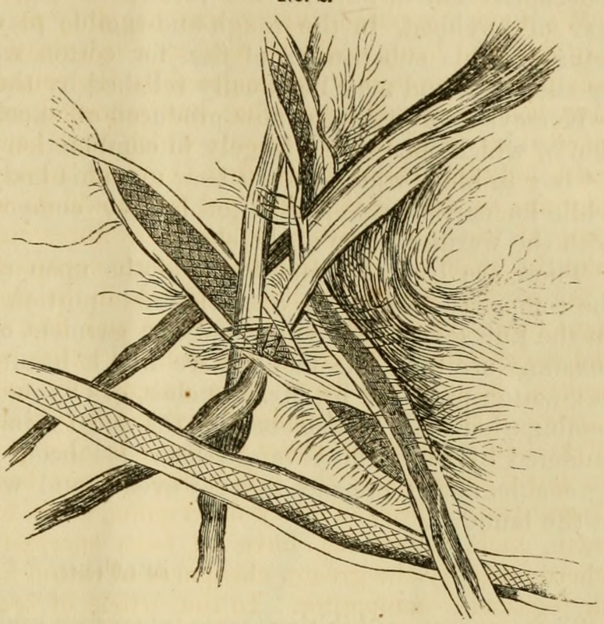
We have supposed that it was our duty to examine how far and in what way flax and hemp could be used as a substitute for cotton. This question has been pretty thoroughly investigated by the commission; its answer may already have been gathered from what has preceded, and the public may have drawn conclusions from the statements which have been made as to the radical differences between these fibres, that they can never really be substituted, because they are so dissimilar. And yet we should do wrong were we not to point out some of the many uses to which these fibres may be and have been applied to take the place which cotton has hitherto occupied.

As cordage and for twines, to which, in the cheaper days of cotton, that substance was extensively applied, hemp and flax still assume their pre-eminence and superiority. Even to the grocer's twine, which must be short and easily broken, these fibres have been extensively and profitably applied. Every variety of twine is now made of flax and tow in several establishments. Thread of the best quality for many purposes is also prepared from this material, and for some branches of the arts it has always been deemed superior to cotton. Coarse linen fabrics of every description, from bagging down through burlaps, crash, duck, diaper, &c., have all been successfully made of flax and hemp, where formerly the greater cheapness of cotton had caused that fibre to supplant its legitimate competitor. In the article of seamless grain-bags, which were formerly made altogether from cotton, we now have a much better article produced from flax. The nicely prepared battings of flax, whether bleached or unbleached, have taken the place, to a great degree, of the application formerly made of the dirty and refuse cotton for this purpose; but the greater weight of the flaxen material depreciates its value and usefulness when to be applied in this way, for a given number of pounds of flax batting will cover a space but half as large as an equal quantity of carded cotton.

It would not be consistent with the limits of this report to take up the discussion of the whole subject of paper-making, although its main feature depends upon the value of these very fibres we have been examining. As in its production, however, flaxen and hempen fibres may very advantageously be substituted for those of cotton, we may be pardoned for making some allusions to this matter. As before intimated, all of these several fibrous substances are composed of nearly pure cellulose, and thus, in their ultimate composition they are very much alike. It further appears that whatever materials be used for paper-making, their value will depend upon the amount of this proximate principle of cellulose which they contain, and whether the stock consist of solid wood, hollow straw, fresh fibre of bast cells from our flax fields, waste cotton from the factories, or worn-out clothing and old ropes, made from these different fibres, their value in every case depends upon the amount of pure cellulose which can be derived from them. The cellulose from the several sources appears to exist in nearly the same proportions, about fifty per cent., whether we take the wood or the straw for the raw material.

The union of these fibrous substances in the tissue of paper depends upon a peculiar condition which has been imparted to them by the action of the paper-machine, so tearing and breaking the cells and fibrils, and fraying their ends as to give them a sort of felting property—quite different, it is true, from what is described as felting, in another part of this report, but still enabling the ends of the fragments to unite with one another so as to form a tissue of more or less consistency, according to the nature of the materials used.

This will best be explained by an illustration taken from the Journal des Fabricants de Papier, vol. I, p. 180.


No. 2.

View of a shred of paper, in which are beautifully exhibited the cylindrical fibresof flax or hemp mingled with the ribbons of cotton fibre; also the confused mass of ruptured fibres completely comminuted. This drawing shows the condition to which fibres are reduced by the rag-engine, and explains the peculiar felting upon which the constitution of paper depends.

Besides the appropriation of considerable portions of the lint produced by our flax fields to the manufacture of paper, which, indeed, appears to be rather a waste, when we consider that old clothing is just as good as new fibre, there are several other applications of this material in the arts.

Considerable quantities of rough tow, such as is cheaply prepared from the tangled and inferior flax straw of crops that have been grown expressly for seed, is used in the stuffing of furniture.

But, it may be asked, when are we to have flax produced in such a condition and in such quantities as to be suitable to provide us with finer goods, like sheetings and shirtings and print-cloths? Even this we are about realizing, and we hope soon to be able to furnish some cloths of quite respectable fineness and finish, in which disintegrated flax fibres shall have been used either alone, or mingled with cotton. Though long discouraged by the failure of attempts to cottonize flax, on account of the injury done to the fibre, and the unsatisfactory results in attempting to reduce the long filaments to an average definite shortness suitable for cotton machinery, we now look hopefully for much more satisfactory products, as will appear in the appropriate place. The radical difficulties of the fibre remain in the less pliant and straighter cell, in the greater specific gravity, and consequently greater conducting power of the product; but the spinning difficulties appear to be in a fair way of being overcome by American ingenuity. (See specimens in museum.)

An application of flax as a substitute for cotton, which was little expected, presented itself in the formation of hard rolls for print-works and bleacheries. In the construction of these rollers it had been a desideratum to get a hard and elastic surface. This was first accomplished by disks of heavy paper closely applied to one another upon a shaft, firmly compressed and then turned into shape. Next cotton itself was used; but it is now found that flax fibre may be applied to this object with the most satisfactory results.

One of the greatest claims which flax presents to our notice is its ability to replace cotton, and with great advantage, too, in all the cases where that substance was formerly used in combination with wool in the production of mixed fabrics. Hempen and flaxen yarns are now resuming their original importance in the manufacture of carpets, both alone and when used as the warp only, of those useful tissues, in which cotton had entered as the leading article.

In the reproduction of the good old-fashioned linseys we are reminded of the healthy days of our boyhood and the infancy of our manufactures, when homespun goods were not yet wholly banished from the farmer's wardrobe by the introduction of the more flimsey cassinets from the power loom, which bore a deceptive finish, but did not furnish the desired resistance to the wear and tear of boyhood, in the rough-and-tumble plays of the school-house. The return to this substitution of flax for cotton will be hailed with acclamation by the boys, and may be equally relished by their careful mothers.

Kerseys and jeans are now produced of excellent quality, into the preparation of which flax enters largely in combination with wool, and there is scarcely a "boy in blue" who does not bear upon his body, in his uniform, fibres of flax, while he carries also a blanket largely composed of this material combined with the warmer fleece of the sheep.

There are beautiful samples of cloths upon exhibition in the museum, into the composition of which a considerable portion of flax has been made to enter. In the knit goods before us, and one garment of which has been subjected to constant use for some months, we find a beautiful merino stuff, in which the flax-cotton prepared by Mr. Fletcher, of Oswego, New York, has been used in combination with wool instead of the usual admixture of cotton. The service rendered by the garment in question has been in every way satisfactory and agreeable, and it appears to wear evenly and well, and has not been fulled up in the laundry.

FELTING.

There are on exhibition some very firm and well printed druggets, which have attracted great attention from visitors who have examined them. But we cannot advise any further experiments in the way of attempting to produce felted goods of mixed flaxen material, for it is manifest that the fibres of flax have no felting properties. To make this apparent it will be necessary to investigate the principles upon which felting depends, when we shall find that the necessary elements are not possessed by the smooth filaments of flax.

This may best be done by quoting from the popular writer of a work entitled "Useful Arts employed in the Production of Clothing," in which we find the following observations that throw great light upon the subject:

"If we hold a human hair firmly by the root and draw it gently between the thumb and fingers, it passes through smoothly and with hardly any resistance or interruption; whereas, if we reverse the motion, holding the hair by the point, and draw it from point to root, a very sensible tremulous resistance will be experienced, accompanied by a cracking sound. Again, if we place a hair loose between the finger and thumb, and then, by alternately bending and extending them, give them a backward and forward movement, the hair will be put in motion, and this motion will always be from root to point, whether the root be in one or the other position with respect to the two rubbing surfaces. A fibre of wool, likewise, under similar circumstances, always moves in one direction. Every schoolboy knows that an ear of barley, if put within the sleeve at the wrist, soon travels up to the arm-pit; he also knows that he can only rub a single awn of barley in one direction between his finger and thumb—that is, from root to point. The awn of barley is visibly jagged at the edge like a saw, the teeth pointing obliquely upwards, and this particular conformation is manifestly the reason why it is capable of motion in one direction, but not in the other. These facts lead to the explanation of the cause of felting.

"Wool is more crisped and spirally curled than hair; this may be seen by holding a small lock up to the light. This varies in the amount of the curl in the wool of different sheep, and is most perceptible in the fine wools. Those which curl most are best adapted for feltings. This twist aids in that arrangement of the fibres which enables them to unite thus together; it multiplies the opportunity for this interlacing, and increases the difficulty of unravelling the felt; but while assisting, it is not the principal agency concerned, which depends upon the ultimate structure of the particles.

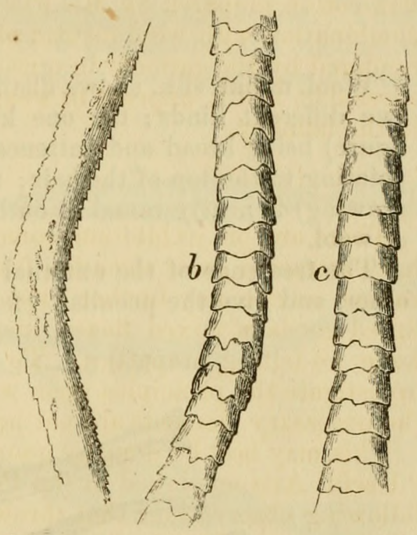
"Felting was formerly supposed to be owing to a kind of attraction or cohesion between the fibres. Dr. Young thought the cloth contracted in felting, because the fibres were unequally bent in the pounding received from the fulling-hammers, and that those most bent were prevented from returning to their original length by their adhesion to their neighboring fibres. This, however, does not apply to the common instances of felting, as in hat-making and the wearing of a woollen sock, for here the fibres are rubbed together and not beaten, as in fulling. Before Monge, the French philosopher, first discovered a satisfactory explanation for this process, a Mr. Plint suggested the following happy conjectures:

"'Respecting the application of the microscope to the examination of the fibre, I am decidedly of the opinion that a careful and minute examination of wools differing in their felting proportions would result in the detection of some specific difference of structure. This property is altogether inexplicable, except in the supposition that the surface of the fibre is irregularly feathered, and that, by compression, these feathered edges become entangled and locked together. These feathers must also point in one direction, from the root to the extremity of the fibre, and if we suppose the feathered edge, or, more properly speaking, the individual tooth or feather, to be of a finer texture, it is evident that one tooth being pushed into another would fasten like a wedge; and if we further suppose that the tooth or feather has a barb, similar to that on a harpoon, the phenonema of felting are explained.'"

How wonderfully these suggestions of Mr. Plint have been verified by the developments of science in the discoveries of the microscope; it has been found that wool has this very feathered or serrated structure. With an instrument of 300 linear power the filaments of wool show teeth resembling those of a fine saw, and different wools present different forms of serration. (See plate of wool magnified 200 times.)

No. 3.—Specimens of different wools. (Dr. Ure.)

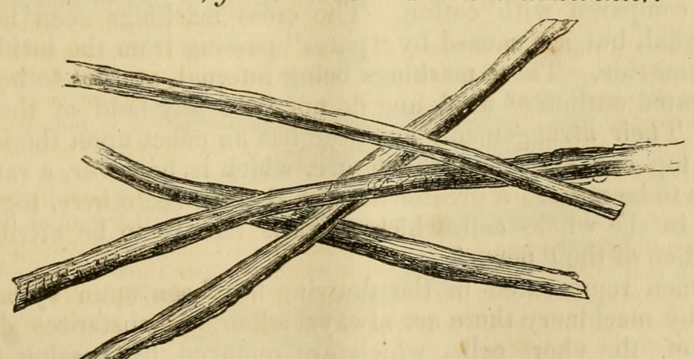
a. Leicestershire.
b. Finest Saxony.
c. Finest Spanish.



Dr. Ure tells us that, when viewed through a powerful microscope, the filaments of wool have something the appearance of a snake with the scales a little raised, so that the profile is serrated, the teeth being toward the point. Each fibre seems to be composed of serrated rings, imbricated over one another. These teeth and the intervening spaces differ in various samples, and these transverse lines resemble the rings of the earth-worm. This appearance has been compared to the effect of a series of thimbles with uneven edges inserted into each other. The existence of these serrated edges explains the reason why these substances may be felted, and it is known that in those which felt the best the serratures are most distinct.

DESCRIPTION OF THE PLATES AND THE FIBRES WHICH THEY REPRESENT.

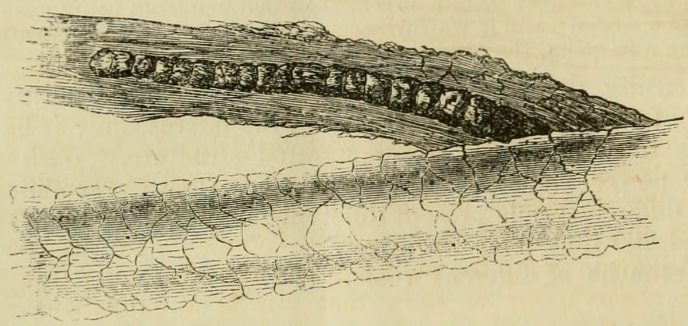
No. 4.—Silk, *from an East India handkerchief.*



The fibre of silk consists of a round or somewhat flattened, narrow, and structureless substance of indefinite length, quite solid—that is, without any internal cavity, and without any visible markings.

