

substitutes for them, he observes: "From the experiments I have made on all kinds of fibre, I fearlessly assert that they can have a cheaper and better supply of fine and coarse fibre from India, for rope-makers and fine spinners, than it is possible for them to get from any other country, and the samples in the Society's rooms are a proof" (referring to his own and the East India House specimens then displayed there). "Dr. Royle gave a very correct account of the superiority in the strength of the Himalayan Hemp compared with that of Russia; but that is not the only advantage to be gained by the importers and consumers of Hemp." "I have made the Himalayan Hemp so soft, fine, and white, that it will not only take the place of Petersburg Flax—now £60 per ton, the best of which can only make 40s. warp yarn—but it can be used in place of Dutch Flax, at £80 per ton; and I speak from twenty years' practical knowledge, when I say it is capable of being spun into 60s. warp yarn."

"The Rheca fibre, or Assam grass, when so prepared by the machines and liquid, is a finer, and, consequently, more valuable fibre. It is equal in strength and fineness to China grass, at £100 per ton." "The Yercum, which very much resembles Belgian Flax, is also well calculated for prime warp yarns, and worth £100 per ton." The Wuckoo nar, Mr. Dickson places near this in another statement. "The Neilgherry Nettle is a most extraordinary plant; it is almost all fine fibre, and the tow is very much like the fine wool of sheep, and no doubt will be largely used by wool-spinners." "The Madras Hemp, and Bombay and Sunn Hems, will at all times command a market, when *properly cleaned out*, at £45 to £50 per ton, for twines or common purposes."

In another published statement (Flax Works, Grove Street, Deptford, April, 1854), Mr. Dickson says of—

"Madras Hemp, valued when imported at £24 per ton :

	cwt.	qr.	lb.
Madras Hemp . . . . .	2	3	3
Produced by the machines :			
Clean, long fibre, good, valued at £45 per ton	1	1	7½
Clean tow, valued at £30 per ton . . . . .	1	1	9
Waste . . . . .	0	0	14½
	2	3	3
Cost of preparation . . . . .	6s. 1½d.		

“This Hemp, when prepared with the patent liquid, became soft, white, and so fine when hackled, as to bear the closest comparison with Flax at £80 per ton. It is better than any Russian Flax for fine spinning.”

Practical men alone can judge of practical questions, when they have made careful experiments on new products, and have laid aside all prejudices in favour of old ones. The Author can only vouch, as he has already done, that he was surprised with the improved appearance and fineness of many of the coarse-looking Indian fibres; though he ought not to have been so, from what he had previously seen of some of these fibres. This more especially, as there is no rational reason why the varied soil and climate of India should not produce as finely divisible fibres as any produced in the short, but warm and dry summers of Russia. These fibres would, moreover, look as well in the market, if the natives of India would take the same trouble with their preparation as is done in Europe with Flax and Hemp.

This appears a favorable opportunity for calling attention to the little justice which the natives of India do to the products of their own country; for most of their fibres, like their cotton, come to market intermixed with much dust; some, moreover, almost in the state of bast, upon which freight and charges have to be paid before they can be used either for cordage or for textile purposes. Manufacturers, therefore, give a lower price for them than would be the case if they reached this country in a clean and workable state.

A considerable loss is likewise sustained, by what is very unusual, that is, the *extra* care bestowed on some of these fibres in different parts of India. Some are twisted into rope-like bundles; others are plaited into the form of Chinese pigtails, or tied together with knots at the ends. In this case, these ends must at once be cut off, and the fibres thus much shortened, before they can be used. When twisted or plaited, boys and girls are obliged to be employed in untwisting and opening them out, in order to bring them to a state from which they have been needlessly removed. All that is necessary is that the fibres should be tied in convenient-sized bundles; and retained in the state in which they are removed from the plant, and that in which they must be when undergoing the

different processes of preparation, that is, nearly parallel to each other. They may then be simply tied together near the thicker end, so as to form what are called *heads*: or they may be similarly tied in two or three places, if it is thought desirable to do so, with long fibres. Such fastenings can most easily be cut across with a knife, and with the least possible expenditure of time and labour; so as to expose the fibres in a state in which they can be immediately made use of. Besides this mode of tying up the bundles of fibres, which would, in fact, save much of the time and labour now injuriously expended, it would be desirable if the natives could be induced, generally, to pay more attention to the preparation of these fibres, especially in not macerating the plants longer than absolutely necessary for the purpose of separation, as already referred to at p. 29. The benefits of such care would soon be apparent in the increased demand and improved prices for Indian fibres, not only in this country but in other parts of the world.

FLAX, LINSEED (*Linum usitatissimum*, *Linaceæ*).

*Sans.*—Atasee. *Hind.*—Atees, Ulsee. *Beng.*—Mushina. *Persian*—Kutan.

The Flax plant is one of those which was cultivated by the earliest of the civilised nations of antiquity, and has continued to be so to the present time, and is becoming every day of still greater importance. We may see from the paintings in the tombs of Egypt, that it was early cultivated in that country; and we can also prove that it was so, from a microscopic examination of mummy-cloth. We read in the book of 'Exodus'<sup>1</sup>

<sup>1</sup> The word Pishtah undoubtedly refers to the Flax plant, of which the preparation for its fibre is so clearly represented in the Grotto of El Kab. The words *bad*, *butz*, and *shesh*, which occur so frequently in the Scriptures, are supposed to indicate different kinds of Linen. But it has been doubted whether, in a language like the Hebrew, it is probable that so many names are applied to the produce of one plant, or whether it is not more probable that they refer to the products of different plants. The Author has ventured to think that Linen, Cotton, and Hemp were all known; and are mentioned—Cotton (*Karpas*), in Esther i, 6. *Bad* is very similar to the Sanscrit *pat*. *Shesh* differs only in the aspirate from *husheesh*, which is one of the Arabic names of the Hemp; as the Author has pointed out in the respective articles in Kitto's 'Cyclopædia of Biblical Literature.'

of the flax and the barley being smitten by the plague of hail in Egypt, and in 'Joshua' of the spies, who had been sent to report on the state of Jericho, being hid with stalks of flax. From many other passages, we know that the spinning and weaving of Flax were common occupations of the people in Palestine. Subsequently, it was much cultivated both by Greeks and Romans. In India, Flax has also been cultivated from very early times, but strange to say, for its seed only, and not on account of the fibre; which everywhere else is the principal object of attention. This is probably owing to India possessing, as one of its indigenous products, the Cotton plant, which requires only the bursting of its fruit to display an elegant and easily spun material, which can be obtained from the Flax only after considerable labour.

We have lately seen how important the Cocoa-nut Palm, one of the princes of the vegetable kingdom, is, not only to the countries where it is produced, but also to those into which its products are introduced. The Flax plant, on the contrary, is one of the humblest of those which are cultivated, and yet it is hardly less important, though not particularly useful as an article of diet. Its slender stem, narrow leaves, and beautiful blue flowers, give it an elegant appearance. Its smooth and shining seeds have their external coating formed of much condensed mucilage, while the white kernel is gorged with oil, especially valued for its drying properties; and the refuse or oil-cake affords a nutritious diet for cattle. The fibre or Flax separated from the stem may be made use of for cordage, for coarse fabrics, or for the finest cambrics and lawns. Hence it is a principal object of attention in Russia and Poland, a highly successful culture in Belgium, carried on also in Germany, France, and Italy, the object of frequent legislative enactment in England, and of recent most successful cultivation in Ireland. Hence, also, it was re-established by the late Pasha in Egypt. It has been frequently recommended for culture in India on account of its fibre, as it already is in almost every part of that country for its seed.

Upon consideration, it will no doubt appear remarkable that this small annual plant should be profitably cultivated over so great an extent of the globe, and in apparently so great a diversity of climate. But the fact is that the winters of these

southern latitudes enjoy a temperature which nearly approaches that of the summers of more northern countries. Therefore, in Egypt and India, Linseed is sown in autumn, and the stalks harvested in early spring, even before the seeds have begun to be sown in the more northern places where it is cultivated. This winter cultivation of southern latitudes has probably given origin to the autumnal sowings of European latitudes. But this lowering of temperature is not all that the plant requires for the production of fine flax, as we shall immediately more particularly inquire. But the natives of India, who are more ingenious in their devices and more successful in their agriculture than is generally allowed, have adopted methods of culture, such as thin sowing, though intermixed with, or in drills as an edging to, other crops, which ensures them an abundant crop of the produce they desire—that is, the seed—which is large and plump; while the stems remain short, branch much, flower freely, and become loaded with bolls filled with the seeds, which abound both in mucilage and in oil.

But before proceeding to a description of the plant, the modes of culture, or the preparation of the fibre, we may briefly notice the importance of these products to the countries producing or importing them, and how beneficial they may probably become to other countries which possess a suitable soil and climate, and no more profitable object of culture or of export.

Several able writers, as Messrs. M'Adam, Nichols, and Wilson, having, within the last few years, drawn attention to the importance of the culture of Flax, we may make use of the facts which they have collected, and apply them to India. Mr. M'Culloch has observed with regard to this country, that "the legislature has paid more attention to framing laws regarding the husbandry of Flax than to any other branch of rural economy;" but not with much success, "as the culture of Flax is, on the whole, found to be less profitable than the culture of corn." It has, moreover, always "been considered one of the most severe crops." This, however, we shall see is not necessarily the case, according to the improved methods of culture and of preparation of fibre. But even in the present day, £1000 per annum has been granted since 1847 to the Royal Flax Improvement Society, for the culture of Flax in Ireland, according

to the Act 10 and 11 Victoria, cap. 115 ; and with considerable advantage, as the culture of Flax has greatly increased. The quality of the Flax has also been so greatly improved, that the Jury of Class IV of the Exhibition of 1851, stated—"The entire collection shown by the Royal Society for Improving and Promoting the Growth of Flax in Ireland is so highly valuable, and so clearly illustrates the great advances which have been made and the important service which this Society has rendered to the country, that they determined to mark their high appreciation of their labours by recommending them to have one of the Council Medals."