The original condition of these fibres, when first unwound from the cocoon, shows them in pairs, agglutinated by a secretion external to the fibre itself. The subsequent treatment separates these fibres more or less until they present the appearance shown in the figure. Silk is wound off from the cocoon, and its parallel fibres are afterward twisted. The broken fragments are carded, and then spun; the resulting fabric has quite a different appearance from ordinary silks.

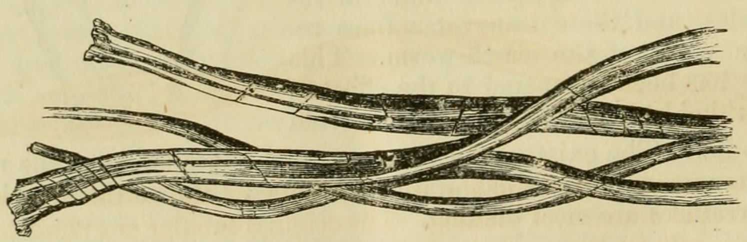
No. 5.—WOOL, *treated with dilute sulphuric acid.*



Wool, unlike silk, shows distinct structure, and is in fact made up of cells of two different kinds; the one kind on the outside (as seen in one part of the figure) being broad and flattened, overlapping each other, with their free edges pointing to the top of the hair; the second kind (as seen in the other part of the drawing) is nearly round in outline, and forms the so-called "pith" of the hair or wool.

The free ends of the external cells prevent the hairs from slipping past each other, and give the peculiar "felting" property to wool.

No. 6.—FLAX, *from a fine Irish linen.*

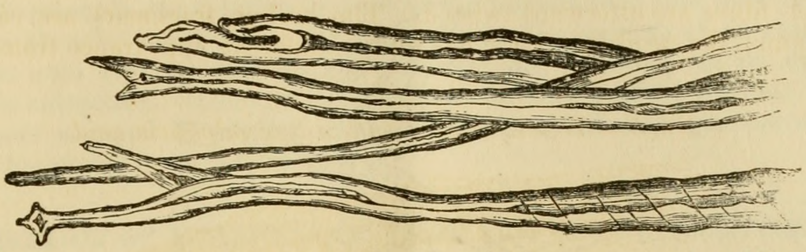


Flax, like all vegetable fibres, is made up, as ordinarily used, of several cells forming a filament. The figure represents the separated cells.

The *bore* or internal cavity of the flax cell is not large; hence its greater strength as compared with cotton. The cross markings seen in the figure are not external, but are caused by "pores" passing from the inside of the cell to near the outside. These markings being internal, are not to be confounded with the serrated outline of wool, and do not give any hold of the cells upon each other. Their arrangement, however, has an effect upon the isolated cell; thus in the top one, shown in the figure, which is, however, a rather unusual form, there is to be noticed a greater flatness than in the others, together with a slight twist in the whole cell, which twist is mainly to be attributed to the oblique direction of the "pores."

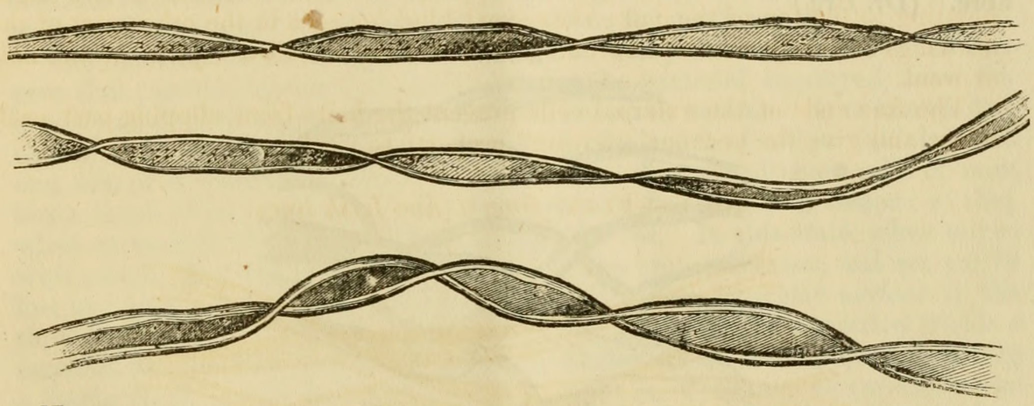
The specimen represented in the drawing has been spun by hand. When flax is spun by machinery there are always adhering substances derived from the remains of the short cells, which are removed by passing through the fingers in hand spinning. When flax is perfectly cottonized the cells should exhibit the appearance shown in the figure, with a smooth and unbroken outline.

No. 7.—HEMP.



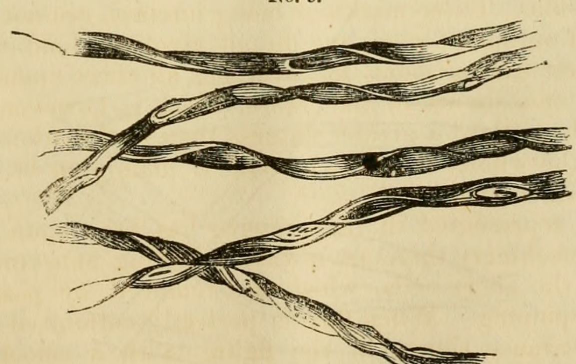
The figure represents the separated cells, which are somewhat like those of flax. Three of these cells are shown with forked ends, but this is by no means a constant character. The cross markings are shown as oblique in one cell, but even this is by no means uniformly found. In the specimens described in another place, it will be seen that while in Russian hemp the same obliquity is noticed, in American hemp the markings are almost exactly transverse. There are too few observations to show that this is a permanent and distinctive difference. *All of these figures represent the objects magnified two hundred times.*

No. 8.—COTTON.



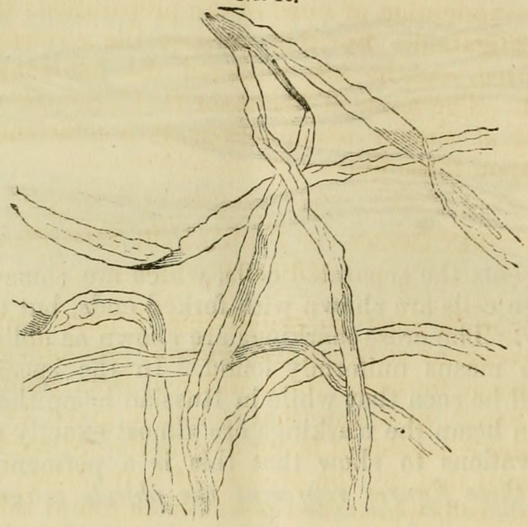
No. 8 represents portions of the separate cells of the cotton fibre as delineated in the beautiful drawing of Riessig. The original tubular or cylindrical character of the line cell is lost, and in desiccating, the walls have collapsed upon one another irregularly, which gives the peculiar spiral character to the fibres. This varies in different specimens, some being nearly like ribbons, while others have a regular twist like a screw.

No. 9.



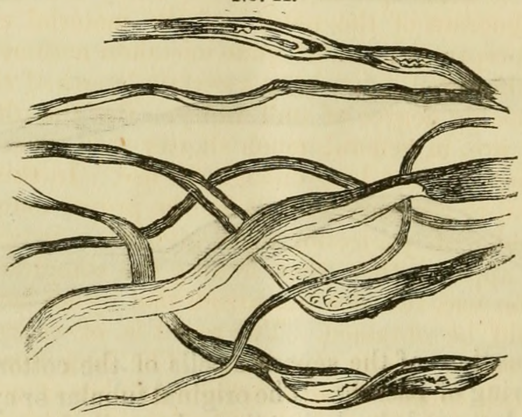
No. 9 from Dr. Ure, best sea island cotton, of which lace and fine muslin are made. Fibres one one-thousandth of an inch in diameter; tortuous semi-cylinders of uniform size.

No. 10.



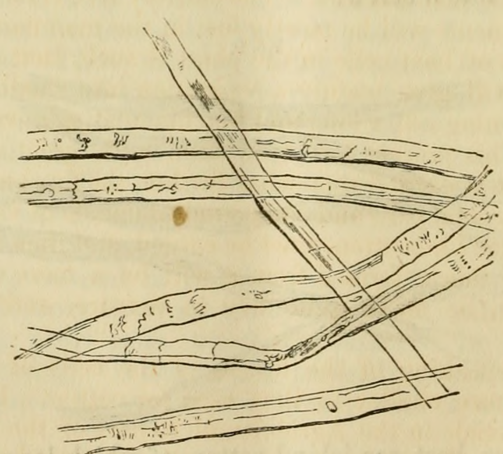
Religious cotton, of which fabrics are worn by the Bramins; a very flimsy fibre. (Dr. Ure.)

No. 11.



Surat cotton, irregular ribbon form. (Dr. Ure.)

No. 12.



Flax fibres as mounted in balsam. (Dr. Ure.)

The commission is happy to be able to present the following results of a very careful microscopic examination of some of the preparations that have been presented for their investigation. For this purpose the services of an expert microscopist were secured, and he has rendered the following report upon the specimens submitted. The name of Professor G. C. Schæffer, who has been for many years engaged in similar examinations, is a sufficient guarantee of the value of his report upon these fibres.

EXAMINATION OF SPECIMENS OF FIBRE FOR THE FLAX-COTTON COMMISSION.

In making this report, it must be stated that I have confined myself to the description of the specimens as presented, without pretending to say what might have been done to them to make them different from what they are. By the words "cottonized fibre" we denote that condition given to an originally long fibre which may render it capable of being used in the ordinary cotton machinery. In general it is claimed that, by the process of cottonizing, the compound fibre is reduced to its single cells which then resemble cotton in this respect, as it also consists of single cells of nearly uniform length. The idea sometimes put forth that the individual cells are themselves split by this process is utterly fallacious, as I have ascertained by repeated examinations for many years.

The examination of these specimens, and of many others, has led me to suppose that persons, ignorant of the nature of the material employed, have frequently made their preparations under quite mistaken notions. It is known that cotton, to be profitably used, must have a certain length of cell or "staple," and one, too, of a reasonable degree of uniformity. But the ultimate cells of most basts (bark fibres) are, in general, much shorter than those of cotton; so that, when cottonized, they are not long enough for use. In this state, when mixed with cotton, they fail to combine with it in the proper manner, and are partly lost and partly found with projecting ends, giving an irregular surface to the thread formed. It appears, then, that, finding the complete operation yields a material too short for use, the idea has arisen that by an incomplete cottonizing a longer staple could be obtained. The result is, of course, as various as the treatment, but the end is nearly the same. The long fibre is broken up into shorter portions which consist of an indefinite number of cells, and, since these are arranged so as to break joint, the length of the filament obtained will be very variable. Hence the apparent length of staple is gained at the expense of great irregularity, while the free ends of individual cells projecting from the filament will interfere with the manufacture. The entirely free cells which may be found among the long filaments will be mostly lost in the manufacture. The arrangement of the bundles of bast cells in the plant is such, that a treatment which is not carried too far will give mainly a separation into smaller bundles by longitudinal division, turning out a long and fine filament, admirably adapted for long staple spinning. This process has been used with great success for centuries. But if the treatment is carried somewhat further, the fine bundles are themselves broken up into individual cells and compound filaments of varying length. This material, when treated like cotton, must be carded, and then becomes only a finer sort of *tow*, and the fabric formed from it will be a more or less fine *tow-cloth*. This may, however, be made quite fine in texture, and suitable for various purposes.

I do not intend speaking of the fitness of the cells of different plants for a process of manufacture similar to that used for cotton. I have enlarged upon this subject in an article in the Agricultural Report of the Patent Office for the year 1859, and generally the matter is so well understood that any repetition in this place would be useless. One thing, however, deserves notice, no matter how well the material may be fitted for cotton spinning, the fabric obtained will vary in character according to the structure of the cells employed. The cells of cotton have thin walls, are very absorbent of moisture, poor conductors of heat, and, for a given surface and thickness, produce a fabric lighter than that of any other material hitherto used

The cells of bast have thick walls and produce heavier fabrics, which are less absorbent, and are better conductors of heat than those obtained from cotton. In short, the cloth obtained from bast cells will always carry with it their peculiar character, and although manufactured as cotton, it will never be cotton-cloth Of course there are many uses for which such cloth might be well adapted, but, as worn in contact with the body, it could never replace cotton.

Again, the action of colors upon cotton and bast fibres is quite different, and the treatment of colored goods from the different substances would be quite unlike. Indeed, it is doubtful whether the same results which are now so cheaply obtained from cotton could ever be produced from bast cell fabrics at an equal cost.

I shall now give the description of the respective specimens as examined by me under the microscope.

Each sample is denoted by a number which I have given for convenience of reference, and by the exact words placed upon the envelope as it came to me.

No. 1. "*Flax disintegrated, by H. Burgess.*"—The envelope contains two specimens—one bleached, the other unbleached. The fibres are of various lengths—appearing under the microscope to be mostly single cells—some quite long. One I found to be one and a quarter inch, with tapering ends. The cells have the usual character of flax. From the unequal lengths, I should be inclined to think that the cells of flax have no great uniformity in this respect.

No. 2. "*Asclepias cornuti cottonized, by Williams.*"—Imperfectly cottonized, and, of course, unequal in staple. Some single cells which could be drawn out were found to resemble flax in most respects, but differing in decided markings that form long spirals, and also in the diameter of the internal cavity which is less than that of flax, and also more irregular.

A specimen of this fibre, perfectly cottonized from Russia, which I have in my collection, shows that the cells will not average more than three-fourths of an inch, if so much.

No. 3. "*Russian hemp, by Burgess.*"—Not quite white. Not well cottonized, and, therefore, with filaments of unequal length.

As compared with American hemp the cells seem to have a greater diameter for the internal cavity, and the transverse markings are more oblique. I cannot say that this is a constant character, but it agrees very well with the drawing of Russian hemp given by Schacht, as will be seen on reference to the figure No. 4.

No. 4. "*Clausenized flax-cotton, Geo. Graham, Cincinnati.*"—Cream-white. Unequal in length; many single cells, but mostly filaments composed of four to eight. This shows that the process has not been carried to completion, as is also indicated by the adhering remains of short or pith cells.

No. 5. "*Green flax boiled in caustic soda, but not cottonized, McFarlane.*"—Yellowish white. Coarse to the touch; very long filaments, the finest containing at least six cells. The filaments are evidently too long and coarse to be treated as cotton.

As the action of caustic alkali is capable of separating the fibre into individual cells, it seems that this product has been obtained by a less prolonged action, or a weaker solution.

No. 6. "*Unretted or green flax, Claussenized by McFarlane.*"—One specimen in long slivers, the other bleached, the latter only examined. Some single and long cells, but many compound; no possible determination of average length. This has evidently been obtained from a flax having very long cells.

No. 7. "*Erolin or flax-wool: G. Davis, Cincinnati.*"—Unbleached; long filaments; seven to ten cells in each; also with adhering remains of short cells.

No. 8. "*By R. T. Shaw; his No. 2 cottonized flax.*"—Yellowish gray; staple *very* unequal; mostly short or broken single cells, some filaments with four or more. There is too much difference in this material to be wholly treated by one process of manufacture. The very great irregularity in length would prevent this. The whole mass is very closely matted. Some cells of extraordinary length were found; it must have been a remarkable flax to furnish such.

No. 9. "*Fibrilia wool, bleached: S. M. Allen.*"—Yellowish cream-white; mostly very long filaments, consisting of twelve or more cells, utterly incapable of being used on cotton machinery.

No. 10. "*Kentucky hemp, by H. Burgess.*"—Unbleached; very unequal filaments; some apparently single cells, or two or more slightly overlapping; very long compound filaments.

No. 11. "*Fibrilia hemp: S. M. Allen, Boston.*"—White (bleached) blue, and unbleached specimens. The bleached only examined. Very unequal compound filaments. The first drawn out containing about four cells.

No. 12. "*Hemp-cotton: R. T. Shaw.*"—This specimen consists almost wholly, if not entirely, of wool, as can be determined by the naked eye, and by the smell when burnt. This has, no doubt, occurred from some accidental confusion of the specimens exhibited to the commission, from which this sample was selected.

No. 13. "*Bœhmeria nivea. India. Urticaceæ. By L. W. Wright, Brooklyn, New York.*"—This specimen must have been presented as a mere curiosity. It shows this splendid fibre with its unrivalled length, but in a condition unfit for cotton manufacture; indeed, it is only in the state of the refuse tow obtained in the preparation of the long fibre which forms the well-known "grass-cloth" of the east. It was not exhibited as a cottonized sample.

No. 14. "*Jute by alkali: R. T. Shaw.*"—Yellowish white; coarse to the touch; unequal staple; single filaments of many cells.

No. 15. "*Flax: R. Fletcher, Oswego, New York.*"—White, bleached; staple very unequal; finer filaments of at least seven cells, many shorter; adhering remains. I am asked to determine if there are many broken cells. A bundle of the shorter part of the staple shows mostly single cells, some of them within broken ends. If this product is from flax cut into moderately short bits, it would seem that some waste would arise from the fragments which fall off in handling the specimen; but the quantity would be very trifling when compared with the waste from such equal staple.

No. 16. "*Fuller & Upham, Claremont, New Hampshire. Unretted and unbleached stock.*"—Grayish white; staple rather shorter than in most of the specimens, and more uniform, but still unequal. Some compound filaments with adhering remains. Seems to contain more flattened cells than are usually found.

The shorter compound filaments, which make the whole product more uniform in length, are to be noted. They may have been obtained by cutting the flax, as this would give a maximum length to the most complex filaments.

No. 17. "*Burgess. Hanks of retted flax, disintegrated, but not separated; also (a,) (b,) (c,) and (d.)*"—My attention has been called to the hank, (unbleached,) which has considerable tenacity when dry, but is readily separated into cells or smaller filaments when wet. The water swells and lubricates the parts, which then slip by each other; while, when dry, the natural arrangement of the cells gives too much friction to allow them to part, and, having been previously wetted, they have turned somewhat in drying, and so gained a hold on each other. Adhering remains of a yellowish color were found.

"*(a.) Retted; steamed with caustic soda and carded; same stock as (b.)*"—Gray; staple unequal, about one-half to one and a quarter inch in length. Mostly single cells, but with many adhering remains. Shows very well the inequality of the flax cells in length. In this specimen there are some cells of very large diameter.

"*(b.) Same stock as (a;) retted, steamed, and picked.*"—Staple shorter than in the last specimen; compound filaments; adhering remains abundant; some broken cells.

"*(c.)*"—No memorandum. Gray; not bleached. Staple unequal; many long compound filaments; also long single cells, as in No. 1.

"*(d.) Retted, and steamed with caustic soda. Crop of* 1862."—Gray; very long staple; many long single cells; still longer compound filaments of a few cells. Seems to be an extraordinary flax, as far as regards the length of the single cells.

No. 18. "*Epilobium; from Rutger B. Miller, Utica, New York.*"—Cream-white; silky lustre. Staple very short. Consists, like most seed-hairs, of single cells. Their walls are very thin; they make sharp bends, and seem to be brittle, without the least wind or twist, and, while resembling the down of asclepias, are of less length, with a rather strong longitudinal marking. Utterly useless for spinning. Even when mixed with other fibres, would fly off in the process of manufacture.

No. 19. "*Bœhmeria, sp. or Laportea? R. Chute, St. Anthony, Minnesota.*"—One specimen unbleached, the other bleached; both of similar character; rather harsh to the touch. On examination, the filaments prove to be compound and flat, consisting of more than five cells. There has evidently been no process used to isolate the cells, which hold together very tenaciously, and also have adhering remains. The smallest fragments that could be drawn out were still compound. A sufficiently prolonged treatment with alkaline solutions would separate the cells; but any mechanical means, or more rapid action of re-agents, only brought to sight portions of single cells from which their character might be determined. These appeared to be flattish, with rather thick walls, and long spiral markings. It is probable that the individual cells are quite long, judging from the appearance of the filaments.

GEORGE C. SCHÆFFER.

OTHER FIBRES.

In entering upon the consideration of any other fibrous plants than those mentioned in the act of Congress, we are aware that the commission may be said to have transgressed the bounds, and to have gone *extra limites;* but the deep interest that attaches to the subject, and the importance of some of these substances in the various arts of life, are thought to justify their introduction into this report.

In the preparation of this section we have been largely indebted to the reports of the juries of the international exhibition at London—a rare work, which is not generally accessible to our countrymen. Quotations are here made the more willingly in consideration of the eminence of the distinguished men who served upon the jury. They are the highest authority upon this topic, and we may do well to observe their dicta with regard to these substances, many of which are comparatively new to civilized life.

There are a great many fibrous plants in various parts of the country that present us with beautiful and strong fibres, which may be utilized in the arts. All of the mallow tribe are characterized by having bast-cells of great strength.

Many of these may be applied to useful purposes. The *sida abutilon* has been prepared many years since, and the fibres exhibited and declared equal to the finest flax. This is a common weed.

Another of this family is the *hibiscus*, or marsh mallow, of which there are several species that have attracted attention, and which have been brought into notice at different times.

The asclepias family are also remarkable for the beauty of the fibres furnished by their stems. Several specimens are exhibited in the museum. The silk attached to their seeds is not useful, though very beautiful. The *cornuti*, or *syriaca*, is a hardy perennial herbaceous plant, which has long been cultivated in Europe. It may be grown from seed, or by subdivision of the root. Planted at suitable distances, it would be easily cultivated, and, if close enough, would produce a heavy crop of tall, slender stems, well clothed with the fibre. This plant, being a perennial, would continue to furnish successive crops for many years without renewal, and would require very little culture. It affects low lands near streams, but may be grown on any tillable soil of moderate fertility. This substance has been attracting a good deal of attention lately in the public press. Other plants of the same family, and nearly allied to this, are also rich in fibre.

The *apocynum* on exhibition has a very fine and silky fibre, and its name, *cannabinum*, indicates that the botanists perceived its hempen characteristics. The Indians used these fibres in the construction of their bow-strings.

After considering the several other textile substances assigned to their investigation, the jury proceed, in their report, which was prepared by Mr. Alcan, to the examination of what are styled *miscellaneous fibres*, as appears in the following extracts:

"In the various collections of raw produce a very large number of other fibrous substances, used as substitutes for cotton, flax, and hemp, are shown; some of these are new, or but little known, and among them are several which, from their valuable properties, seem likely, ere long, to become important articles of trade, and not merely to form excellent substitutes for the substances already employed by manufacturers, but even in some cases to lead to the development of new branches of industry.

"An interesting series of hemp, flax, and other fibrous substances is contained in the Liverpool collection of imports. These include—

Name of fibre.	Name of plant.	Whence derived.	Amounts.	
			1849.	1850.
			Tons.	*Tons.*
1. Dutch flax	Linum usitatissimum	Holland	78	153
2. Egyptian flax	...do ... do	Alexandria	......	270
3. Tow	...do ... do	Holland	3	3
4. Hemp	Cannabis sativa	Canada	......	......
5. Jute	Corchorus capsularis	East Indies	8,660	12,216
6. Sunn	Crotolaria juncea	..do ...do	......	81
7. Coir rope	Cocos nucifera	Bombay and Calcutta	470	1,100
8. Coir yarn	..do ... do	....do ... do	200	370
			Bales.	*Bales.*
9. China grass	Urtica nivea*	Canton and Hong Kong	150	320
			Tons.	*Tons.*
10. Picaba	Attalea funifera	Para	......	300
11. Manilla hemp	Musa textilis	Manilla	81	192
12. Brazil palmetto	Carnanba palm	Para	......	......
13. Brazil jute	Unknown	..do	......	......
14. Spanish moss	Tillandsia usneoides	Brazil	......	......
15. Vegetable silk	Chorisa speciosa	.. do	......	......

* Bœhmeria nivea.

Among fibrous materials one of the most interesting is the "China-grass," of which numerous specimens are exhibited in various departments of the building, some of the most complete and valuable series being in the English gallery.

Although China-grass fibre is comparatively a new material in the hands of our manufacturers, yet it has been known to men of science for a very considerable time; but certain practical difficulties have hitherto prevented it from being usefully and profitably employed. China-glass fibre is obtained from *Urtica nivea*,* abundant in China and in various parts of the Indian empire, where it has long been used by the natives, who, by the simple maceration of the plants, obtain from them a strong and very useful fibre. Of the various fibres examined by Dr. Roxburgh, at the commencement of the present century, with a view to the discovery of some cheap and good substitute for hemp, one of the most promising was the "Callooee" hemp, "Kankhura," or the "Ramy," of the islands and Malay peninsula. This he found to be the produce of the Urtica, to which he gave the name of *Urtica tenacissima*. The plant was introduced in 1803, from Bencoolen to Calcutta, where it was cultivated for several years in the Botanic Garden, then under the charge of Dr. Roxburgh. A considerable quantity of Callooee hemp having been imported into England in 1814, its practical value was tested by some competent authorities, and as the reports were highly favorable as to its strength and other valuable qualities, the Society for the Encouragement of Arts and Manufactures awarded a silver medal to Captain Joseph Cotton, of the East India Company, for its introduction. The chief obstacle which interfered, however, with its use was the difficulty which was found to exist in the preparation of the fibre from the stems of the plants. None of the processes usually adopted with flax or hemp were found to be at all suitable to them, and the rude, wasteful, and imperfect means employed by the natives in preparing the fibre for the manufacture of twine, thread, and fishing nets, by the mere process of scraping, were wholly inapplicable on a large scale, and gave, besides, a very inferior result. When macerated or retted in water, it was found that the fibre itself was more easily destroyed than the glutinous matter of the stem. It was hoped that the introduction of the machines of Mr. Lee for breaking the straw unretted, and of Messrs. Hill & Bundy, already referred to, would have obviated this difficulty; but such did not prove to be the case.

During the last forty years various attempts have been made to devise a good and cheap process for preparing this fibre, but hitherto without much success; and consequently, till quite recently, the cost of the fibre was such as to preclude its being brought into the market as a substitute for flax. But recent investigations have shown that the *urtica tenacissima* and the *heterophylla* may be obtained, in almost unlimited quantities, in various parts of India; and a process which has lately been patented appears, to a very great extent, to have removed the practical difficulties which previously stood in the way of its employment by manufacturers, so that in a few years it is probable that the Callooee hemp will constitute an important addition to the fibrous materials employed in the arts.

The process of Messrs. L. W. Wright & Co., for the preparation of China-grass, &c., for which a patent was obtained in 1849, consists essentially in a very ingenious arrangement for boiling the stems in an alkaline solution, after they have previously been steeped for twenty-four hours in cold water, and for twenty-four hours in water of a temperature of 90°. The fibre is then thoroughly washed with pure water, and finally subjected to the action of a current of high-pressure steam till nearly dry.

The following table shows the comparative strength of several of these East Indian fibres, as ascertained by Dr. Roxburgh; but it must be borne in mind that in several instances the fibres had evidently been very rudely and imperfectly prepared: the experiments were made in 1804.

		Breaking weight.
1. Hemp (English)	Cannabis sativa	105 pounds.
2. Murga (Sanseviera)	Aletris nervosa	120 "
3. Aloe	Agave americana	110 "
4. Ejoo	Saguerus Rumphii	96 "
5. Donsha	Æschynomene cannabina	88 "
6. Coir	Cocos nucifera	87 "
7. Hemp (Indian)	Cannabis sativa	74 "
8. Woollet comal	Abroma augusta	74 "
9. ......do	Bauhinia	69 "
10. Sunn	Crotalaria juncea	68 "
11. Bunghi paat	Corchorus olitorius	68 "
12. Ghu nala paat	" capsularis	67 "
13. ......do	Hibiscus manihot	61 "
14. Flax (Indian)	Linum usitatissimum	39 "

* Bœhmeria nivea.