But, notwithstanding the endeavours of successive governments, the supply of home-grown Flax has never reached the extent required by our manufacturers. At present, it is considered that the consumption is equal to 150,000 tons. About 70,000 tons were, for several years, annually imported ; or more precisely, in the year 1831, 46,820 tons : in the year 1843, about 72,000 tons were imported ; but in 1853 no less than 94,000 tons, or an increase of about 31 per cent. in the last decennial period. If the 150,000 tons be valued at an average of forty, or, according to others, at fifty pounds a ton, the amount is enormous. To this must be added "£1,500,000, the value of 650,000 quarters of linseed, used as seed and for crushing purposes ; and about £500,000, the cost of 70,000 tons of oil-cake, which we annually import, in addition to that made at home, for feeding purposes. The quantity of Flax fibre necessary to supply the demand of the United Kingdom would consume the produce of 500,000 acres ; while in Ireland, during the past year, only 136,000 were cultivated, and, probably, not a fourth of that quantity in the rest of the kingdom." (Wilson.) The seed is imported from India, Egypt, Russia, Sicily, Prussia, and Holland ; and the oil-cake from France, Germany, and the United States.

Mr. Fane is of opinion that—"Under proper arrangements, the whole might be home-grown. If all were, the money result would be enormous, because every ton of fibre involves the growth of eight tons of flax straw—eight tons of straw being required to produce one of fibre ; and every ton of straw involves the production of six bushels of seed, worth at least 6s. 6d. a bushel. These would give the following money result :

1,200,000 tons of straw, producing six bushels of seed to each ton, at 6s. 6d. a bushel, would give	. . . . .	£2,340,000
150,000 tons of fibre, at £50 a ton, would give	. . . . .	7,500,000
		<u>£9,840,000.</u> "

Without advocating, or considering it desirable, that all the increasing quantities of Flax required by our manufacturers should be, or can be grown in this country, we may take advantage of the information collected as applicable to other countries. It has, indeed, been objected, by Mr. H. S. Thompson, that if forty stone of Flax (value 7s. 6d. per stone) is the average produce of a reasonably well cultivated acre of Flax, 70,000 tons of imported Flax would require 280,000 acres of land for its cultivation, which is "clean and in good tilth," *i.e.*, "precisely in the state in which it is best fitted for producing corn," and "on an average at least four quarters." "The 280,000 acres required to produce the Flax now imported, would therefore produce, if cropped with wheat, 1,120,000 quarters, worth (at 7s. per bushel) £3,136,000; which approaches tolerably near to the estimate given by Mr. Nichols of the value of the imported Flax, *viz.*, £3,490,000." But these objections are made to the occupation of good land in a country like England, where the whole quantity is but limited, and "where every acre of even moderate fertility has its work to do, and no new crop can be introduced without displacing an old one;" but do not apply, as stated, to countries like America and Australia, where there may be an unlimited extent of fertile but uncultivated land. Nor, indeed, to many parts of India, where more corn is grown than is required by the people, and for which they would gladly substitute some readily saleable or exportable product. Further—

"If we refer to the statistics of British and Irish exports, we find that in 1843 there were shipped from the United Kingdom, in round numbers, 91,000,000 yards of linen, and that the exports of 1853 reached nearly 130,000,000 yards; the total value of all kinds of linen and yarn exported in the former year being £3,702,052, and in the latter £5,910,355." ('Belfast Mercury.')

Though the culture of Flax is considered by some as not particularly eligible for the best-cultivated lands of England, it

is yet, in other countries, accounted a most desirable object of attention, being in Belgium called "the Golden Crop," and in Ireland "the Rent-paying Crop." In Russia, it is one of the principal objects of culture, and has been much extended by the continual advances of English capital; while in Egypt, the culture was re-established by the vigorous but despotic policy of the late Mehemet Ali. In India, it is to be hoped that the ryots may be induced to cultivate it in suitable localities, on account of the fibre, as they already do for the sake of the seed. In such situations, it will, no doubt, be an eligible crop, as land is cheap and labour almost everywhere abundant. Mr. Nichols says—"The quantity of Flax which ought to be cultivated in any locality, must, in some measure, be governed by the quantity of labour there obtainable. One acre in a hundred, and one in fifty, have each been named as a suitable proportion to be applied for the growth of Flax. In former times the farmer was by law required to cultivate one acre with Flax, out of every sixty acres occupied." And he further observes: "If the quantity of Flax grown be limited by the labour which can be obtained, so may the amount of obtainable labour be said to indicate the extent to which culture ought to be carried in any locality. It is calculated that an acre of good Flax, as it stands in the field, containing, say about fifty stone of fibre, will afford employment for from twelve to fourteen weeks to a man skilled in the several processes of its preparation." But it is not to men only that the Flax affords employment, but also to women and to children; as it is skill rather than strength that is required for many of the operations. Hence, its introduction is very desirable in suitable localities, where population is abundant.

Success in culture will, therefore, depend on many considerations; as it is necessary to have a suitable soil and favorable climate; also, a sufficient population, with facilities for the sale and the transit of the produce. At present, Flax is produced over a very wide area, and there seems no sufficient reason why this may not be still further extended.

The principal sorts of Flax which are imported into this country are Russian, Prussian, Egyptian, Dutch, Belgian, and French. Of these the first three are, speaking generally, coarser in nature than the last three. The proportion per cent.



of the (say) 80,000 tons imported from different countries may be judged of by the following table, as given in the Jury Report of Class IV, p. 96, calculated on the average imports of 1840, 1844, and 1849. The details are given in the successive editions of M'Culloch's 'Commercial Dictionary,' and will be given for one year at the conclusion of this article.

	1840.	1844.	1849.
Russia . . .	69	70	74
Prussia . . .	11	10	10
Holland . . .	9	8	6.5
Belgium . . .	6.5	7	4
France . . .	3.5	3.5	1.5
Other Countries .	1.5	1.5	4.5

The increase under the last head, in this table, is chiefly due to the importation of Flax from Egypt. Some is also imported from Italy, Sicily, and Turkey. Much Flax is grown in Ireland, and also in the West and North of England.

Though all the above countries produce some coarse Flax, it is chiefly from Russia, Prussia, and Egypt that this kind is imported, and is that which is chiefly required in increasing quantities. In a letter with which I have been favoured from Mr. J. M'Adam, he observes—"It is certain that all hot countries, or those which, like Russia, have a short, warm summer, cannot furnish fine Flax fibre; but it is precisely coarse fibre that is now so much wanted. The bulk of fine Flax used in the linen manufacture is trifling compared with the coarse. A Belfast or Leeds mill of 5000 spindles will consume only 200 to 250 tons of Flax annually; while one of the same size, at Dundee or Kirkaldy, will consume 1000 to 1200 tons. Belgium, Holland, France, and Ireland can supply all the world with fine fibre; but Russia and Egypt cannot keep pace with the demand for coarse." The quality of the latter has, however, greatly improved of late years. "Fifteen years ago, Egyptian Flax was selling at Belfast for £24 a ton, and, in some cases, as low as £18. It now readily brings £30 to £40 on an average, and since the war has run up to £56." The above average prices ought to pay for its growth in India,

considering that Jute is grown and prepared there, and sold at still lower prices.

In order to succeed in the culture in new situations, it is necessary to know what is considered requisite in the situations where the cultivation is successful. We shall, therefore, first consider the nature of the plant, and then its culture in Europe, and, subsequently, the attempts which have already been made in India to produce Flax. From these, and the extended information which we now possess, we shall draw our conclusions respecting eventual success, either in the old or in new localities, of the wide-spread territories of India.

#### THE FLAX PLANT AND ITS PRODUCTS.

The Flax plant belongs to the natural family of Linaceæ, so named from the botanical name (*Linum*) of the genus to which it belongs. The species are found chiefly in temperate parts of the world, with a few in tropical regions; most are remarkable for the tenacity of the fibre of their inner bark. The native country of the Flax plant is unknown; but as it was cultivated by the earliest civilised nations, it is probably a native of oriental regions, from which it has travelled southwards into India and northwards into Europe.

*Description of plant.*—It is an annual, with long and slender but fibrous roots, which penetrate to a considerable distance into the soil, where this is loose and friable. The stem is smooth, simple, and erect; branched, or, as usually cultivated, branching only towards the top; from one and a half to three feet in height. It consists of a pith and woody part, with the layer of bast fibres covered with cuticle on the outside.

The leaves are alternate, sessile, linear-lanceolate, and smooth. The flowers, of a blue colour, are arranged in a corymbose panicle. The sepals or green outer leaflets of the flower are five in number, ovate acute, slightly ciliated, nearly equal to the capsule in length. The petals, blue in colour and five in number, are obscurely crenate, comparatively large, and deciduous. The stamens are equal in number to the petals and alternate with them, having their filaments united together near their bases into a kind of ring. The ovary, or young seed-vessel, is divided into five cells, and is surmounted by five stigmata. Capsule, or *boll*, roundish, but rather pointed at the apex, divided into five perfect cells, each of which is again subdivided by an imperfect partition, thus forming ten divisions, each of them containing a single seed. These seeds are oval in shape, flattened or plump, smooth and shining, of a brownish colour externally, but sometimes white; always white internally: the seed-coat mucilaginous, and the kernel of the seed oily and farinaceous.