It is evident, however, that these experiments could not be regarded as giving at all accurate comparative results; they only proved that many of the fibres were very strong, and well merited further trials. In 1808 Dr. Roxburgh made a second series of similar experiments, the result of several of which was as follows:

		Breaking weight.
1. Bow-string hemp	Asclepias, sp	248 pounds.
2. Callooee hemp	Urtica tenacissima	240 "
3. ......do	Corchorus capsularis	164 "
4. Sunn	Crotalaria juncea	160 "
5. Hemp (Indian)	Cannabis sativa	158 "
6. Donshà	Æschynomene cannabina	138 "
7. ..do	Hibiscus strictus	128 "
8. Musta paat	" cannabinus	115 "
9. Bunghi paat	Corchorus olitorius	113 "
10. Plantain	Musa	79 "

Dr. Ure states that the relative tenacities or strength of several textile fibres has been experimentally found by suspending weights to threads or cords of them of a certain diameter, and the following results were obtained:

Flax	1000
Hemp	1390
New Zealand flax	1996
Silk	2894

The strength of cotton and wool, he adds, has not been so well ascertained, but it is much inferior to that of the preceding filaments. The New Zealand flax, which forms so strong a rope, is easily broken by any flexure, and therefore does not form a durable canvas.*

It is plain that the strength of all these fibres was ascertained under very unfavorable circumstances, and there is no doubt that they would have been found even yet more valuable had they been well and properly prepared. The principal vegetable fibres contributed from India are the following:

1. "Callooee," "Rhea," or "China-grass," the fibre of *Urtica tenacissima*, and one or two other varieties of *Urtica*, already mentioned as well known in commerce under the name of "China-grass." Strictly speaking, it is probable that China-grass and Callooee hemp are the produce of two distinct species of Urtica, though the fibre of the two is very similar, and, for all practical purposes, in fact identical. China-grass, as it is most commonly called, is the produce of the *Urtica* (*Bœhmeria*) *nivea* of Willdenow, whilst the Callooee, Kalmoi, or Rami, of Sumatra, is obtained from the *Urtica* (*Bœhmeria*) *tenacissima* of Roxburgh. It is from this latter plant, also, that the Rhea of Assam is procured. The plants yielding this beautiful fibre are very abundant in many parts of the empire, and may be had in almost unlimited quantities.

In the form of hemp, and when the fibre is well prepared, it is remarkably strong, and when thoroughly bleached, though the strength is then somewhat diminished, it acquires a most remarkably beautiful white silky lustre; unfortunately it is one of the most highly venomous of all the nettle tribe. It is stated that the Todawars prepare the fibre of this plant by boiling the stems in water, after which they readily separate it from the woody parts, and then spin it into a coarse but very strong thread. The Malays simply steep the stems in water for ten or twelve days, after which they are so much softened that the outer fibrous portion is easily peeled off.

2. "Yercum nar." The fibres of the *Calotropis* (*Asclepias*) *gigantea*, a plant which grows wild abundantly in various parts of the Bengal and Madras Presidencies, and is used by the natives in the manufacture of cord called "Lamb-dore," or "Toondee coir." The fibre is of very remarkable strength: from some recent experiments made by Dr. Wight, its tenacity, as compared with some of the other Indian fibres when made into rope, is as follows:

* Philosophy of Manufactures, p. 101.

		Breaking weight.
1. Yercum nar	Calotropis gigantea	552 pounds.
2. Janapum	Crotalaria juncea	407 "
3. Cutthalay nar	Agave americana	362 "
4. Cotton	Gossypium herbaceum	346 "
5. Marool	Sanseviera zeylanica	316 "
6. Pooley Mungu	Hibiscus cannabinus	290 "
7. Coir	Cocus nucifera	224 "

Specimens of the Yercum, or fibre of *Asclepias gigantea* (and of the Tongoos, and of the *Asclepias tenacissima*), or bow-string hemp of Rajemahal, are sent from Coimbatore and other districts in the Madras Presidency.

3. "Umbaree," or "Maestee pât;" the fibre of the Palungeo, or *Hibiscus cannabinus*, a plant common all over India, and cultivated in many parts for the sake of its fibre. The process generally adopted seems to be that of steeping the stems in water till putrefaction commences, when they are taken out, washed, and beaten until the fibre separates from the woody portion of the stem; this fibre is contributed from Madras.

4. "Marool," or "Moorva;" bow-string hemp, obtained from the *Sanseviera zeylanica*, a plant abundant in the southern parts of the continent of India, sent from Cuttack, Coimbatore and other districts in the Madras Presidency.

5. "Jute," or "Paat," &c., the fibre of various species of Corchorus, especially *C. olitorius*, well known in commerce, one variety of it having been formerly called Chinese hemp. Many different samples of this fibre are contributed from Calcutta and from Madras. From Rungpore, in the district of Moorshedabad, samples of three varieties of jute are sent, called Suffed Hemonty Pat, Lall Hemonty Pat, and Lall Petrie Pat.

6. "Sunn," "Janapam," Indian hemp; the fibre of the *Crotalaria juncea*, likewise well known in commerce. Good samples are contributed from Coimbatore, &c.

7. "Dhuncha," or "Dunche," obtained from the *Æschynomene cannabina*, used by the natives of Bengal to make fishing-nets; a remarkably strong, though rather harsh fibre, pretty well known in commerce. The plant is commonly cultivated in Bengal.

8. "Coir," the fibrous part of the husk of the cocoa-nut, *Cocos nucifera*, well known in commerce; good samples are sent from Calicut.

9. Nar, or aloe fibre, the produce of the *Agave vivipara*, and other allied species. A valuable and strong fibre is prepared in many parts of India from different species of aloe. A very interesting series of these fibres, which are obtained from the large Hill aloe, and from the small aloe, illustrating the preparation of the fibre, exhibiting some of the uses to which it is applicable, and showing the facility with which it may be dyed of various colors, is exhibited.

10. Specimens of aloe fibre are contributed from various parts of the Madras Presidency, Madras, Madura, Coimbatore, &c., and from Singapore.

11. Yucca fibre, obtained from *Yucca gloriosa*, is also sent from Madras.

12. Ejoo, or Gommuti, obtained from the *Arenga saccharifera* (*Saguerus Rumphii*) or Gummuttee Palm, much esteemed in the Eastern Archipelago for making ropes and cables, in consequence of its extraordinary elasticity and durability in water; unfortunately the value of this fibre is greatly diminished by its peculiar fragility. Very good samples of this fibre are contributed from Singapore.

13. Putwa or Mawal fibre, obtained from the *Bauhinia racemosa*, a plant common throughout the lesser hills of India, contributed from Bhaugulpore, in the division of Patna.

14. Talli Nanas, fibre of the pine-apple, *Bromelia ananas*, from various localities. Good samples are exhibited from Madras, Singapore, and from Travancore, &c. Some very beautiful specimens of fibre called "ananas flax" are exhibited from Java; the real source of this fibre does not seem to be very certain, for though from its name it might be supposed to be pine-apple fibre, it more closely resembles that of the Urticas, or Bœhmerias, already mentioned.

15. Plantain fibre and Manilla hemp, obtained from the *Musa textilis* and *M. paradisaica*, contributed from Madras, from Dacca, and from Chittagong. Excellent canvas and ropes are shown made by this fibre, which is extensively used in the government establishments at Ceylon.

16. Marsdenia fibre, obtained from *Marsdenia Roylii*, and contributed from Nepal.

17. Pulas, fibre of the Butea frondosa, used for making common cordage, from Beerbhoom, in the division of Moorshedabad.

18. Parkinsonia fibre, obtained from the stems of *Parkinsonia aculeata*, introduced from the West Indies, sent from Madras, said to be well suited for the manufacture of paper.

19. Roxburghia fibre, obtained from the *Roxburghia gloriosoides*.

20. Artocarpus fibre, obtained from an *Artocarpus;* this and the preceding fibre are contributed from Assam.

21. Trap fibre, obtained from the bark of the trap tree, a species of *Artocarpus*, contributed from Singapore.

22. Trophis fibre, from the *Trophis aspera.*

23. Daphne bark, the fibrous bark of the *Daphne cannabina*, used in the manufacture of Nepal paper.

Besides these, several other fibrous substances from different parts of India are exhibited, such as the fibres of the Palmyra leaf, *Borassus flabelliformis*, from Madras, the bark of the Sissi tree, and a series of vegetable fibres from Arracan, called Theng-ban-shaw, Pathayon-shaw, Shaw-phyos, Ngan-tsoung-shaw, Shaw-me, and Ee-gywot-shaw, &c.

Several of the Indian fibres, already mentioned, are also contributed from Ceylon. Good samples are shown, both as mere fibres, and also in the various states of thread, ropes, and coarse cloth; of coir, aloe, flax, and the fibre of the Plantain, Hibiscus, and Sanseviera. Specimens of aloe fibre are contributed from the Cape of Good Hope. Aloe fibre, obtained from *Agave americana* and *A. vivipara*, has been also sent from Barbadoes.

From St. Vincent, samples of the "Mahant" bark in its raw state, the fibrous part in the state in which it is employed in the manufacture of fishing-nets, and samples of lapeto, used also in the manufacture of common cord and coarse lines for fishing-nets, are exhibited.

Several interesting specimens of various fibres are shown in the collection from British Guiana; among these are specimens of silk-cotton obtained from the *Bombax ceiba*, from George Town, Demerara, said to be exported to the United States, and used in the manufacture of hats.

Plantain fibre, *Musa paradisaica* and *M. sapientum*, from Plantation Vigilance, East Coast, Demerara, and from Plantation Klein, Pouderoyen river, Demerara. It is calculated that about eight hundred weight per acre of this excellent fibre might be obtained; at present very little of it is used. It is worthy of remark that, in some of the first lists of premiums offered by the Society of Arts, about 1762, special attention was drawn to the beautiful fibre of the plantain: "Whereas the stem of the Asiatic and American fruit-bearing plantain affords three sorts of fibrous materials, which resemble hemp, hard silk, and cotton, all which have been experimentally found capable of being wrought into various sorts of manufactures; and among others, into cordage, fustians, lawn, knitting, gauze, blonde lace, and excellent candle-wicks, sundry specimens of which manufactures may be seen in the hands of the register of the society, &c." This advertisement was continued for several successive years, but as no candidate came forward to claim the offered reward, it was at last discontinued.

Silk-grass fibre, the fibre of the *Agave vivipara*, from Plantation Vigilance, East Coast, Demerara, and Fibiiri fibre, obtained from the Ita palm, *Mauritia flexuosa*, from the river Berbice, are exhibited.

Mahoe, or Mahoe fibre, *Hibiscus elatus* or *Thespesia populnea*, from Demerara, is exhibited; it is a very strong, but coarse fibre, used for making cordage, coffee bags, &c.

Some good samples of Yucca hemp, together with a leaf of the *Yucca serrulata*, from which it is obtained, and rope and cordage manufactured from it, are shown from Nassau, Bahamas; also specimens of the fibre of the Palmetto, and of rope made from it.

In the Trinidad collection are some specimens of the fibre of the pine-apple and aloe, and also of the fibre of the Mahagua, or Majagua, *Sterculea carribæa.*

Specimens of the leaf and fibre of the *Doryanthes excelsa* are contributed from New South Wales, as well as some rope made of the latter.

Some good samples of New Zealand flax, *Phormium tenax*, are contributed by various exhibitors. Among others New Zealand flax, cleaned and prepared by machinery.

In the Austrian collections specimens of fibrous wood, divided into very thin and slender strips, and used instead of straw in the manufacture of plaited work, are shown, from Zinnwald, near Köplitz, in Bohemia.

A good fibre prepared from the date palm, together with rope, string, nets and brushes made from the fibres, are contributed from Broulos, Ghizeh, and other places in Egypt.

Specimens of flax, cotton, pita, or aloe fibre, and mallow fibre, are contributed from Madeira.

A fine and very beautiful fibrous material called "Bejuco" is exhibited from the island of Luzon. This substance is very strong, and is used in the manufacture of plaited work, and a sort of cloth remarkable for its strength and softness.

Specimens of several of the textile fibres of Cuba are contributed, including the Daguilla, or fibrous inner bark of the *Lagetta lintearia*, together with cord made of it; cord and mats made of palm fibre; Magagna, the fibre of the *Paritium elatum*, and the fibre of the *Hibiscus cannabinus.*

Samples of a valuable grass, the *Macrochloa tenacissima*, much used for the manufacture of cord, &c., and which might probably be advantageously employed by paper-makers, are exhibited from Huesca.

Plantain fibre, prepared from the stem of the plantain, *Musa sapientum*, is exhibited from Puerto Rico; and Pita, the fibre of the wild aloe *Agave americana*, is shown from Murcia.

Other fibres, from Jamaica, by N. Wilson, who has named the species correctly.