Besides other species of the same genus, such as *L. perenne*, which affords a strong though coarse fibre, and one difficult to separate from the woody matter, there are some varieties of the true Flax plant known; but these are much fewer than is the case with most other long-cultivated plants. Dr. Lindley, as already quoted by Mr. J. Wilson, in his paper on 'Flax; its Treatment, Agricultural and Technical' (in 'Journ. Royal Agric. Soc.,' vol. xiv, p. 188, 1853), describes two different forms:

1. The *Linum humile* or *crepitans* (the Springlein or Klanglein of the Germans), a plant somewhat shorter and more inclined to branch than the other, and possessing larger capsules, twice as long as the calyx, which burst with considerable elasticity when ripe; its seeds, too, are both larger and of a paler colour.

2. The *Linum usitatissimum* or true winter flax (Winterlein of the Germans), which has smaller capsules, scarcely larger than the calyx, not bursting with elasticity, but firmly retaining their seeds, which are of a dark brown colour.

Mr. Wilson adds, that "in Austria and North Europe, where the winters are severe, and the snow lies too long on the ground to admit of early tillage in the spring, the Winterlein is extensively used, and sown in the autumn; the summer season being too short and too hot to admit of the successful cultivation of the Springlein. With us the custom is to sow in the spring, though, no doubt, in some of our northern districts, where the ground cannot be got ready sufficiently early in the spring, Flax could be advantageously cultivated if sown in the previous autumn."

The Indian plant, called *ulsee* or *tesee*, may be considered a variety which has acquired certain characters from the peculiarities of soil, of climate, and of long and peculiar culture. It is always short, probably not more than eighteen inches in height, much branched, loaded with bolls, which are filled with large, ovoid, plump seed. That this retains its character even in other situations, appears from a fact, of which I have been informed by Mr. M'Adam, the able secretary of the Society for the Promotion of the Growth of Flax in Ireland. The Society having imported some seed for experiment from India, found that the plant did not grow beyond fourteen or eighteen inches.

But that it is also ready to change its habit, is evident from facts to be detailed respecting the experiments which have been made in India. I have also been informed that in a recent experiment made by Mr. Burn, in Sindh, with thick sowing and irrigation, it grew at once to upwards of two feet. I have no doubt that, with a repetition of the process of thick sowing for a few times, the Indian seed would produce plants with tall, straight, and little-branched stems, each with but comparatively few bolls and seeds.

A perfectly white variety of Linseed is common in the Saugur and Nerbuddah territories, which was brought to the notice of the Agricultural Society of India by Col. Ousley. Seeds sent by him were distributed to different parts of the country by the Society. Mr. Finch, of Tirhoot, after two years, returned five maunds; and stated that three fourths of his crop were destroyed by caterpillars, while the common Linseed grown in the vicinity of the white, was left untouched by them.

The useful products of the Flax plant consist of the seeds and of the fibre or Flax. Linseed, or the seeds of the Flax plant, are oval, pointed in shape, compressed with a sharp margin; brownish coloured, smooth, and shining on the outside, but white internally, and without odour. The outside has a bland, mucilaginous taste, in consequence of the skin of the seed being covered with condensed mucus. The white part, or almond of the seed, has an oily taste, from containing fixed oil, which is separated by expression.

These seeds, analysed by Meyer, consist, in one hundred parts, of 15.12 mucilage (nitrogenous mucilage with acetic acid and salts, according to some), chiefly in the seed-coat, 11.26 fatty oil in the nucleus. In the *husk*, emulsin 44.38, besides wax 0.14, acrid soft resin 2.48, starch with salts 1.48. In the *nucleus*, besides the oil, gum 6.15, albumen 2.78, gluten 2.93, also resinous colouring matter 0.55, yellow extractive with tannin and salts (nitre and the chlorides of potassium and calcium) 1.91, sweet extractive with malic acid and some salts 10.88.

The condensed mucus which abounds in the testa of the seed is readily acted on by hot water, and a viscid mucilaginous fluid is formed, in which are two distinct substances; one completely soluble in water, analogous to common gum, called

Arabine by chemists; the other portion is merely suspended, and is considered to be analogous to the Bassorine, found chiefly in Gum Bussora, and in Cherry-tree Gum. Alcohol produces a white flaky, and acetate of lead, a dense precipitate in mucilage of Linseed.

Linseed oil, which we have seen is contained in the kernel of the seeds, is obtained by expression, and may be either cold-drawn, or, as usually obtained, after the seeds have been subjected to a heat of 200°. The former, as in the case of cold-drawn castor oil, is paler, with less colour and taste than Linseed oil prepared with the aid of heat. This is of a deep yellow or brownish colour, of a disagreeable smell and taste, specific gravity 0.932, soluble in alcohol and ether; differing from many other fatty oils, especially in its property of drying into a hard, transparent varnish—a peculiarity which is increased by boiling the oil, either alone, or with some of the preparations of lead.

“The yield of oil from a bushel of East Indian seed is 14 $\frac{3}{4}$  lb. to 16 lb.; of Egyptian, 15 lb; of Sicilian, 14 $\frac{1}{2}$  lb. to 15 $\frac{1}{2}$  lb.; of Russian, 11 lb. to 13 lb.; of English or Irish, 10 $\frac{3}{4}$  lb. to 12 lb.”

Linseed oil, according to Sace, is composed of Margarine and Oleine in nearly equal proportions. But the oleic acid of Linseed differs from that of other fatty bodies. The anhydrous acid is composed of carbon 46, hydrogen 38, oxygen 5. The Margarinic acid is as usual composed of carbon 34, hydrogen 33, oxygen 3. The Glycerine obtainable from Linseed oil in large quantities, is also similar to that procured from other fats.

Linseed, after having had the oil expressed from them, are in the form of a flat mass, commonly called *oil-cake*. This being reduced to coarse powder, forms the Linseed meal which is so commonly employed for making poultices, though these are also formed of the simply powdered seeds. Here it is evident, from the internal oleaginous and external mucilaginous parts being all ground together, and their properties elicited by hot water, an admirable mixture is produced for making a readily made emollient poultice. From the chemical composition, it is also evident how nourishing the Linseed is likely to be, and, indeed, from experience, is well known to be, for fattening cattle.

## CHEMICAL CONSTITUENTS OF THE FLAX PLANT.

In addition to the composition of the seed, it is interesting to know that of the plant in general. This we are now able to do in a very satisfactory manner, from Dr. Hodges' 'Lecture on the Composition of the Flax Plant,' and his paper read before the British Association, at Belfast, 23d September, 1852. In this he communicated the history of a crop grown by himself for experimental purposes, and the progress of which he was able carefully to watch, from the sowing of the seed to its conversion into dressed Flax for the market. From this we obtain the following information :

July 28th.—One plant of Flax, in seed, was taken—height above ground, 31 inches, root,  $5\frac{1}{2}$  inches long; length from surface of field to first branch, 24 inches. About 5 inches of the lower end of stem had become yellow. The weight of entire plant was 71.1 grains. It was cut into three portions, which were separately incinerated, with the following results :

"1. Root and lower part of stem weighed, dried, 6.60 grains, gave 0.094 ash = 1.424 per cent.

"2. Capsules and branches, dry, weighed 9.47, gave .293 ash = 3.094 per cent.

"3. Middle portion, dry, weighed 5.55, gave .143 ash. Ash in dry stem, 2.622 per cent.

"August 10th.—One plant taken—entire length with root, 37 inches; length from surface of soil to branches, 29 inches; stem of a light straw colour; leaves withered on 10 inches of stem; capsules 10 in number—seeds green; weight of entire plant, 71 grains; branches and capsules, 31.8 grains; water in plant, 45.335 grains; solid matter in do., 25.665; inorganic matter in do., 1.006 grains.

PER-CENTAGE COMPOSITION.				
Water	.	.	63.852	dry.
Organic matters	.	.	34.732	96.08
Ash	.	.	1.416	3.92
			100.000	100.00
Total	.	.	100.000	100.00

"August 25th.—The pulling of the crop was begun. A plant was taken and examined; weight of entire plant, 62.40 grains; weight of capsules, 22.50.

PER-CENTAGE COMPOSITION OF STEM.			
		In Fresh Plant.	Dry.
Water	.	56.64	—
Organic matters	.	41.97	96.89
Ash	.	1.39	3.11
		100.00	100.00
Total	.	100.00	100.00

"Water in straw of plants as sent to the steeping works, after 14 days' exposure to the air in stooks, 12.2 per cent; water in air-dried capsules, 11.84 per cent; weight of the air-dried Flax, with bolls produced on the experimental field, 7.770 lb.

## COMPOSITION OF THE CROP.

"One hundred parts of the ash of the dry straw and capsules had respectively the following composition :

	Ash of Straw.	Of Capsules.
Potash . . . . .	20·32	16·38
Soda . . . . .	2·07	6·25
Chloride of Sodium . . . . .	9·27	12·98
Lime . . . . .	19·88	13·95
Magnesia . . . . .	4·05	3·91
Oxide of Iron . . . . .	2·83	0·38
Sulphuric Acid . . . . .	7·13	14·51
Phosphoric Acid . . . . .	10·24	23·26
Carbonic Acid . . . . .	10·72	6·37
Silica . . . . .	12·80	0·67
Total . . . . .	99·31	99·66

“The proportion of nitrogen contained in the straw and capsules were ascertained to be as follows, per cent.:

1. In the straw, dried at 212° . . . . .	0·53
2. In the capsules or bolls, ditto . . . . .	1·26

“The general results of the examination of a specimen of Flax straw taken from the experimental crop, are as follow: The presence of a volatile oil having been indicated, a quantity of the stems of the plant carefully deprived of the seed capsules was distilled with water containing common salt; and from the distillate, which was without action on litmus, I obtained an oil of a yellow colour. Five pounds of the stems afforded about ten grains of this oil, which had an agreeable, penetrating odour, and the distillate of the stems suggested the peculiar smell which is remarked on entering a room where Flax is stored. The solutions obtained on examination were found to contain wax; traces of chlorophylle; a peculiar green resin; a bright brown gum resin, which presented some of the characters of the principle which Pagenstecher termed *linen*, but could not be identified with it; a modification of tannic acid which afforded a grey precipitate with perchloride of iron, but was not affected by solutions of isinglass or tartar emetic; gum, not affected by solution of borax or basic silicate of potash; a brown colouring matter; albumen; casein; starch; pectin; cellulose; and salts.”