Musk okra, Abelmoschus moschatus, six feet six inches. Common okra, A. esculentus, nine feet.
Abroma augusta, six feet six inches.
Abutilon graveolens, five feet.
Abutilon venosum, four feet three inches.
Adansonia digitata, three feet nine inches. Monkey bread.
Æschynomene cannabina, four feet six inches. Dunsha of India.
Agave karato, three feet six inches. American aloe or karato.
Alisma cordifolia, two feet six inches. Water plantain.
Alpinia nutans, four feet. Shell-plant of India.
Alpinia allughas, three feet six inches. Shell-plant of India.
Amomum sylvestre, four feet. Common wild ginger.
Ananassa sativa, four feet six inches. Pine-apple, black var.
Anona muricata, four feet. Sour sop.
Anona cherimolia, four feet six inches. Cherimoyer.
Anona palustris, five feet. Cork-wood or cow-apple.
Artabotrys odoratissima, five feet two inches.
Arum macrorhizon, nineteen feet—twenty-six feet six inches.
Arum funiculaceum, four feet six inches.
Arum funiculaceum, aerial root, ten and a half feet–fourteen and a half feet.
Arum funiculaceum, petiole of, two feet six inches.
Astrapœa Wallichii, two feet six inches.
Bambusa gigantea, six feet. Bamboo.
Bixa orellana, four feet. Arnatto.
Bœhmeria nivea, three feet eight inches. Rhea or China-grass.
Bromelia pinguin, five feet six inches. Pinguin.
Bromelia karatas, ten feet two inches. Pinguin silk-grass.
Calathea zebrina, two feet six inches. Petiole of zebra plant.
Canna indica, one foot six inches. Indian shot.
Carludovica palmata, ten feet. Yipi yapa for the Panama hats.
Carludovica peduncle, two feet six inches.
Carica papaya, five feet. Pawpaw.
Carolinia insignis, four feet six inches.
Cecropia peltata, petiole, two feet three inches. Trumpet tree.
Caryota urens, two feet six inches. Kitool fibre from a palm.
Caryota urens, from spathe, four feet six inches.
Corypha umbraculifera, petiole, six feet six inches. Talipot palm.
Costus afer, three feet six inches. African costus.
Cocus nucifera, coir. Cocoa-nut palm. One nut yields one pound fifteen ounces.
Cordia sebestena, four feet six inches. Scarlet cordia.
Cordia macrophylla, six feet. Broad-leaved cherry.
Cordia gerascanthus, three feet. Spanish elm.
Cordia collococca, five feet. Clammy cherry.
Corchorus olitorius, three feet six inches. Jute of India.
Corchorus siliquosus, two feet eight inches.
Cordyline heliconiæfolia, two feet.
Cochlospermum hibiscifolia, five feet.
Curcuma longa, three feet. Turmeric.
Cyperus elegans, four feet eight inches. Elegant sedge
Daphne tinifolia, five feet. Burn-nose bark.
Eriodendron anfractuosum, five feet. Silk cotton tree.
Guazuma ulmifolia, four feet. Bastard cedar.
Gossypium hirsutum, four feet two inches. Cotton shrub.
Glossospermum, six feet.
Hedcyhium longifolium, four feet six inches. Garland flower.
Helicteres jamaicensis, four feet six inches. Screw tree.
Helicteres isora, three feet.
Heliconia brasiliensis, six feet six inches. Wild plantain, Brazil.
Heliconia bihai, seven feet. Wild plantain of Jamaica.
Heliconia psitta corum, two feet six inches.
Hibiscus rosa sinensis var., five feet. Chinese rose.
Hibiscus liliiflora, four feet. Lily-flowered shoe-black.
Hibiscus radiatus, six feet ten inches. Purple shoe-black.
Hibiscus Sabdariffa, six feet six inches. Indian sorrel.
Hibiscus vitifolius, four feet.
Hibiscus lampas, five feet.
Ismene calathina, peduncle of three feet six inches. Gigantic lily.
Kæempferia galanga, two feet six inches. Galingale.
Kleinhofia hospita, three feet ten inches.
Kydia calycina, four feet four inches.
Lagetta lintearia. Lace bark.

Malachra capitata, five feet. Wild okro.
Malachra urens, three feet.
Malvaviscus arboreus, six feet six inches. Wild mahoe.
Maranta sanguinea, two feet six inches.
Maranta arundinacea, one foot six inches. Arrowroot.
Momordica luffa. Vine strainer.
Musa textilis, six feet. Manilla hemp.
Musa violacea, five feet six inches. Violet-flowering plantain.
Musa coccinea, four feet six inches. Scarlet flowering plantain.
Musa sapientum, eight feet six inches. Banana.
Musa paradisaica, nine feet. Plantain.
Musa cavendishii, three feet six inches. Chinese banana.
Ochroma lagopus, eight feet. Down tree fifty–seventy feet.
Oncidium carthaginense, two feet six inches. Orchid epiphytal.
Pandanus spiralis, five feet. Leaves of screw pine.
Pandanus spiralis, three feet. Aerial roots.
Pandanus moschatus, leaves, three feet.
Pandanus moschatus, aerial root, three feet.
Pandanus variegatus elegans, five feet, leaves of.
Pandanus variegatus, aerial root of, five feet.
Paritium elatum, seven feet. Mahoe tree, fifty–seventy feet.
Paritium macrophyllum, five feet. East Indian mahoe.
Paritium macrophyllum, petiole of, one foot six inches.
Paritium tiliaceum, five feet. Sea side mahoe.
Pothos violacea, two feet six inches. Wild coco.
Pothos violacea, wild coco, new, two feet six inches. Substitute for straw plait.
Pavonia odorata, three feet three inches.
Pavonia racemosa, three feet three inches.
Sterculia carribœa, three feet six inches. Large tree.
Sterculia patens, three feet three inches.
Sanseviera zeylanica, three feet. Bow-string hemp.
Sanseviera guineensis, three feet.
Sanseviera cylindrica, three feet.
Sida mollis, five feet six inches. Broom-weed.
Sida hirsuta, four feet.
Sida jamaicensis, two feet three inches. A common weed.
Sida siliaris, three feet. A common weed.
Sida dumosa, six feet. A common weed.
Sida rhombifolia, two feet eight inches.
Sida ulmifolia, three feet six inches.
Thrinax parviflora, four feet six inches. Fan palm.
Theobroma cacao, eight feet. Cocoa.
Tillandsia serrata, four feet six inches. Wild pine.
Triumfetta semi-triloba, four feet six inches. Burr-weed, common.
Typha latifolia, four feet. Cats'-tail.
Urena sinuata, three feet three inches.
Urena typhalea, three feet nine inches. White-flowering burr-weed.
Uvaria pendulata, four feet eight inches. Large tree.
Veronia curassavica, four feet six inches. Black sage.
Zingiber officinale, three feet six inches. Ginger.
Yucca aloefolia, two feet. Dagger plant.
Yucca filamentosa, one foot six inches.
Yucca gloriosa, three feet.

The most valuable of these for cordage will be the Bœhmeria nivea, introduced from India, the mahoes, the sanseviera, the common and wild plantains, and the bromelias.

Silk-cottons are produced in great abundance in many tropical countries, but the extreme smoothness and roundness of their beautiful silky fibres render them utterly useless for spinning, and being very brittle and easily reduced to dust, they are not well adapted for stuffing cushions or bedding. They may be useful for gun cotton.

The Brazilian collection contained the following:

Down of the seeds of *Echites suberosa.*
Yellow down, (paina de pedra or amarella,) the silk-cotton tree seeds, a species of *Bombax.*
Down of the Imbiriçu, *Bombax carolinum.*
Silk-cotton, from seeds of the Cuba, a *Bombax.*
Silk-cotton tree (paina de paineira macho,) from seeds of *Chorisia pecholtiana.*
Down of seed (paina de abobora) supposed to be one of the *asclepiadaceæ.*
Down of the silk-cotton tree (paina fema,) *Chorisia speciosa.*
White down of a silk-cotton tree, supposed to be a *Bombax.*
Down of a climber (paina loura, or cipo de pennes,) *Stipecoma peltigera.*
Down of seeds of *Oxypetalum campestre.*

Down of seeds of *Asclepias curassavica.*
Down of seeds of *Aranja albena.*
Down of seeds of *Bombyco spermum.*

From Trinidad:

Ochroma lagopus.
Manicaria saccifera.
Tillandsia usneoides.
Bromelia karatas.
Agave vivipara.
Sanseviera guineensis.
Musa rosaceæ, M. textilis, M. sapientum, and M. paradisaica.
Mauritia flexuosa.
Apeiba Tibourbon, A. ulmifolia, and A. aspera.
Triumfetta semitriloba.
Guazuma ulmifolia.
Theobroma cacao.
Sterculia caribea.
Hibiscus rosa-sinensis, H. trilobus, and H. esculentus.
Paritium tiliaceum.
Malachra capitata.
Pavonia racemosa.
Urenna sinuata.
Sida cordifolia, and S. rhombifolia.
Courupita guianensis.
Lecythis adatimon.
Bauhinia megalandra.

These lists of tropical plants are the more valuable and interesting because many of them have been introduced from foreign countries, and are preserved in the government conservatories, where they may be studied in their growing state. It is truly surprising to observe in these collections so many valuable fibrous materials, and a new interest is at once imparted to the inspection of these exotics, when we find them possessed of so great utility.

The commission also refer to the very extensive and exceedingly interesting cabinet of fibres which was opened for their study by Dr. G. C. Schæffer of this city, among which were the following rare fibres:

ENDOGENOUS.

Agave americana.
Arum funiculaceum, (root.)
Pandanus spiralis.
Ananassa sativa.
Musa violacea.
Abroma augusta.
Malvaviscus arboreus.
Heliconia braziliensis.
Fourcroya gigantea.
(Pita cauca?)
(Madagascar palm?)
Ahauwa (Coricaceæ.)
Carica papaya.
Cocoa-nut, coir.
Musa paradisaica.
Musa sapientum.
Yucca gloriosa.
Pothos violacea.
Bromelia karatas, long and fine.
Carlodovica palmata.
Yucca aloifolia.
Bromelia penguin, very fine.

EXOGENS.

Tillandsia serrata.
Kydia calycina.
Helicteres jamaicencis.
Triumfetta semitriloba.
Sida jamaicencis.
Urena typhalea.
Sida mollis, very soft.
Hibiscus esculentus, coarse.
Cordea macrophylla.
Hibiscus liliiflora.
Ochroma lagopus.
Hibiscus subdariffa.
Cordia sebestena.
Eurena simulata.
Hibiscus elatus, 60 to 80 feet.
Kleinhoflea hospita.
Œnothera biennis.
Asclepias cornuti, very strong.
Asclepias tuberosa.
Lagetta lintearea.

Hibiscus rosa-sinensis.	Bœhmeria nivea, Java.
" rubroflore pleno.	Broussonettia, South Sea islands.

Flax and hemp from various sources, and many other fibrous substances.

CHINA-GRASS.

From the Asiatic continent we have some specimens of cloth made of China-grass. This article is no doubt, in its essential qualities and uses, a species of flax, and therefore properly comes under our notice. It has been produced for many years by the industrious and ingenious people of China. We have remarked that in the coarse kinds of cloth made from it the fibre appears to be split into lengths, and attached to each other at the smaller ends. In this simple state the pieces are put together with great dexterity. This is an interesting example of the position of this manufacture among one of the most ancient nations of the world.

Besides the coarser kinds of cloth, there are exhibited some beautiful handkerchiefs and other fine linens made from this material. At the present day China-grass is occasionally used in making colored fabrics, combined with other substances, such as silk and cotton; and from the peculiar brilliancy of the fibre it shows to much advantage in this way. It has not as yet entered into extensive use for plain goods; but some very meritorious attempts to ascertain its utility for that purpose have been made and are still in progress.

The commissioners were very much pleased with specimens of this material contributed by Lemuel W. Wright, from Brooklyn, New York, which are remarkable for their beauty. They consist of the raw material, and of combed and cleaned fibres, some of which are beautifully dyed. There was also a portion of tangled fibres or tow which was examined by the microscope, though not presented as flax-cotton. The fibres of this material are made up of very long cells which would be ruptured in any attempts to cottonize it, and it should be used as long-line. The specimens of cloth presented in which this fibre was combined with wool were very beautiful. No description of processes and apparatus used in the preparation of this material was laid before the commission.

The admirable appearance of this fibre so attracted the attention of the commission that they at once investigated the history of the plant since its introduction into this country and propagation at the Congressional gardens. As will be seen by reference to the United States Patent Office reports for 1855, Mr. Smith succeeded in growing plants from seed sent him from the West Indies by Mr. Wilson. Mr. Smith propagated many plants, and we understand that they were widely distributed throughout the southern States, under the impression that the climate would prove well adapted to it. Our observations upon the plants that remain in the Congressional gardens, confirmed by the opinion of Mr. Smith and other botanists, induce us to believe that Washington is on the northern boundary of the region where this plant may be successfully cultivated.

Specimens of an allied species have been presented from the northwest, St. Anthony, Minnesota, which demonstrate that we have a native plant of great value, to which we desire to direct public attention. Unfortunately, the specimens of the dead plant were in too imperfect a condition to identify its botanical classification.

Dr. Schæffer, in the Patent Office report for 1855, notices the China-grass in the following paragraphs:

"Many exogenous plants are herbaceous—that is, grow with little strength to the stem for one year, and then die down to the ground. Even the perennial plants of warmer climates may, in the milder regions of the temperate zones, become annuals. In the case of true annuals there is no need for any great hardening of the woody tissues of the stem, as the sole end to be attained is a sufficient support for the plant until it flowers and the seeds ripen. Herbaceous stems, which die down to the ground each year, are evidently designed for a similarly restricted end. In the case of perennials, which, in other climates, might at length become woody shrubs, a single year's growth is not enough to allow of much induration of the wood-cells, and hence they approach nearly to the condition of true annuals, although the tendency to produce firm wood is constantly shown. If, under either of these three heads, a plant is found which furnishes a long and useful bast, a common and well-known treatment can be economically employed for the separation of the fibre. The plant is exposed to the action of the air and moisture, with more or less of fermentation, until the different tissues become separated, and even until the different cells are loosened in their adhesion, by which the harder and shorter woody fibres are broken, and in part removed, while the pliability of the bast allows it to pass through the treatment without injury. At the same time, the short and more tender cells are also removed, the latter stages of the process differing for different plants, all contributing to the complete separation of the remains of the adherent and useless types.

"Two things, then, must concur to make a useful fibrous plant; for not only must the bast be long, pliant, and in bundles of the proper size, but the wood which is to be rejected must be brittle, with short cells, not much hardened, or not strongly adhering together. Flax and hemp are, in our own country, the best specimens of these favorable conditions, but we have other plants nearly, if not quite, as well adapted to the manufacture of useful fibre; and other countries show that nature has not been stinted in her supply of materials capable of meeting one of the first wants of mankind.