The result of Dr. Hodges' experiments has been further placed in a very clear light by Mr. Wilson. The object of these was to ascertain the relative proportions of the produce of Flax, and also the distribution of inorganic matter in them. The Flax employed had been steeped in the ordinary way, and was found to contain 1·73 per cent. of ash. Of this, air-dried straw, 4000 lb. weight, were taken, which produced:

Of dressed fibre . . . . .	500 lb.
„ fine tow . . . . .	132 „
„ coarse tow . . . . .	192 „
Of fibre in all . . . . .	824 lb.

These products contained:

## CHEMICAL CONSTITUENTS OF FLAX

In the dressed Flax	4.48 lb. of ash.
„ fine tow	. 2.08 „
„ coarse tow	. 2.56 „

Or, in the whole of the fibre 9.12 lb. of inorganic matter.

So that 59.08 lb., which the crop had withdrawn from the soil, remained in the useless portion, while only 9.12 lb. were carried off in 824 lb. of the dressed fibre and tow.

Analyses of the Flax plant and of the soils in which it is grown were first carefully made by Sir R. Kane, and afterwards by Dr. Hodges and others. They have been repeated by Messrs. Mayer and Brazier, in the Laboratory of the Royal College of Chemistry.<sup>1</sup> The localities from which the latter obtained their specimens of Flax, by the aid of Mr. A. Marshall, of Leeds, were Esthonia or Estland, Livonia or Lievland, Courland, and Lithuania. The first of these districts, with the second and third mentioned, are situated on the eastern shores of the Baltic; the fourth, Lithuania, is the only inland country.

From their analyses, the following comparative table was made, from which it will be readily seen, in what points the ashes of these different specimens agree in composition.

	Lievland.	Courland.	Lithuanian.	Estland.
	I.	II.	III.	IV.
Potash . . . . .	43.42	37.44	36.61	25.70
Soda . . . . .	—	3.74	3.06	8.37
Lime . . . . .	21.35	25.39	24.09	26.41
Magnesia . . . . .	7.79	7.71	7.45	11.74
Sesquioxide of Iron . . . . .	1.15	1.13	1.04	1.02
Manganese . . . . .	—	trace.	—	—
Chloride of Sodium . . . . .	—	1.94	3.75	1.67
„ of Potassium . . . . .	1.31	—	—	—
Phosphoric Acid . . . . .	10.94	8.31	14.30	15.47
Sulphuric Acid . . . . .	5.66	5.89	3.65	4.64
Silicic Acid . . . . .	8.38	8.45	6.05	4.98
	100.00	100.00	100.00	100.00

“ We also append, in a tabular form, the results of Sir R. Kane’s analyses of this plant, taken from his paper, read before the Royal Dublin Society, on the 6th of April, 1847.

“ To facilitate comparison, we have re-calculated these analyses after deducting the carbonic acid.

<sup>1</sup> Mr. Mayer is now Professor of Chemistry at Madras.



	A Courtrai District.		C Antwerp District.		E District in Holland.	F Dublin.	G Armagh.
	B Heestelt.	B Escanaffles.	D Hamme Zog.	D Not named.			
Potash . . . . .	9.69	30.62	26.67	28.62	21.35	11.78	6.60
Soda . . . . .	24.16	none.	16.88	0.48	12.65	11.82	6.61
Lime . . . . .	19.37	22.04	22.15	21.19	21.30	14.85	23.67
Magnesia . . . . .	4.34	4.45	4.70	4.05	3.50	9.38	4.22
Sesquioxide of Iron . . . . .	5.66	2.03	1.31	2.53	2.74	„ „	14.10
Alumina . . . . .	0.56	0.58	0.86	„ „	1.67	7.32	„ „
Manganese . . . . .	trace.	trace.	trace.	„ „	„ „	„ „	1.12
Sulphuric Acid . . . . .	7.93	8.33	8.18	13.43	11.22	3.19	9.30
Phosphoric Acid . . . . .	14.10	15.78	10.66	12.19	12.82	13.05	7.29
Silicic Acid . . . . .	3.85	4.54	3.20	3.36	6.18	25.71	0.94
Chloride of Sodium . . . . .	10.34	11.63	5.49	14.15	6.57	2.90	26.15
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

“On comparing the results of our analyses with those of Sir Robert Kane, we find at once that the general features of both are identical, although, as might be expected, discrepancies present themselves respecting the individual constituents. In the ashes, both of the Belgian and of the Russian specimens, we meet with a very large amount of alkali (nearly 40 per cent.): the quantity, too, of phosphoric acid is very considerable (from 10 to 15 per cent.) Our analyses then furnish a further proof that Flax must be classed among the most exhausting crops, for, the amount of valuable mineral substances which we remove from the soil in this plant considerably exceeds the quantity which is generally extracted from it in the form of wheat or corn.

“From a statement of Mr. M'Adam,<sup>1</sup> it appears that one rood of land yields about 12.7 cwt. of recently pulled Flax plant. If we take this number as the basis of calculation, and the average per centage of ash at 3.53 lb., of alkalis at 39.58 lb., and of phosphoric acid at 12.51 lb., we find that a Flax crop removes from a rood of land not less than 12.21 lb. of alkalis, and 5.94 lb. of phosphoric acid. On the other hand, we have learnt from the researches of Mr. Way,<sup>2</sup> that a rood of land, which has served for the cultivation of wheat, loses (an average taken from a great number of analyses) about 7.5 lb. of alkali and 6.9 lb. of phosphoric acid. These figures show that the amount of phosphoric acid in the Flax crop closely approaches that of the wheat, whilst the latter extracts only about half the quantity of alkali which we find in the former. Hence, it would appear, that a Flax crop is at least as exhausting as a crop of wheat.

“There is, however, one striking point of dissimilarity between the cultivation of wheat and that of Flax, and we are indebted to Sir Robert Kane for having for the first time brought this point under the notice of the farmer in a forcible manner, viz.: that while the mineral ingredients which we remove from our fields in wheat, or cerealia in general, become constituents of food, and enter in this manner into a circulation, from which, even under very favorable circumstances, they return to the soil only after the lapse of some time; the woody fibre of Flax, as a necessary preliminary

<sup>1</sup> ‘Royal Agricultural Journal,’ vol. viii, p. 361.

<sup>2</sup> ‘Royal Agricultural Journal,’ vol. vii, p. 593.

to its being used by man, is separated to a considerable extent from those very mineral substances which are so essential for its successful growth. This mineral matter, when economised in a proper manner by the farmer, may be returned to his field to keep up the equilibrium of its fertility.

"The vegetation of the Flax plant resembles in this respect the growth of the sugar-cane, from the culture of which, we expect a material consisting entirely of atmospheric constituents. The inorganic substances taken up by the plant are only instruments used in its production, which should be as carefully preserved as tools in a manufactory, and will then do further duty in promoting the elaboration of future crops."

Messrs. Mayer and Brazier then directed their attention to the soils upon which the different specimens of Flax had been grown, samples of which, through the kindness of Mr. Marshall, had likewise been forwarded to Dr. Hoffman. These soils all gave a brownish colour to boiling water, owing to a portion of the organic matter being soluble in that menstruum.

From their various analyses, Messrs. Mayer and Brazier obtain, by calculation, the following amounts of constituents of 100 parts in the soils :

	Lievlund.	Courland.	Lithuania.	Estland.
Potash . . . . .	0·5011	0·3241	0·5466	0·3726
Soda . . . . .	—	0·1320	0·0452	0·0480
Lime . . . . .	0·3751	0·7816	0·4980	0·7955
Magnesia . . . . .	0·2006	0·1304	0·1805	0·3619
Alumina . . . . .	1·1919	1·8731	2·1418	2·0102
Sesquioxide of Iron . . . . .	1·8076	2·3767	3·1900	2·0206
Manganese . . . . .	trace.	trace.	trace.	trace.
Chloride of Sodium . . . . .	0·0455	0·0247	0·0421	0·0790
Sulphuric Acid . . . . .	0·1539	0·0880	0·1206	0·1618
Phosphoric Acid . . . . .	0·1399	0·0538	0·0805	0·1597
Organic matter . . . . .	4·7176	4·0300	4·3442	4·8630
Insoluble residue after deduct- ing organic matter . . . . .	91·0634	88·4872	88·4724	88·2364
	100·1966	99·3016	99·6619	99·1087

The insoluble residue constituting the greater portion of the soil, was fused with carbonate of potash. Upon calculation, they yielded the following results per cent :

	Lievlund.	Courland.	Lithuania.	Estland.
Lime . . . . .	traces.	1·8727	0·8778	2·0120
Alumina . . . . .	11·6270	6·1145	2·2452	5·7549
Sesquioxide of Iron . . . . .	traces.	traces.	traces.	traces.
Phosphoric Acid . . . . .	traces.	traces.	none.	traces.
Silicic Acid . . . . .	79·3424	81·5000	85·0938	80·5676
	90·9694	92·6224	88·2168	88·3345

In all the four soils, they found, comparatively speaking, considerable quantities of alkali, especially potash, and also of phosphoric acid. They

closely resemble the Belgian soils analysed by Sir Robert Kane, as may be seen from the tables which they borrow from Sir Robert's paper.