"Differences in degree. even in the same plant, under varying circumstances, must frequently occur. The wood may become harder and greater in amount, the bast weaker and less in quantity, and the necessary inference might be drawn that judgment and skill in the culture of the plants would favorably modify these conditions. Experience, in advance of anything like an accurate knowledge of plant structure, has shown that this is true, at least for our common fibrous crops. Single stalks of hemp, or other such plants, allowed to grow at a distance from each other, or from other plants, would furnish but sorry specimens of fibre, as a single plant invariably shows a hard woody stem, and a coarse fibre in the bark. But when a number of plants are grown in a small space, every one knows that they grow longer, and are more slender than when separate. In this way the strength of the wood is greatly diminished, and the fibre of the bark, if less abundant, is finer, and possibly longer. If the plant has a tendency to branch, this is thus advantageously prevented. The close cultivation of okra, cotton, and other plants, which we are accustomed to see separated from each other, would probably show a fibre in the bark far more capable of treatment by the ordinary process than would be suspected by most persons. A knowledge of correct principles is here of the greatest advantage, when new materials are concerned."

TROPICAL FIBRES.

Mr. Squier has presented a very pretty book upon tropical fibres, their production and economic extraction. It is based upon extensive observations made during his residence of some years in Central America, while acting as minister of the United States to that country. From this work we make some extracts and condensations.

He says he was struck with the number and variety of endogenous plants, such as agaves, pine-apples, plantains, and palms, which are characteristic features of the landscape. These plants all abound in valuable textile fibres, while many of them produce staple articles of food, oil, and refreshing as well as intoxicating drinks. The fibres are capable of being reduced to any degree of fineness, and are possessed of great strength, and are thus fitted for the most delicate tissues as well as for the strongest cables.

He very naturally asks himself, "Why are not all these fibre-bearing plants with which the country teems in some way utilized?" This question was soon answered when he came to observe the rude method by which the fibres were extracted. The natives slowly remove the pulpy and vascular portions of the plants with a triangular scraper, or a blunted knife, and thus procure but a few pounds of imperfectly cleaned fibres during a long day's toil. They have no machinery, and even in the Philippine islands, where ten million dollars worth of plantain fibres are annually produced, he learned that no machinery was yet applied.

The object of the book appears to be, to direct attention to some of these numerous and valuable plants, in the hope that Yankee ingenuity will succeed in producing and applying machinery by which a single man may extract a greater quantity of fibres, and in better condition, than one hundred men can obtain through the primitive modes now in use. This great desideratum, Mr. Squier thinks, we have obtained in some modification of Sanford & Mallory's flax and hemp machines.

The following tables are given of the value of these products:

Tropical fibres imported into the United States for the year 1860, (*custom-house valuations.*)

Kind.	Quantity.	Value.
Manilla hemp	347, 431 cwts.	$1, 631, 884
Sisal "	5, 630 "	25, 114
Coir, &c.	112, 585 "	163, 039
Gunny bags		287, 387
" cloth		1, 795, 256
Total		3, 902, 680

Tropical fibres imported into Great Britain for the year 1855, *(estimated real value.)*

Kinds.	Quantity.	Value.
Jute (gunny)	539, 297 cwts.	$2, 235, 835
Manilla hemp	92, 755 "	1, 443, 495
Other fibres	8, 591 "	51, 545
Total	640, 643	4, 730, 875

These quantities, however, he considers insignificant compared to the illimitable sources of supply.

Mr. Squier asserts that nearly all of these fibres are white while the plants producing them are in their green state, and that they become discolored by their exposure to the sun's rays while they are yet associated with the sap and its gummy and coloring matters. He also alludes to the danger from excessive fermentation to which vegetable tissues are exposed in attempts at rotting them in tropical climates. These gummy, coloring, and other extraneous matters of plants are said to be soluble in cold water, if the plants are treated while in a green condition, and may be removed by crushing the tissues, scraping and heckling and washing them simultaneously. The gum held in solution by plants, while in the growing state, becomes dried upon the fibres, and renders them harsh, brittle, and more or less unfit for textile purposes.

The pine-apple, *Bromelia sylvestris*, the wild species produces the silk grass of the British West Indies, the pita of Mexico and Central America. This plant is hardy and luxuriant, and produces an abundant and excellent fibre, which entitles it to a high rank among fibre-producing plants. All the bromelias yield a similar fibre. All varieties of the *musa* or plantain family produce good fibres; of these the *musa textilis* or Manilla grass, though a native of the east, flourishes in great luxuriance in tropical America and the Antilles. The agaves are peculiar to America, but the *Agave americana* flourishes in southern Europe and Algeria. The *Agave mexicana*, or maguey, and the *A. sisalina*, or *Henne-quin* and varieties, are peculiar to America; the latter yields the Sisal hemp, which is said to be equally hardy with the *Bromelia sylvestris*, and grows in every variety of soil, even among rocks and in arid wastes where it produces an abundance of excellent fibres.

Dr. Henry Perrine attempted the introduction of some of these plants into southern Florida, under protection of Congress, granted in 1837, by which he acquired pre-emption to certain lands south of the 26th parallel of latitude. Among the plants he introduced from Central America were three or four species of the agave, the cochineal cactus, paper mulberry, date palm, &c.; all of which succeeded well until the occurrence of the Seminole war, which resulted in the destruction of the plantations and in the death of this patriotic citizen. Of some of these plants Dr. Perrine has written, that being "lighter, stronger, more elastic, and more durable than the cortical fibres of hemp or flax, and produced by perennial self-propagation, in stony, sandy, or swampy surfaces, with the easiest and cheapest cultivation, and the speediest and simplest preparation, the relative and positive prices and properties of the foliaceous fibres of the agaves and the plantain, insure their substitution for cortical fibres in the general consumption of mankind."

This prophecy has in great degree been fulfilled within our time in the increased consumption of this class of fibres, but we do not agree with Mr. Squier, who asserts that our agaves and bromelias supply better substitutes for flax and hemp than any of the Old World plants. We must admit that provident Nature has prepared special products for special uses, endowing them with peculiar properties, and varying forms in their ultimate structure, so that each is especially adapted to the several particular purposes to which the ingenuity of man in the course of centuries has applied it.

Mr. Squier reminds us that all vegetable fibres may be resolved into three great classes: the foliaceous, cortical, and capsular. The first are obtained from *endogenous* or *monocotyledonous* plants. Near the tropics this class of plants is largely represented by the yuccas, agaves, plantains, and palms, their fibres are imbedded in the cellular tissues and pulpy matter of their stems and leaves, and may generally be extracted by mechanical means.

The cortical fibres of this classification are obtained from the *exogenous* or *dicotyledonous* plants, containing the true *bast* fibres. They are often of great length, and but little hardened, some form great trees, while others are herbaceous. Among them we find the mallows, the nettles, the flax, and some of the bean family. In all of these there is also a woody tissue embraced by the bast, and constituting the stem of the plant, while the bundles of fibres are connected together, and with the stem, by a peculiar vegetable substance which needs to be separated in their preparation.

The third class, or capsular fibres, are obtained from the pods where they are associated with the seeds. Cotton is a familiar illustration of this class.

He quotes Mr. Dennis as speaking of the Sisal hemp thus:

"This gigantic plant delights in dried, rocky land containing an abundance of lime, and there are thousands of acres of land in this region, worthless for other agricultural purposes, on which a ton of clean Sisal hemp might be produced yearly, after the plant has reached an age to allow of cutting off its lower leaves, which would be in from three to five years, according to circumstances. Neither the growth of the plant, nor the amount of its product here, is any longer an experiment. Nor is there any longer a doubt as regards the value of the fibre, a number of tons of it having been collected and sent to market, where it readily brought within half a cent per pound as much as the best Manilla hemp, and that is about two hundred and fifty dollars per ton. A thousand plants should be set to the acre, and from the constant shoots which spring up it will be seen that the same land will not require replanting. After the plant is of sufficient growth, the lower leaves are cut off at proper times, leaving enough on top to keep it healthy. These leaves are composed of a soft, watery pulp, and are from two to six feet long, from four to six inches wide in the middle, and frequently three inches thick at the butt, having the general shape of the head of a lance. They contain a gum, which is the chief cause of their being rather troublesome in separating the fibre from the pulp. Neither the epidermis nor the pulp is more than a powder, after becoming dry, if the gum be entirely crushed or mashed out. This is a most important fact in relation to the means to be adopted to clean the fibres from the pulp. As these are continuous and parallel, and imbedded in the pulp, I feel certain that a system of passing the leaves through a series of heavy iron rollers, firmly set, something like those of a sugar mill, and throwing water on the crushed leaves, in jets or otherwise, in sufficient quantities to wash out the gum, (which is perfectly soluble in water,) will thoroughly clean the fibres without loss, so that when they become dry, and have been beaten to get out the dust, they will be fit for use. *At any rate, the right plan for separating the fibres has not yet been discovered, although there has been enough done in it to show that they can be got out at a profit.* Here, the people either preserve the primitive process (which is practiced in Yucatan) of beating and scraping the leaves, or, after crushing them between a pair of rollers, steeping them in an alkaline solution for a few days and then heckling them. But both scraping and combing destroys too many of the fibres by breaking them, which would not be done by a system of rolling and washing out the gum. In Yucatan they sometimes ferment the beaten leaves in water or mud; but this stains and weakens the fibres so as to reduce their value, I believe, more than half. Even steeping the leaves in an alkaline pickle, although it may not much weaken the fibres, as the juice of the leaves is acid, nevertheless destroys the silky gloss which they possess when got out of the fresh leaves by aid of pure water alone, besides increasing the cost of extraction. I have some fifty acres of the plants under cultivation, and am increasing the quantity as I have opportunity."

Mr. Hermonds, of Indian River, Florida, informs me that the Sisal hemp grows well there, and has continued to thrive well for four years. He thinks that my estimate of a ton of fibre per acre is too low. The experiments which I have made during the past year, in getting out a number of tons of this fibre, prove that all the vesicles of the leaves are ruptured by crushing or rolling, and that the pulp or gum can easily be washed out by either salt water or fresh. The plan which I have found most successful was to wet the leaves, being careful to rupture all the vessels, then confine these crushed leaves in an open-work wooden frame or box, which I placed in such a manner that the tide forced the sea-water through them both at the ebb and flow. In this manner the gum and pulp were so far washed out, in from three to six days, according to the temperature of the air and water, that by beating the fibres a little they were fit for market.

Mr. Hermonds mentions, as a tested fact, that steeping the crushed leaves in boiling water, even for a few minutes, at once dissolved the gum and cleaned the fibre. This renders it almost certain that when a steam-engine is used to propel rollers and crush the leaves, the waste steam can be rendered effective to clean the hemp by blowing it off between the rollers, aided by a little water, in a jet, while the leaves are passing through.

Mr. Squier objects to the use of steam or hot water. The amount of Sisal hemp imported into the United States in 1854 was 925,900 pounds, valued at the custom-house at $64,516, but having a real value of upwards of $100,000.

Mr. Squier tells us that the Maguey is chiefly cultivated in Mexico for its juice. The plants are set in rows, about five feet apart. When the *hampe*, or central stem, which often attains the height of forty or fifty feet, is on the point of efflorescence, it is cut off, and a hollow scooped out for receiving the sap. This keeps running for two or three months, the reservoir being emptied three or four times a day. The yield from a vigorous plant is about four hundred English cubic inches per day, or, for the season, from two to three hundred gallons. This enormous product is all the more remarkable from the fact that the Maguey plantations are generally in arid grounds, and frequently on ledges of rocks scarcely covered with vegetable earth. The plant has firm and vigorous leaves, and is neither affected by drought, wet, hail, nor by the excessive cold which prevails in the higher Cordilleras of Mexico. It perishes after efflorescence, but an infinity of shoots then spring from the decaying roots. No known plant multiplies with greater facility.

The fibre of the Maguey is coarser than that of the *Agave sisilana*, but nevertheless of great utility and extensively used.

Agave americana.—This plant, which has been naturalized in the south of Europe and Algeria, is often confounded with the *Maguey* or *Agave sisilana.* Its flowering or central stem, when the plant is vigorous, rises to the height of forty feet or upwards, and throws out branches on every side, like those of a candelabrum, so as to form a kind of pyramid, each branch supporting a cluster of greenish red flowers. These give place to bulbous seeds, which, when planted, spring up rapidly and luxuriantly. The original plant, however, dies. The time of flowering varies with localities and climate. An erroneous notion is that it flowers only once in a hundred years. Hence the popular name of century plant. The fibres from its leaves closely resemble those from the Maguey. It is a hardy plant, and often covers rocky, barren eminences, where every other kind of vegetation fails to take root.

Bromelia sylvestris, or wild pine-apple, the *istle* of Mexico, but known as *pita* and *peñnella* in Central America and Panama, and in the West Indies as *bromelia pinguin*, or *penguin*, can hardly be said to rank second to the *hennequins* in economic importance. It is widely diffused throughout the tropics, growing everywhere, in all varieties of soil. It is extensively used for hedges, for which its long, straight, and spiny leaves admirably adapt it, and may be cultivated with a minimum of labor and cost, and in unlimited quantities.

The leaves are from five to eight feet long, from one and a half to three inches wide, thin, and lined with a fine, tough fibre, the *pita*, equal in strength and beauty, and in other respects better than that of the *hennequin*. It is altogether a superior substitute for flax

This plant is self-propagating, and, left to itself in an open field, will soon cover the ground. In Central America, but particularly in Nicaragua, it is so abundant in the forests as to be a serious obstruction to the passage of man or beast.

Major Barnard, United States army, in his report on the isthmus of Tehuantepec, speaks as follows of the *istle:*

"Among the spontaneous products of the isthmus is *Bromelia pita*, or *istle*, which differs in some respects from the *Agave americana* of Europe, the *pulque magucy* of Mexico, and the *Agave sisilana* of Yucatan. Of this prolific plant there are numerous varieties, all yielding fibres which vary in quality from the coarsest hemp to the finest flax. It is indifferent to soil, climate, and season, and the simplicity of its cultivation, and the facility of extracting and preparing its products, render it of universal use."