	Heestert.	Escamaffles.	Hamme Zog.	Not named.	Holland.
Potassa . . . .	0.160	0.123	0.068	0.151	0.583
Soda . . . . .	0.298	0.146	0.110	0.206	0.306
Lime . . . . .	0.357	0.227	0.481	0.366	3.043
Magnesia . . . .	0.202	0.153	0.140	0.142	0.105
Alumina . . . . .	2.102	1.383	0.125	0.988	5.626
Sexquioxide of Iron . .	3.298	1.663	1.202	1.543	6.047
Manganese . . . .	trace.	trace.	a trace.	no trace.	trace.
Chloride of Sodium . . .	0.017	0.030	0.067	0.009	0.023
Sulphuric Acid . . . .	0.025	0.017	0.013	0.026	0.023
Phosphoric Acid . . . .	0.121	0.152	0.064	0.193	0.159
Organic matter not driven off at 100° per cent. . . . .	3.123	2.361	4.209	3.672	5.841
Clay . . . . .	14.920	9.280	5.760	4.400	17.080
Sand . . . . .	75.080	84.065	86.797	88.385	60.947
	99.703	99.600	99.975	100.081	99.783

In conclusion, the authors express their warmest thanks to Dr. Hofmann for his instruction and valuable advice during the prosecution of these analyses. (v. the details in the 'Proceedings' of Chemical Society.)

That we may have a complete view of what is required in soils for the successful culture of Flax, we adduce Sir R. Kane's analyses of three Irish soils and one Belgian, from the report of the Flax Improvement Society of Ireland. The Irish soils, as described by Mr. M'Adam, were from the counties of Londonderry and Tyrone, and were considered very good for Flax. The Belgian was from Duffel, in the province of Antwerp, and may be taken as representing a third-rate class of Flax soil in that country, requiring much manure, but producing good crops. The large proportion of sand and the little moisture in this last, deserve notice :

	Irish, No. 1.	Irish, No. 2.	Irish, No. 3.	Belgian.
Silica and Siliceous Sand . . . . .	73.72	69.41	64.93	92.78
Oxide of Iron . . . . .	5.51	5.29	5.64	0.66
Alumina . . . . .	6.65	5.70	8.97	1.11
Basic Phosphate of Iron . . . . .	0.06	0.25	0.31	0.21
Carbonate of Lime . . . . .	1.00	0.53	1.67	0.35
Magnesia, Alkalies, and Sulphuric and Muriatic Acids . . . . .	0.32	0.25	0.45	0.12
Organic matters, with Nitrogen . . . .	4.86	6.67	9.41	2.74
Water . . . . .	7.57	11.48	8.62	2.03
	99.78	99.78	100.00	100.00

## CULTURE OF FLAX.

The importance of Flax culture being admitted, we may devote a few words to the objections which are usually alleged against it. These chiefly consist of the opinions entertained respecting the exhausting nature of a Flax crop. This is certainly true, where everything is taken from the soil and nothing returned to it; but the elementary principles of which both cotton and fibre, as well as sugar, consist, are now known to be obtained almost entirely from the atmosphere. Therefore, by taking away only the cotton, the flax, or the sugar, and returning all the other parts of the plant to the soil, these products will impoverish the soil as little as it is possible for any culture to do. This, as far as Flax is concerned, may be effected by some of the improved methods of preparing the fibre, and by feeding cattle on the oil-cake of the seeds, and thus returning all the other constituents which had been taken from the soil. Mr. Nichols observes that "every farmer will be enabled, by applying the seed of his Flax crop to that purpose, to obtain a supply of the richest manure, which, with the offal separated from the fibre in course of preparation, will serve to renovate the soil and secure its undiminished fertility." This we find fully proved by the foregoing and other analyses of the different parts of the plant, and of the soil in which it has been grown, as well as of the products obtained in the improved steeping and preparation of the fibre.

The analyses of Mayer and Brazier correspond closely with those made by Sir R. Kane, of specimens of Belgian Flax; and their conclusions also coincide with his: that, while the mineral ingredients which we remove from our fields in Wheat, become constituents of food, the woody fibre of Flax is separated from those very mineral substances which are so essential for its successful growth; and they forcibly observe that "the inorganic substances taken up by the plant, are only instruments in the production of Flax, which should be as carefully preserved as tools in a manufactory, and will then do further duty in promoting the elaboration of future crops."

*Climate.*—One of the most important considerations in at-

tempting the culture of Flax in new situations or countries is that of climate, though one that is very frequently neglected. On this subject, Mr. M'Adam has made some very just observations, which we shall afterwards have occasion to refer to. He observes that though the climate of the British Isles is well adapted to the growth of this plant, those districts which possess the most equable temperature will be found the most suitable. A regular supply of genial moisture in spring, without an excess of wet in autumn, is most favorable. Our climate is better adapted to Flax, in some respects, than that of Belgium, since the severe droughts which frequently occur there in spring often destroy the crop. If, after springing to the height of two or three inches, a long continuance of drought should occur, with a hot sun, the heat parches up the earth, as the delicate leaves of the plant are unable to exclude the scorching rays from the surface soil, and the roots have not penetrated sufficiently deep to secure a supply of moisture. "Flax is then in the most critical state; the plant droops, turns a whitish yellow, and, if the drought continue long, dies on arid tracts of land. In such a case Flax may be beneficially watered; and a regular water-cart will go over an acre a day."

When the plant acquires a sufficient height to thoroughly cover the ground, dry weather becomes comparatively harmless; but occasional gentle showers are very needful to produce a regular and vigorous growth. "In fact, a slow, steady growth, from the germinating of the seed to the maturity of the plant, is requisite for the quality and yield of fibre. Hence it is found that in countries approaching the northern limits of the temperate zone, the short, hot summers induce too rapid growth, and, although the quantity of fibre produced is pretty large, it is never of a fine reed. This is strongly exemplified by Russia, as, out of an export frequently reaching 40,000 to 50,000 tons per annum, none sells higher than £48; whereas, in Belgium and Holland, the price often reaches £150 and £180 per ton." The best samples of British Flax sell for £65 to £70 per ton, or even £85 per ton.

"For the same reason, insular climates or long lines of coast, whose position insures a more equable temperature and continued supply of moisture from spring till autumn, are found

to produce the best Flax. In such the plant springs up to a height of thirty or forty inches, in a straight, slender stem, with few or no branches, and only two or three seed-vessels to each stalk." Thick sowing produces the same effect.

So, also, Mr. Nichol: "Flax will bear a good deal of moisture, and, in fact, thrives best in a moist climate. Hence the peculiar suitability of England for its growth; our climate being generally more humid than that of the Continent, especially in the Western counties. Indeed, long-continued drought is the chief enemy the flax-grower has to dread." (p. 447.)

The hot summers of Russia and Egypt cause a dryness and brittleness of fibre, and prevent its retaining that elasticity, pliancy, and oiliness which characterise the Flaxes of Belgium, Holland, and Ireland.

"In Egypt, though the plant attains great luxuriance in the rich alluvial soil of the Nile, yet the fibre does not attain fineness and softness, and, notwithstanding the efforts made to improve the culture and preparation, its value has not exceeded £44 per ton."

*Culture.*—In connection with the climate we may notice peculiarities of culture in different countries.

"In Flanders a great variety of crops are raised; the farms being for the most part small—the majority varying from eight or ten to twenty and thirty acres." (p. 448.) "Every Belgian farmer, whether large or small, grows Flax sufficient to keep himself and his people employed when not at work on the land."

The cultivation of Flax in Flanders is conducted with the greatest care. The ground is well ploughed, rolled, enriched with liquid manure, harrowed, and when the seed is sown again harrowed in with a light harrow, and the surface rolled. The fields when thus accurately prepared display an extreme degree of neatness and smoothness. The liquid manure is prepared with considerable care. It consists of the urine of cattle in which rape-cake has been dissolved, and in which the cleansings of privies from the neighbouring towns and villages have been mixed; and is collected in subterranean vaults of brick work. About 2800 gallons (beer measure) are allowed to the English acre.

In Russia the Flax is cultivated with less care, and without any manure in the Ukraine. The time of sowing is from the 25th of May to the 10th of June, and that of reaping, from the end of August to the end of September. The Flax is about four months in a state of vegetation.

The directions for culture which, however, are most desirable for us to notice, are those which have been drawn up with so much care for the guidance of cultivators in Ireland. We, therefore, reprint, in full, the—

DIRECTIONS FOR THE PROPER MANAGEMENT OF THE FLAX CROP,  
COMPILED BY THE COMMITTEE OF THE ROYAL SOCIETY FOR  
THE PROMOTION AND IMPROVEMENT OF THE GROWTH OF  
FLAX IN IRELAND.

The following directions have been carefully arranged from the mass of information obtained by the Society and their agriculturists, during their ten years' experience in the improved system of management :

*Soil and Rotation.*—By attention and careful cultivation, good Flax may be grown on various soils ; but some are much better adapted for it than others. The best is a sound, dry, deep loam, with a clay subsoil. It is very desirable that the land should be properly drained and subsoiled ; as, when it is saturated with either underground or surface water, good Flax cannot be expected.