In the year 1857, (January 14,) Chief Justice Temple, of Belize, or British Honduras, read a paper before the Royal Society of Arts of London, on the resources of that part of Central America. Among other objects of interest, he exhibited a quantity of the fibre of the plant under notice, as well as of the *Agave sisilana*. Of the former, or *Bromelia sylvestris*, he said:

"The plant called *Bromelia pita*, *istle* by the Mexicans, and *silk-grass* by the Creoles of British Honduras, grows spontaneously in the greatest abundance. The leaves are of a soft, dark green, from five to thirteen feet long, and from an inch and a half to four inches wide. Along the edge of the leaf, about six inches apart, are short, sharp, curved thorns. When the plant is cultivated, these gradually disappear. The fibre which the leaf contains is unquestionably of a very superior description, and, I have no doubt, could be used in every species of textile fabric. I have been informed by leading manufacturers that this fibre is equal to the best China-grass, superior to the New Zealand flax, and capable of being manufactured into the finest fabrics."

In the discussion which took place among the leading members of the society on the paper of Judge Temple, Mr. P. L. Simmonds, editor of the Mark Lane Express, said:

"I have to-day seen some of the indigenous specimens of the *penguin*, or *bromelia*, from Honduras, which have been operated upon by a new, patented process of Messrs. Pye Bros., of Ipswich, and am astonished at the remarkable improvement and high commercial value which have been given to the article. The main difficulty that has stood in the way of utilizing many of these fibres, and making them cheap and of universal use, has been the want of cheap and efficient machinery for preparing them, and getting rid of the gummy and other matters which surround them, without injury to the fibres. Such machinery is a desideratum of the age."

Mr. J. B. Sharp said:

"He could confirm all that had been said by those who preceded him. He had that morning submitted some of the fibres to a close microscopical examination, and had ascertained that each fibre contained from five to twelve, or more, fine filaments, held together by gummy matter capable of being dissolved by proper processes. Some of the specimens before them had been passed over the comb or hackles of a flax-mill, and had been pronounced by the most experienced flax-spinners of the country (England) to be greatly superior to Russian flax, and approaching the best descriptions of Belgian flax, in capability of application to the finest textile fabrics.

"He had no hesitation in saying that the three British colonies of Jamaica, Honduras, and Guiana were capable of furnishing fibres from the plants in question to the value of $15,000,000 per annum."

MUSA OR BANANA FAMILY.

The various members of this family rank only second to the *agaves* and bromelias in the quantity and value of their fibres. Several varieties are cultivated for food, yielding a delicious and nourishing fruit; and in such abundance that Humboldt estimates the product of a single acre as equal to the average product of 133 acres of wheat, and 44 acres of potatoes. An interesting and, for the purpose which we have in view, a most important fact, is that the tree or plant, whether plantain or banana, is almost universally cut down when the fruit is gathered. With proper machinery for extracting the fibre, the many millions of plants thus left to rot could be converted into articles of first utility for mankind, such as cordage, cloth, paper, &c.

Manilla hemp.—The fibre known to commerce as *Manilla hemp* is extracted from a variety of the banana, the *musa textilis*. It is a round, silky-looking fibre, nearly white. It is admirably adapted for cordage, and from the finer fibres obtained from the petioles of the leaves are made many of the delicate and celebrated muslins of India.

The stems of all the plants of this order or family are made up of the united petioles of the leaves. They contain such a remarkable abundance of spiral vessels that they can be pulled out by handfulls, and are sold for tinder. Each spiral vessel contains six or seven fibres, which when separated constitute the *Manilla hemp*.

The value of Manilla hemp in the English market is about $25 per ton more than the best Russian hemp.

M. Perronttel, botanist of the French government in Gaudaloupe, has given a very full account of the *abaca* of Manilla, and the mode of extracting its fibres:

'The *abaca* of the Philippines differs essentially from all the varieties of banana known. Its stem, which rises from a tuft of shoots, has a height of from fifteen to twenty feet, of a dark-green color, and very smooth on its surface. Its leaves are of the same color, long and straight, with strongly marked nerves both parallel and transverse. The fruit is small, triangular, resembling abortive bananas, and scattered here and there near the extremity of the fruit-stem. It is full of black seeds, almost round, and similar to those of the *gumbo*. These seeds fructify rapidly after planting, and the young plants are strong and vigorous, attaining the dimensions already indicated within the short space of eight or nine months. The plant requires a rich, humid soil, and rejoices in thick forests, at the base of mountains, where it acquires in a short time an extraordinary development. I have never seen it in such perfection as on the humid yet high grounds belonging to M. de Lacharriése (Guadaloupe,) notwithstanding its entire abandonment to itself in the midst of a jungle of other plants. Only two shoots were planted here, about seven years ago, yet now the whole valley is covered with them so as to resemble a forest. This fact proves sufficiently that the plant is robust and easily cultivated; indeed, that it can be propagated with a minimum of care to the greatest needful extent.

"No doubt, however, its regular cultivation would be beneficial in many respects, especially if the plants were kept at a reasonable distance apart, so as to permit their full development. In the Philippines the stems are cut down as near the ground as possible at the moment they evince signs of flowering—that is to say, about eight months after planting. The outer sheath or envelope is then stripped off, leaving the petioles that compose the stem proper. The stem is next split into two, and afterwards into four parts, after which the petioles or layers are stripped off, working from the exterior. Those composing the very interior or heart of the stem are thrown aside, as being destitute of fibres of sufficient strength for economic purposes. The reserved filaments or slips are now pounded with clubs of hard wood, first on one side and then on the other, until the transversal and cellular tissues and porous and gummy matters are expelled. After this the fibres are passed frequently through a coarse hackle, and washed many times in clear, running water, until perfectly free from all extraneous matters. They are then hung over ropes or poles to dry in the shade.

"As the fibres are not all of the same size, those being finest which come from the slips nearest the heart of the stem, they are carefully separated by hand; the coarsest being laid aside for cables, ropes, cords, &c., according to their relative fineness, while the finest are reserved for the more delicate tissues.

"In sending them to Europe for sale, the fibres are packed in bales of greater or lesser size. Those which are of fifteen feet in length or upwards are folded back on themselves three or four times, according to the length of the cases containing them; those of less length are folded two or three times, after which the cases are hermetically closed, in order to protect their contents from humidity on board ship.

"This is the manner in which the *abaca* of the Philippines is prepared, and it only remains to indicate the purpose for which it may be used in France.

"As already said, the coarser fibres are used to make cables, which have great solidity and durability. Ropes of great tenacity are also made from the stems, which are used in many ways, but particularly in rigging coasting vessels; of the finer sort, tissues or muslins of great beauty are made, which are very dear even in Manilla. I had a number of shirts made from this muslin, which lasted me a very long time, and were cool and agreeable in the use. But it is especially in France that tissues of this material are best made and of greatest beauty. They receive all colors with equal perfection. Veils, crapes, neck-handkerchiefs, robes, and women's hats, all of great beauty and high cost as well as of wonderful durability, are among the manufactures from the *abaca* fibres. Besides, they are used for various articles of men's wear, such as shirts, vests, pantaloons, &c.

"Ever since this precious fibre became known in France, our vessels have frequented Manilla, returning freighted in part with the article. The quantity imported, however, falls far short of the demands of the manufacturers, and its production certainly deserves the attention of all our southern colonies. Its cultivation, as we have seen, is easy, and as regards cost, next to nothing; and there is no reason why it should not become an important article of commerce throughout tropical America."

Mr. Jules Itier, special agent connected with a late French mission to China, made a report to his government on the productions and resources of that empire:

"The *abaca* cloth is almost transparent, somewhat rigid, light, and cool to the touch, and is used by the Tagals for napkins, handkerchiefs, shirts, &c., of various colors. The fibres are not spun or twisted, but the threads are used in their natural state, being only tied together at their ends. They are next wound into balls, soaked for a day in hot water, dried in the sun, and are then ready to be woven."

THE PALM FAMILY.

The *Gommuti saguere*, or Ejoo fibre, from the variety of palm known to science as *arenga saccharifera*, is produced by the splitting or decay of the leaf-stalks. To the natives of the tropics these naturally prepared fibres are invaluable, supplying them with materials for canvas, cordage, and a variety of economic purposes. It is best known as a product of the East Indies, but a similar article is also found under the tropics in America, where it is produced from a variety of palm known to science as the *attalea funifera*. The tree producing the *gommuti* fibre rises from twenty to thirty feet in height, and has a dense crown of leaves. The petioles are very stout, and it is at the base of these, completely embracing the trunk of the tree, where the horse-hair-like material, which co-operates to render this palm so valuable, is found. Cheaper, more durable, and stronger than *coir*, it has the additional advantage of resisting moisture, for which reason it is highly valued for ropes, especially cables, from their not being liable to injury when stowed away below, wet with salt-water. Underneath this naturally produced fibre the *gommuti* palm produces a soft, gossamer-like substance, called *boru*, used in place of oakum for calking, &c.

To the natives of the East Indies and the Philippine islands this tree is invaluable. Its juice, when reduced, produces sugar, and when fermented, an intoxicating liquor. From one hundred and fifty to two hundred pounds of sago may also be obtained from a single tree, which will furnish from four to seven pounds of fibre.

Piassava, monkey-grass, or Para-grass, and called by the natives *chiqui-chiqui*, is produced from a variety of palm (*attalea funifera*,) which abound on the Amazon river and its tributaries, in very much the same manner as the *gommuti* from the Arenga palm. The tree is one of the most elegant of its family. Its stem rises from twenty to thirty feet, straight as an arrow. From the top of this springs a tuft of pinnated fronds or leaves, often nearly twenty feet in length. Before the decay of the petioles the fibres become detached at the margin of their bases in large quantities, hanging down ten or twelve feet in tufts, whence comes the name *funifera*, rope-bearing.

Nearly all the cordage used on the Amazon is made from the *piassava* fibre, which is remarkably round, not very pliable, and often about the thickness of the small green rush. In 1851, eight hundred tons were exported from Para to England, where it is used for making brushes and brooms. The brushes of the street-sweeping machines of London are made from this fibre.

Coir, or cocoa-nut fibre, manufactured from the husk or outer covering of the common cocoa-nut, is nearly as strong as hemp, and is used in the east for cordage. The fibre is prepared by soaking the husks in water for a long period of time, not unfrequently for six months, and until they become soft. They are then dried and beaten until the woody part falls out like saw-dust, leaving only the fibres. The cordage made from *coir* is second to that from no other material. The amount of *coir* rope imported into Great Britain from the East Indies, for the year 1859, was 8,238,200 pounds, valued at $392,265.

Corosal, *coyal*, or Corajo palm, abounds in dry, arid, rocky ground throughout tropical America, but particularly in Central America, and in the interior of Cuba. It grows to the height of twenty feet, and the trunk is covered, from bottom to top—as are also its leaves—with long, narrow, *sharp*, and hard spines. It produces a large cluster of nuts with a hard shell, of the size of grape-shot, from the kernel of which is extracted an oil indistinguishable from that of the cocoa-nut. The woody exterior of the trunk covers a pulpy heart, saturated with a juice of a fresh, agreeable flavor, which may be obtained by incision, and which is called *vino de coyal*. When fermented, it becomes intoxicating, like the pulque of the *maguey*. In times of great drought, when vegetation is destroyed, this pulpous heart is often fed to cattle. The leaves of the *coyal* are lined with a long and excellent fibre, called, in Cuba, *pita de corojo*, from which ropes, cords, &c., are manufactured. The fibres are equal to those of the *hennequin*, from which they can hardly be distinguished.*

CATALOGUE OF CONTRIBUTIONS OF FLAX, HEMP, AND OTHER FIBRES.

RAW MATERIALS.

No. 12. GEORGE C. DAVIES, *Dayton*, *Ohio*.—5, flax-straw tangled; broken on Messrs. Sanford & Mallory's old machine.

" 17. STEPHEN ALLEN, *Boston*, *Massachusetts*.—13, 16, 17, flax-straw.

" 19. R. TENANT SHAW.—1, broken tow and flax.

" 45. JOSHUA S. COE, *Newton Square*, *Chester County*, *Pennsylvania*.—Flax retted, broken and heckled.

" 46. WILLIAM S. LOWRY, *Saratoga Springs*, *New York*.—Retted flax, good specimen.

" 55. LEMUEL W. WRIGHT, *Brooklyn*, *New York*.—China-grass in the crude state as stripped from the plant.

" 58. H. BURGESS, *Royer's Ford*, *Pennsylvania*.—1 and 3, raw flax; 6, Kentucky hemp; 8, Russia hemp.

" 59. J. W. SWAN, for the Medina Flax Company, *Medina*, *New York*.—Flax-straw, dew-retted.

" 60. J. D. LANG, *Vassalboro*, *Maine*.—Flax-seed and straw, well grown.

" 63. Captain C. W. PEDEN, *Parkersburg*, *Western Virginia*.—Flax-straw in the boll, good.

" 66. G. L. THOMPSON, *Wood Lawn*, *Maryland*.—Hibiscus esculentus, showing the fibre produced by this plant.

" 67. S. W. POND, *Shakopee*, *Minnesota*.—Urtica? or Bœhmeria, the species not identified.

" 68. *Apocynum species*.—Unknown, but believed to be A. cannabinum. Contributor unknown.

" 73. *Crude flax*.—Contributor unknown.

" 74. J. S. RITCHIE, *Superior*, *Lake Superior*, *A. D.* 1863.—Fire-weed, Epilobium angustifolium. See Dict^e^. Hist^e^. Naturelle, Paris, 1819, page 74, where it is set forth that attempts had been made with this substance, which had proved unavailing.

" 77. JOHN H. MOORHEAD, *Ida*, *Ida County*, *Iowa*.—Wild flax, a native plant; the botanical identification of which could not be made out.

" 109. R. B. DEAN, *Waterford*, *Minnesota*.—Grass-down, of Eryophorum polystachyon; a very beautiful grass, but not applicable in the arts, so far as we know.

" 128. RUTGER B. MILLER, *Utica*, *New York*.—Epilobium angustifolium, a useless fibre which cannot be easily separated from the plant and collected in quantity.

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* Condensed from *Tropical Fibres*.

PREPARATIONS.