Without method there cannot be success. Different soils require a difference of rotation. In the best soils of Flanders, Flax is grown in the third year of a seven-course rotation, or the fifth year of a ten-course rotation.

It is not considered generally advisable to grow Flax more frequently than once in ten years ; not because it exhausts the land more than any other crops, but because good *Flax* cannot be had, at short intervals, on the same soil.<sup>1</sup> In Belgium it invariably follows a corn crop—generally oats ; and in this country, where oats is such a usual crop, the same system might be profitably pursued : but it must be understood, that it is only after oats following a green crop or old lea, and never after two or three succeeding crops of oats—which bad practice still prevails in some districts. It is a very general error among farmers, to consider it necessary that Flax

<sup>1</sup> The following rotation, which would bring Flax once in ten years, has been proposed :—First year, potatoes ; second, barley, laid down with grasses ; third year, cut for soiling ; fourth year, pasture ; fifth year, flax ; or the one half might be better in flax, the other in oats, so that, with the return of the rotation, which would be in five years, the flax could be put on the ground which, in the last rotatory course, was under corn, throwing a range of ten years between the flax crops coming into the same ground.

A gentleman of much practical knowledge recommends the following as being the most profitable :—1. Oats after the grass and clover. 2. Flax pulled in August ; then ploughed and harrowed in with two cwt. guano and two cwt. gypsum ; then sown with rape. 3. Potatoes or turnips, well manured. 4. Wheat, sown in spring, with clover and ryegrass. 5. Hay and clover. 6. Grazing. 7. Oats. 8. Flax and winter vetches ; guano, as before mentioned. 9. Turnips, well manured. 10. Barley, sown with ryegrass and clover. 11. Clover and hay. 12. Grazing. 13. Oats. should follow a potato crop. Except on very poor soils, a better crop will

be produced after grain, and the double benefit of the grain and Flax secured. If old lea be broken up, and potatoes planted, followed by a grain crop, a very fine crop of Flax may be obtained in the ensuing year.

*Preparation of the Soil.*—One of the points of the greatest importance in the culture of Flax, is by thorough-draining, and by careful and repeated cleansing of the land from weeds, to place it in the finest, deepest, and cleanest state. This will make room for the roots to penetrate, which they will often do to a depth equal to one half the length of the stem above ground. (Sometimes twenty to thirty inches.)

After wheat, one ploughing may be sufficient, on light friable loam, but two are better; and, on stiff soils, three are advisable—one immediately after harvest, across the ridges, and two in spring, so as to be ready for sowing in the first or second week of April. Much will, of course, depend on the nature of the soil, and the knowledge and experience of the farmer. The land should be so drained and subsoiled, that it can be sown in flats, which will give more evenly and much better crops. Subsoiling should not be done at a less interval than two years prior to the Flax crop. This gives the land time to consolidate. But, until the system of thorough-draining be general, it will be necessary, after oats, to plough early in autumn, to the depth of six or eight inches. Throw the land into ridges, that it may receive the frost and air; and make surface drains to carry off the rains of winter. Plough again in spring, three or four inches deep, so as to preserve the winter surface for the roots of the Flax. The spring ploughing should be given some time before sowing, to allow any seeds of weeds in the land to vegetate, and the harrowing in of the Flax seed will kill them, and save a great deal of after weeding. Following the last harrowing, it is necessary to roll, to give an even surface and consolidate the land, breaking this up again with a short-toothed or seed harrow, before sowing, which should be up and down, not across the ridges or anglewise.

*Seed.*—The seed best adapted for the generality of soils is Riga, although Dutch has been used in many districts of country, for a series of years, with perfect success. American seed does not generally suit well, as it is apt to produce a coarse, branchy stem. If used, it should be on deep, loamy soils. In buying seed, select it plump, shining, and heavy, and of the best brands, from a respectable merchant. Sift it clear of all the seeds of weeds, which will save a great deal of after trouble, when the crop is growing. This may be done by fanners, and through a wire sieve, twelve bars to the inch. Home-saved seed has produced such excellent crops, of late, that it is strongly recommended that every farmer should only sow, each year, as much foreign seed as would produce a sufficient quantity for his Flax crop of the following season.<sup>1</sup> The thinner portion of the crop would be the best for this purpose, as, when Flax grows thin, it produces much seed. This plan, besides the saving effected in the price of foreign sowing seed, would effectually secure the farmer from any danger of loss from fraudulently made up seed. It will be best, in most cases, to use the seed which is saved from this, in the following year, for feeding, or to sell it for the oil mills, although it often produces good crops.

*Sowing.*—The proportion of seed may be stated at three and a half imperial bushels to the Irish or plantation acre; and so on, in proportion to the Scotch or Cunningham, and the English or statute acre. It is better to sow too thick than too thin; as, with thick sowing the stem grows tall and straight, with only one or two seed-capsules at the top, and the fibre is found greatly superior, in fineness and length, to that produced from thin sown Flax, which grows coarse, and branches out, produces much seed, but a very

The produce of seed averages about twelve bushels the statute acre, so that the seed saved off one statute acre would sow about five.



inferior quality of fibre. The ground being pulverized and well cleaned, roll and sow. If it has been laid off without ridges, it should be marked off in divisions, eight to ten feet broad, in order to give an equable supply of seed. After sowing, cover it with a seed harrow, going twice over it—once up and down, and once across or anglewise—as this makes it more equally spread, and avoids the small drills made by the teeth of the harrow. Finish with the roller, which will leave the seed covered about an inch—the proper depth. The ridges should be very little raised in the centre, when the ground is ready for the seed, otherwise the crop will not ripen evenly; and, when land is properly drained, there should be no ridges. The sowing of clover and grass seeds along with the Flax is not advised, when it can be conveniently avoided, as these plants always injure the root ends of the Flax. But carrots may be sown, in suitable soils, in drills, so that the person pulling the Flax may step over the rows, which may be afterwards hoed and cleaned, and should have some liquid manure. A stolen crop of rape or winter vetches, or of turnips of the stone or Norfolk globe varieties, may be taken, after the Flax is pulled. Rolling the ground after sowing is very advisable, care being taken not to roll when the ground is so wet that the earth adheres to the roller.

*Manure for the Flax Crop.*—Recent chemical investigations have shown that the fibre of Flax does abstract from the soil certain matters, although not in so large a proportion as several other commonly cultivated crops. To supply to the soil all the matters which the entire plant requires, so as to leave the land in the same state of fertility as before, the following compound has been proposed as a manure, which may be sown broadcast on the land, prior to the last harrowing before sowing the Flax seed:

FOR A STATUTE ACRE OF LAND.			s.	d.
Muriate of Potash, 30 lb.,	.	. cost about	2	6
Chloride of Sodium (common salt), 28 lb.,	.	„	0	3
Burned Gypsum, powdered, 34 lb.,	.	„	0	6
Bone Dust, 54 lb.,	.	„	3	3
Sulphate of Magnesia (Epsom salts), 56 lb.,	.	„	4	0
			<hr/>	
			10	6

[Oil-cake of rape, cameline, and colza, applied either dry or with urine, are also recommended as manures.]

*Weeding.*—If care has been paid to cleaning the seed and the soil, few weeds will appear; but if there be any, they must be carefully pulled. It is done in Belgium by women and children, who, with coarse cloths round their knees, creep along on all-fours. This injures the young plant less than walking over it (which, if done, should be by persons whose shoes are not filled with nails). They should work, also, facing the wind, so that the plants laid flat by the pressure may be blown up again, or thus be assisted to regain their upright position. The tender plant, pressed one way, soon recovers; but if twisted or flattened by careless weeders, it seldom rises again.

*Pulling.*—The time when Flax should be pulled is a point of much nicety to determine. The fibre is in the best state before the seed is quite ripe. If pulled too soon, although the fibre is fine, the great waste in scutching and hackling renders it unprofitable; and, if pulled too late, the additional weight does not compensate for the coarseness of the fibre. It may be stated, that the best time for pulling is, when the seeds are beginning to change from a green to a pale brown colour, and the stalk to become yellow for about two thirds of its height from the ground. When any of the crop is lying, and suffering from wet, it should be pulled as soon as possible, and kept by itself. So long as the ground is undrained, and imperfectly levelled

before sowing, the Flax will be found of different lengths. In such cases, pull each length separately, and steep in separate pools, or keep it separate in the same pool. Where there is much second growth, the Flax should be caught by the puller just underneath the bolls, which will leave the short stalks behind. If the latter be few, it is best not to pull them at all, as the loss from mixture and discoloration by weeds would counterbalance the profit. If the ground has been thorough-drained, and laid out evenly, the Flax will be all of the same length. It is most essential to take time and care to keep the Flax even, like a brush, at the root ends. This increases the value to the spinner, and, of course, to the grower, who will be amply repaid, by an additional price, for his extra trouble. Let the handfuls of pulled Flax be laid across each other diagonally, to be ready for the—

*Rippling*, which should be carried on at the same time, and in the same field, with the pulling. If the only advantage to be derived from rippling was the comparative ease with which rippled Flax is handled, the practice ought always to be adopted; but, besides this, the seed is a most valuable part of the crop; being worth, if sold for the oil mill, £3 per acre, and if used for feeding stock of all kinds, at least £4 per acre. The apparatus is very simple. The ripple consists of a row of iron teeth screwed into a block of wood. This can be procured in Belfast, or may be made by any handy blacksmith. It is to be taken to the field, where the Flax is being pulled, and screwed down to the centre of a nine-feet plank, resting on two stools. The rippers may either stand or sit astride at opposite ends. They should be at such a distance from the comb, as to permit of their striking it properly and alternately. A winnowing sheet must be placed under them, to receive the bolls as they are rippled off; and then they are ready to receive the Flax just pulled, the handfuls being placed diagonally, and bound up in a sheaf. The sheaf is laid down at the right hand of the rippler, and untied. He takes a handful with one hand, about six inches from the root; and a little nearer the top, with the other. He spreads the top of the handful like a fan, draws the one half of it through the comb, and the other half past the side; and, by half a turn of the wrist, the same operation is repeated with the rest of the bunch. Some, however, prefer rippling without turning the hand, giving the Flax one or two pulls through, according to the quantity of bolls. The Flax can often be rippled, without being passed more than once through the comb. He then lays the handfuls down at his left side, *each handful* crossing the other, when the sheaf shall be carefully tied up and removed. The object of crossing the handfuls so carefully, after rippling, when tying up the beets for the steep, is, that they will part freely from each other, when they are taken to spread out on the grass, and not interlock, and be put out of their even order, as would otherwise be the case. If the weather be dry, the bolls should be kept in the field, spread on winnow-cloths, or other contrivance for drying, and, if turned from time to time, they will win. Passing the bolls first through a coarse riddle, and afterwards through fanners, to remove straws and leaves, will facilitate the drying. If the weather be moist, they should be taken in-doors, and spread out thinly and evenly on a barn floor or on a loft, leaving windows and doors open, to allow a thorough current of air, and turned twice a day. When nearly dry, they may be taken to a corn kiln (taking care not to raise it above summer heat), and carefully turned, until no moisture remains. By the above plan of *slow* drying, the seed has time to imbibe all the juices that remain in the husk, and to become perfectly ripe. If it be taken at once from the field, and dried *hurriedly* on the kiln, these juices will be burned up, and the seed will become shrivelled and parched, little nutritious matter remaining. In fine seasons, the bolls should always be dried in the open air, the seed thrashed out, and the heaviest and plumpest used for sowing or crushing.

The light seeds and chaff form most wholesome and nutritious feeding for cattle. Flax ought not to be allowed to stand in the field, if possible, even the second day; it should be rippled as soon as pulled, and carried to the water as soon as possible, that it may not harden.

Though immediate rippling is thus recommended as the general practice, it may not be convenient in all situations to adopt it. We, therefore, add directions for *stooking* from other authors.

"Flax is always pulled up by the roots: these handfuls are usually laid across each other, and subsequently bound up into small sheaves; these are set up in circular stooks, the butts of each being spread out as much as possible, to allow the air to have free access to them: there they remain until sufficiently dried; they are then either stacked in the field or at the homestead, or the seed is separated at once, and then merely the stem or straw stacked." (Wilson.) "The drying must be sufficient to prevent their heating. They must then be tied up in small sheaves or beets, and then carted home." (Nichol.)

"Many different modes, both of stacking and separating the seeds, exist: probably, the cheapest and most efficient is to pass the straw through plain rollers, which crush the capsule and let the straw pass through uninjured." (Wilson.) "The seed is separated from the capsule, or 'boll,' by winnowing, and the straw remains to be stacked in the usual way." (Nichol.)

Under favorable circumstances we may expect an average crop to produce from 30 cwt. to 40 cwt. of straw, and 12 to 16 bushels of seed, to the acre.

#### GENERAL OBSERVATIONS ON CULTURE OF FLAX.

From these various details respecting the culture of Flax in the localities where it succeeds best or is most extensively cultivated, we become acquainted with the points requiring most attention. We learn that though one of the crops occupying a shorter time than most others, it is, like these, liable to failure, and from causes often beyond our control. Of these, the most important appears to be climate; as, of this, the temperature should be moderate, and the moisture, though not excessive, yet abundant and continuous, except at the period of gathering the crop. We also learn that though sandy loams and alluvial soils appear best suited to its cultivation, which water may permeate and the roots spread through it in every direction; yet the soil ought to be able to retain moisture sufficiently to benefit the plant, and not let it run off at once, as some open soils do. Manure in many soils is useful; but in others, or when a large quantity is applied, the Flax is apt to grow coarse. Then it will not yield a fine fibre, and is apt to be lost from the weakness of the stem. Hence, it seems to succeed best after a corn crop which has been manured, or on recently turned-up ground. The soil requires to be well tilled, and brought to a level, in order that the Flax plants may all

grow of the same length. In Great Britain and Ireland draining is most important, but in India, facilities for irrigation will be not less so. It ought to be freed from weeds as much as possible; and there is no fear of the land becoming exhausted, if the modern methods of culture and of preparation are adopted.

In selecting seed, considerable care is necessary, though, perhaps, too much importance is attached to foreign seed.<sup>1</sup> The interchange of seed is useful for all crops, and, therefore, is no doubt beneficial for Flax; but it is a question whether it should be carried to the extreme extent of always using foreign seed, or limited to only using it occasionally. Some prefer Riga seed; others, that which has been obtained as the first crop from such seed. Dutch seed is preferred by others, especially for heavy soils. American seed is not generally approved of in this country; but it has succeeded well in India.

Excellent crops have been grown in Ireland, from seed saved from the Russian; and it is recommended by Mr. M'Adam and others, that enough of the foreign seed should be produced annually, to raise seed for sowing the crop of the following year. In Norfolk and Essex, Flax has been grown year after year from seed produced in the country, and good crops have continued to be obtained. Mr. Nichol says that the seed may be either home-grown or foreign—Flax equally good being raised from both; but an occasional use of Dutch, Belgian, or Riga is recommended as affording the completest change; but that the seed "grown in England appears to be the best, both from its great weight and freedom from weeds."

Early sowing is especially recommended, and Mr. Wilson considers that even autumn sowing might be suitable in some localities; but the time of sowing must, of course, depend entirely on the season which is to follow for the growth of the crop; and must be very different in Egypt from what it is in

Riga seed is imported in barrels, containing  $3\frac{1}{2}$  bushels, and covered with a coarse linen bag. The barrels are branded in Russia by officers named *brackers*, who classify the seed, as it arrives from the interior, under the terms "sowing seed," "rejected sowing seed," and "crushing seed." But, notwithstanding this, Riga seed usually contains from 15 to 20 per cent. of the seeds of weeds, and therefore requires to be carefully sifted. Dutch seed is seldom adulterated. It comes in old wine-hogsheads, containing 7 bushels each.

Riga seed varies in price from 7s. to 16s. per bushel; and Dutch from 7s. to 13s. 6d. per bushel. (M'Adam.)

Ireland. By sowing early, that is, in the latter end of March or the beginning of April, the crop might be gathered in before the regular corn harvest in England. But another advantage is, that early sowing is followed by slow and steady growth, which is indispensable for obtaining a fine fibre. Later in the season, vegetation is more rapid, the fibre grows more quickly, and has not time to fine and mellow. The fineness of fibre, however, depends also upon the proportion of seed which is employed. From two to three bushels per acre—the latter for fine fibre, and the former for medium quality of fibre; therefore,  $2\frac{1}{2}$  bushels, or about 130 lb. of clean seed is a fair average to the English or statute acre; but if the crop of seed is the principal object, then six pecks per acre is sufficient.

The time of pulling is, of course, a subject of the greatest importance, as, if pulled too early the fibre will be flimsy, and if too late, it will be coarse. If the object is to obtain very fine fibre, then the crop is pulled before the seed is quite ripe, and the seed should then be taken off by rippling. As long as the seed is in the husk it continues to ripen; but if good seed is required for future sowings, it should be grown for this purpose, and allowed to ripen fully. In the directions of the Irish Flax Improvement Society, it is strongly recommended to separate the seeds immediately from the stems, and thus to preserve a portion of the crop, which, in many places, is now unnecessarily wasted. According to ancient custom, the plants should then be steeped for a longer or shorter period, but often the former, to the manifest detriment of the fibre. This may all be avoided, either by stacking the dried Flax stems until some convenient time, or adopting some of the improved methods for separating the fibre.

With a few observations on the proportions of the different parts of the crop obtainable per acre, and the probable profits of the culture, we may proceed to apply the information which we have collected to India, and ascertain what are the prospects of success in the different parts of that wide-spread territory.

## PROFITS OF THE CULTURE OF FLAX IN GREAT BRITAIN.

Mr. Nichols gives an estimate of the value to the grower of an acre of Flax; observing that, "although any such estimate must at best be uncertain, depending as it does upon variable contingencies, it may nevertheless not be without its use in this place.

"The produce of Flax per acre, under a good system of cultivation, is generally found to be from 40 to 50 stone—although 60 stone is not unfrequently obtained; and this quantity has, in several instances, been grown in Norfolk within the last few years. Forty stone per acre may, therefore, I think, be assumed as a safe average. The price for Flax of average quality may fairly be taken at 7*s.* 6*d.* per stone of 14 lb.; but that of the finer qualities is much higher. The general yield of seed per acre is from 16 to 24 bushels, but it sometimes rises to 30 bushels—and 20 bushels may, therefore, be taken as a moderate average. The price of Linseed varies from 8*s.* to 10*s.* per bushel for the finest sorts for sowing, to 6*s.* and 7*s.* for the common kind, such as is used for crushing and cattle feeding; 7*s.* per bushel may, therefore, be assumed as a fair average. Against these estimations must be placed the rent of the land, and the charge of cultivation and preparing the fibre for market. The amount for an acre of Flax will then stand as follows:

	£	s.	d.		£	s.	d.
Rent, rates, and taxes . . .	1	10	0	40 stone of flax, at 7 <i>s.</i> 6 <i>d.</i> . . .	15	0	0
2½ bushels of seed, at 9 <i>s.</i> . . .	1	2	6	20 bushels of seed, at 7 <i>s.</i> . . .	7	0	0
Tillage . . . . .	1	0	0	Chaff, refuse, flax, and tow . . .	10	0	
Pulling, steeping, &c. . . . .	1	10	0				
Beetling 20 bushels of seed, at 1 <i>s.</i> , and re-tying the flax . . .	1	0	0		22	10	0
Breaking and scutching 40 st., at 2 <i>s.</i> per stone . . . . .	4	0	0	Deduct outlay . . . . .	10	2	6
				Leaving a balance in favour of the grower, of . . . . .	£12	7	6
	£10	2	6				

"Making every allowance," Mr. Nichols concludes, "for unfavorable seasons, and the other contingencies to which Flax growing, in common with all other agricultural operations, is subject, a profit of £10 or £12 per acre may, I think, be

reasonably expected by the grower of Flax, provided he attends properly to the business, and makes the most of the fibre and the seed."