LONG FIBRES.

" 5. THOMAS H. QUERIAN, *Baltimore, Maryland.*—Specimens of jute, in the crude state as presented in commerce.

" 11. STEPHEN ALLEN, *Boston, Mass.*—12, prepared flax; 13, flax broken; 16, flax-straw retted; 17, flax-straw unretted

' 12. GEORGE C. DAVIES, *Cincinnati, Ohio.*—5, tangled flax-straw broken by Mallory's machine, shown as the stock from which he prepares his clean tow, called Erolin, or flax-wool.

" 15. JOSEPH LEA, *Philadelphia, Pennsylvania.*—Specimens bleached by Lea & Roth's process: 1, Dutch flax retted 50 minutes; 2, Dutch flax slightly done; 3, American retted one half done; 4, Dutch flax retted 50 minutes; 5 and 6, American retted, only half done; 7, American retted 65 minutes; 8, Riga flax retted 25 minutes; 9, Dutch retted 60 minutes; 10, unretted American; 11, unretted Irish, part bleached; 12, Friesland, bleached and unbleached 75 minutes; 13, American, unretted, bleached and unbleached; 14, old tarred rope, bleached; 18, samples of crude flax, same as made into yarn. These are beautiful samples of bleaching, and appear to be perfectly clear of chlorine.

" 17. GEORGE GRAHAM, *Cincinnati, Ohio.*—2, flax-straw broken; 6, cottonized flax; specimens of the Claussen product.

" 19. R. TENANT SHAW, *South Lansing, New York.*—7, long-line disintegrated and bleached; 8, long-line disintegrated and heckled; 10, jute treated; 13 and 14, "extract de Vlas" flax fibre; 15, tangled fibre; 16, from green straw as above; 17 and 18, tow as above; 19 and 20, jute by same process; 21, China-grass as above. These latter are prepared by a peculiar patented process, in which a ferment prepared from the flax itself is used to set up the fermentation.

" 41 & 81. C. G. GRABO, *Detroit, Michigan.*—Flax cut, to illustrate his apparatus for shortening the fibre; the cut ends are soft and even.

" 45. JOSHUA S. COE, *Newton Square, Pennsylvania.*—Flax retted, broken and heckled by hand; good flax.

" 46. WILLIAM S. LOWRY, *Saratoga Springs, New York.*—Dressed flax, very good specimen.

" 49. MARY MC CREARY, *Anderson, Ohio.*—Prepared flax, beautifully prepared.

" 51. AUGUSTE FEIJE, *Theresa, Wisconsin.*—Flax very beautifully dressed, soft and fine, and of good color.

" 55. LEMUEL W. WRIGHT, *Brooklyn, New York.*—Specimens of prepared China-grass, very beautiful illustrations of the silky character of this foreign fibre when properly treated. The process not disclosed.

" 56. LOCKPORT FLAX COMPANY, *Lockport, New York.*—Broken flax, heckled flax specimens of stock used at this mill.

" 57. ARNOLD WILKINSON, *Providence, Rhode Island.*—1, hemp whitened; 2, flax whitened; 3, flax "decolorized without caustic;" hemp from old rope whitened; 5, hemp baling rope. These specimens show what may be done in operating upon very unpromising material.

" 58. H. BURGESS, *Royer's Ford, Pennsylvania.*—3, raw flax and straw; 10, disintegrated in the straw; 6, hemp; 1, flax. The processes by which these are prepared is given in the chapter on manufacturing.

" 59. J. W. SWAN, for Medina Flax Company, *Medina, New York.*—2, flax broken by his machine; flax dusted by his machine; well prepared.

" 61. H. MC FARLANE, *Rocky Hill, New York.*—1, green flax cottonized; 2, green flax treated; 4, unretted flax treated; 8, hemp Claussenized; 12, China-grass prepared. See process and statement in the appropriate chapter.

" 62. Specimens lost and contributors unknown.

" 65. MARY ALLEN, *Pittsburg, Pennsylvania.*—Prepared flax brought from Antrim, Ireland, a very beautiful specimen.

" 68. Contributor unknown; 2, Asclepias cottonized; 3, Asclepias retted and broken.

" 69. C. C. WILLIAMS, *Oswego, New York.*—Cottonized tow by Neil Cook, a very good specimen.

" 70. JAMES Y. SMITH, *Delaware, Ohio.*—1, straight flax scutched by McBride's machine; 2, tangled tow.

" 73. Contributor's name lost; bleached flax.

" 83. JAMES Y. SMITH, *Providence, Rhode Island.*—1, flax from tangled straw, dressed on McBride's machine; 2, flax from retted straw grown in Delaware, Ohio, dressed as above; both good specimens of long-line.

" 103. JAMES E. MALLORY, *New York city.*—1 to 6, retted flax, well broken; 7, unretted flax, some shives; 8, Irish water-retted, beautifully prepared, elegant ribbons of fibre; 9, tangled straw not retted, some shives; 10 to 12, straight straw, well broken, and has some loose shives; 13, Missouri hemp, dew-retted, good. All broken on the Sanford & Mallory machines, and are good illustrations of their capability to break the straw.

" 105. Contributor's unknown, *Piqua*, *Ohio*.—1, flax tow.

" 107. CHARLES KEMPER, *Orange Springs*, *Snyder county*, *Pennsylvania*.—Asclepias fibre, strong and very promising for application in the arts.

" 113. ISAAC HEDGES, *Chicago*, *Illinois*.—Flax fibre prepared, very nice flax.

" 122. REUBEN HENDRICKSON, by Hon. John Law.—Fine flax, a good specimen.

" 129. A. BEEBE, 229 *Broadway*, *New York*.—1, two shades jute; 2, American hemp tow; 3, Russian tow; 4, dyed jute "lubricated."

" 130. R. CHUTE, *St. Anthony*, *Minnesota*.—1, fibres of a native Bœhmeria, long and strong; 2, tow of the same; 3, bleached fibre of the same plant. See microscopical examination and report in chapter on peculiarities of fibres.

SHORT FIBRES.

" 4. JAMES H. CHILDS, *Pittsburg*, *Pennsylvania*.—1, 2, flax-cotton; 3, cottonized hemp.

" 11. STEPHEN ALLEN, *Boston*, *Massachusetts*.—9, Fibrilia wool, bleached; 10, Fibrilia hemp brown, colored and bleached; 11, Fibrilia wool, natural. Shown as specimens of stock used in the production of the fabrics contributed.

" 12. GEORGE C. DAVIES, *Dayton*, *Ohio*.—1, Erolin, or flax-wool; 2, Erolin, blue; 3, Erolin, black; 4, Solferino; to show the capacity of this material for taking color.

" 14. CYRUS BACON, jr., assistant surgeon U. S. A., *Baltimore*, *Maryland*.—Cottonized flax, carded; cottonized Asclepias; nice specimens. For the latter see report of microscopist.

" 17. GEORGE GRAHAM, *Cincinnati*, *Ohio*.—3, flax-cotton; 4, 5, 5½, same.

" 19. R. T. SHAW.—3, flax disintegrated and retted; 4, tangled tow treated; 5, hemp as No. 4; 6, flax as No. 3; 9, flax-cotton; 11, tow bleached; 12, tow bleached chemically. These specimens are not so satisfactory as we should desire.

" 21. BRADLEY N. HOWELL, *Philadelphia*, *Pennsylvania*.—Flax-cotton, small hand specimen of good appearance.

" 36. L. YEOMANS, *Fulton*, *Oswego county*, *New York*.—Flax-wool for batting, &c.

" 37. JONATHAN KNOWLES, *Providence*, *Rhode Island*.—Flax-cotton, nice specimen. Process not communicated.

" 18 & 39. ROBERT FLETCHER, *Oswego*, *New York*.—1, flax-cotton to work with cotton; 2, flax-cotton to work with wool, beautiful specimens. See microscopic report. Process withheld by contributor.

" 43. THOMAS WILLIAMS, *Vernon*, *Oneida county*, *New York*.—Flax-cotton, good specimen.

" 50. L. BARDICK, *Espytown*, *Pennsylvania*.—1, flax-cotton bleached; 2, flax-wool unbleached, good.

" 52. E. TOWNE, *Utica*, *New York*.—1, 2, and 3, flax-cotton. Prepared in the dry way by machinery, not very promising for cotton machinery. See letter in chemical chapter.

" 54. UPHAM & FULLER, *Claremont*, *New Hampshire*.—1, flax-cotton; 2, flax-cotton fibres cut; 3, flax-cotton fibres cut to work with wool; 4, flax-cotton picked and carded, not cut. See later contributions and report of microscopist of these fibres; also, the section on manufactures.

" 55. LEMUEL W. WRIGHT, *Brooklyn*, *New York*.—Tow from China-grass. This does not pretend to be cottonized. See microscopic report upon it.

" 56. FLAX COMPANY, *Lockport*, *New York*.—1, flax-wool; 2, same; 3, flax-wool bleached. These are useful products for the upholsterer, and may be used with wool.

" 57. ARNOLD WILKINSON, *Providence*, *Rhode Island*.—Bleached tow, "no bleach used." Nicely prepared; process not stated.

" 58. H. BURGESS, *Royer's Ford*, *Pennsylvania*.—2, prepared flax of 1862; 4, same of 1863; 5, prepared flax and bleached of 1863; 7, prepared Kentucky hemp; 9, prepared Russian hemp; 10, flax disintegrated in stalk. See remarks in chapter on manufactures for estimates and description of processes.

" 61. H. McFARLANE, *Rocky Hill*, *New York*.—3, green flax cottonized; 5, green flax treated; 6, flax-wool from green flax; 7, hemp cottonized; 10, 11, flax-cotton carded; 12, China-grass carded. A very interesting group of products. For processes see letter in appropriate chapter.

" 68. CYRUS BACON, *Baltimore*, *Maryland*.—2, Asclepias cottonized, a pretty specimen; 3, Asclepias retted and broken.

" 69. C. C. WILLIAMS, for Neil Cook, *Oswego*, *New York*.—Cottonized tow, very good.

71. CYRUS BACON, *Baltimore*, *Md*.—Asclepias cottonized, very pretty.

" 72. Bayard Taylor.—Flax cottonized, from Russia.
" 75. James Whitehill.—Flax cotton.
" 84. Charles Beach, *Penn Yan, N. Y.*—Specimens not found.
" 105. Robert Sanderson, *Piqua, Ohio.*—2, crude bleached and cleaned tow; 3, unbleached tow.
" 127. Upham & Fuller, *Claremont, N. H.*—1, Ohio seed flax broken and pickered; 2 is No. 1 steamed, pressed, exploded, and pressed; 3 is No. 2 once picked on wool cards pickered twice on fine picker; 4 is No. 3 carded three times on wool cards (breakers); 5 is No. 4 with ⅝ wool mixed; 6 is hemp tow; 7 is No. 6, boiled, pressed, exploded, picked twice, and carded three times on coarse wool cards; 8 is ½ wool and ½ flax, worked like No. 1 to No. 4.
" 131. Same party, as Jos. B. Fuller, *Norwich, Conn.*, again show: 1, from unretted flax, treated, picked dry; 2, same stock, picked, moist, carded with Gambrel card; 4, same stock bleached, not picked; 6, same stock bleached, picked, moist, and carded with ¼ American cotton; 9, same stock colored, also drawings and rovings; see description in chapter on manufactures.

MANUFACTURES.

" 11. Stephen Allen, *Boston, Mass.*—1, 2, 3, druggets, see remarks in chapter on peculiarities of fibres; 4, knit stuffs; 5, felted 33 per cent. fibrilia; 6, roving; 7, jeans and satinets; filling 40 per cent. cotton; 40 per cent. flax-cotton; 20 per cent. wool; 8, fibrilia yarn; 14, Canton flannel, ½ fibrilia and ½ cotton; 15, calicoes and prints; 18, papers referring to the above; 19, brake as represented in a plate.
" 15. Joseph Lea, *Philadelphia, Pa.*—15, St. Petersburg flax, bleached in the fibre, spun at Mechanicsville, N. Y., beautiful; 16, yarn spun as above, very good thread; 17, yarn, American Linen Company; Fall River, Mass., good, bleached in two hours and forty minutes; a piece of duck, very handsome goods.
" 17. George Graham, *Cincinnati, Ohio.*—Union cloths and stuffs mixed with flax-cotton.
" 21. Bradley N. Howell, *Philadelphia, Pa.*—2, roving of flax-cotton.
" 37. Jonathan Knowles, *Providence, R. I.*—2, flax roving; 3, flax thread; 4, thread.
" 39 & 82. Robert Fletcher, *Oswego, N. Y.*—Knit stuffs, very good articles, see report of trial in wear.
" 45. Joshua S. Coe, *Newton Square, Pa.*—Flax thread.
" 49. Mary McCreary, *Anderson, Ohio.*—Linen cloth.
" 51. August Feije, *Theresa, Wis.*—Flax thread, by hand, very fine.
" 55. Lemuel W. Wright, *Brooklyn, N. Y.*—4 and 5, specimens of cloth, China-grass and wool mixed; specimens of roving; specimens of dyeing China-grass, very beautiful products.
" 59. J. W. Swan, for Medina Flax Co., *Medina, N. Y.*—7, flax combed; 8, flax warp; 9, twines; 10, calicoes and woollens; 11, brown wrapping-twine; 12, white wrapping-twine. A very interesting group of products; the twines are particularly good.
" 60. John D. Lang, *Vassalboro', Me.*—Specimens of cloth and kerseys; very good.
" 61. H. McFarlane, *Rocky Hill, N. Y.*—9, stuff. Flax and wool.
" 76. M. Knowles.—Flax thread.
" 122. Reuben Hendrickson, *Dale P. O., Spencer Co., Ind.*—2, flax thread.
" 132. J. B. Fuller.—3 yarn, No. 24, spun from fibre; No. 2 (see No. 131,) very promising; 7, yarn spun from No. 6, (see 131,) very good; 8, yarn half flax, half cotton, excellent product. See chapter on manufactures. Also print cloth, warp cotton, weft flax-cotton, good quality.