Mr. Nichols, however, refers also to an account published by Mr. S. Druce, of Ensham, near Oxford, who gives £8 as the rate of profit. But, as Mr. Nichols observes, he only obtained 23 stone per acre; and his Flax was evidently of inferior quality, as it sold for only about 5s. per stone.

According to some accounts, about 800 lb. per acre is sometimes obtained in Great Britain. In the United States, 400 lb. of good clear Flax, and 8 or 10 bushels of seed, are considered a medium crop.

Mr. M'Adam has given two estimates: No. 1 being for an acre, sown thinly, with a view to having a large produce of seed, which necessitates a coarser description of fibre; and No. 2 being sown more thickly, producing less seed, but a finer fibre. The expenses of the culture and preparation of both are about £9. The first (No. 1) is expected to yield 38 stone of Flax (16 lb. each), at 6s. 6d.; 18 bushels of seed, at 6s. 6d.; and 50 bushels of husks, at 4d.; yielding a profit of £10. No. 2 is expected to yield 30 stone of Flax, at 9s. 6d.; 10 bushels of seed, at 6s. 6d.; husks, 8s.; yielding a profit of £8 14s. 6d.: but the value of the Flax may reach as high as 15s., or even 20s. Mr. M'Adam observes that "the profits are usually pretty equal, whether the Flax be grown primarily for seed or for fibre; the greater produce in the first case of seed, and the higher value of the dressed Flax in the second, maintain a just equilibrium."

#### REPORT ON THE CULTURE OF FLAX IN INDIA.

"India having, at least, for centuries grown the Flax plant, on account of the oil yielded by its seeds (Linseed), the country has very naturally been looked to as a source of Flax fibre; the supply of which is so greatly diminished by the war with Russia.<sup>1</sup> The Belfast Chamber observe, that "as India annually exports nearly 100,000 quarters of seed to Great Britain and Ireland, it has been calculated that the plants

<sup>1</sup> The following formed the substance of a Report prepared by the Author, in August, 1854, and is printed nearly as it was written.

which produced this quantity of seed would yield, annually, at least 12,000 tons of fibre—value, say £500,000; all of which now goes to waste.” Besides the above quantity of seed, much is also exported to North America and to other countries, and much is consumed in the country in the form of oil, while the cake is in some places employed in feeding their cattle. There can be no doubt, therefore, that the question is one of considerable importance, not only to this country, which requires such immense quantities of Flax fibre, but to India, which produces such enormous heaps of seeds, and is supposed to waste so much of valuable exportable material. But it does not follow that the production of fibre is in proportion to that of seed. Indeed, we have often to check vegetation, in order to favour the production of flowers and fruit; while an undue growth of the parts of vegetation, that is, of the stem, branches, and leaves, is often obtained at the expense of the parts of fructification.

The subject, however, has not escaped notice.

The earliest attempt to produce Flax in India seems to have been made by Dr. Roxburgh about the beginning of this century, as at that time, the East India Company having established a Hemp farm in the neighbourhood of Calcutta, he made many experiments on the substitutes for Hemp and Flax. He also cultivated Hemp and Flax in the Company's farm at Reshera, in the neighbourhood of Calcutta.

Of Flax, he says, it is very generally cultivated during the cold season in the interior parts of Bengal and Behar. “Samples of the Flax have frequently been procured by the Board of Trade, and sent to England to the Honorable Court of Directors, so that it is from home we may expect to learn its properties. If the Flax has been found good, large quantities may be reared at a small expense, as the seed alone which the crop yields must be more than equal to the charges to render it profitable to the farmer.” (‘Obs. on Subs. for Hemp and Flax,’ p. 17.)

The Author, as long since as the year 1834, stated in his ‘Illustrations of Himalayan Botany:’ “In India the Flax is cultivated only on account of its seed, of which the mucilage is valued as a demulcent in medicine, and the oil in the arts; but the plant, which in other countries is most valued, is there



thrown away; and others, such as *Hibiscus cannabinus* and *Crotolaria juncea*, are cultivated almost in the same field, for the very products which this would yield. It seems, therefore, worthy of experiment whether a valuable product might not be added to the agriculturist's profits, without much additional expense."

And again, in the year 1840, the Author called attention to this subject, in his 'Essay on the Productive Resources of India.'

In the year 1839, moreover, a Company was established, by the influence of Mr. A. Rogers, at one time one of the Sheriffs of London, expressly for the growth of Flax in India. Money was subscribed; a Belgian cultivator and a Belgian preparer of Flax were sent out to Bengal, with both Riga and Dutch seed, and all the tools which are employed in the culture and preparation of Flax in Europe. A pamphlet, moreover, was published, in which full directions were given for the culture and preparation of Flax, and illustrated with figures of the various tools employed for this purpose. The subject was warmly taken up by the Agricultural Society of India, and a small committee appointed of members who took a special interest in the subject.

The directions of the Irish Flax Society were printed in their 'Proceedings,' as well as those of Mr. Andrews from the 'Northern Whig.' Translations of plain directions were made into the vernacular languages, which, as well as models of the tools, were distributed. The Gold Medal of the Society was offered for the production of a large quantity of Flax, and smaller prizes for the natives. Experiments were made by several members of the Society, in different parts of the Bengal Presidency, as well as by the Belgian Farmers.

Specimens of the Flax produced having been sent to Calcutta, comparisons were instituted between the samples produced by different individuals, and those from European and from indigenous seed. Mr. Deneef, the Belgian farmer, pronounced the samples worth from £44 to £60 a ton; and some that was produced from country seed and heckled, was thought worth £66 a ton. Some of the specimens sent to Liverpool, were valued at from £30 to £45; and those which were forwarded to me by the Secretary of the Agricultural Society, were pronounced

by Mr. Hutchinson, of Mark Lane, to be worth from £40 to £45 a ton. The experiments were made chiefly near Burdwan, Monghyr, and Shahabad ; but the best native seed was obtained from the northern station of Saharunpore, and a white Linseed from the Saugur and Nerbuddah territories. A little Flax was also produced by Mr. Williams, at Jubbulpore, under the direction of Mr. Macleod.

Mr. Leyburn gave as the result of his experiments near Shahabad, that the expenses of culture of a bigah of land, and the preparation of the fibre, amounted to Rs. 25 la. 3p.; and the profits to Rs. 27 la. 5p., supposing the four maunds of Flax produced to be worth £35 a ton.

In consequence of a communication which had been received from the Honorable Court of Directors, Sir T. H. Maddock, at that time Secretary to the Government of India, addressed a letter to the Agricultural-Horticultural Society. In this the Society was requested, in order to assist the Government in determining on the measures proper to be adopted for improving the cultivation of Flax, to supply such accurate, detailed information as they may possess, or as they may be able to obtain.

The Society accordingly prepared a report which contained everything that was known at that time on the subject of the cultivation of Flax in India. This was forwarded to the Government, and also published in their 'Proceedings' for Nov., 1841. In this report, the Society took a very favorable view of the probabilities of the profitable culture of Flax in India.

The Revenue Secretary to the Indian Government, on this, wrote (November 22d, 1841) to the Agricultural Society, that—  
“The cultivation of Flax can no longer be considered a doubtful experiment, since it appears from your report to have proved in many instances successful ; and where successful, to be very fairly profitable. His Lordship in Council is therefore much inclined to doubt whether any bounty or reward from Government is necessary, or would be justifiable.”

Notwithstanding this favorable inference, the Flax Company did not go on with the cultivation ; the various individuals who had taken up the culture did not proceed with their experiments, the several medals offered by the Agricultural Society seem

never to have been claimed, and there are no appearances of the culture of Flax on account of its fibre in any of the places where the experiments were made. It is probable, therefore, that the success which appeared sufficient when the experiment was of the nature of garden culture, was not realised when on a greater scale.

M. de Verinne, indeed, states that the experiment in the season of 1840-41 was a complete failure at Bullea, owing to too little seed having been sown, to the unusually dry weather at the late sowings, and to the improper time (the hot winds) in which the Flax was cleaned.

Mr. Wallace, who had carried on the cultivation for three or four years at Monghyr, writes on the 8th July, 1841: "The crop has been in a great measure a failure this year. About one eighth the produce that a favorable season would yield." But in the year 1844, he again forwarded samples to the Agricultural Society, which were improved in cleanness and were also softer than the produce of former years, from the same cultivation. These were portions of several tons that had been grown at Monghyr, and which he intended shipping to Dundee, the port to which his last batch was sent. But Mr. Wallace added, with regret, that after several years' labour, with a view to establish Flax cultivation at Monghyr, and after having taught the art of dressing the article to many parties, the speculation must be abandoned unless the Government gave some encouragement. He therefore requested the assistance of the Society in bringing the subject to the notice of the authorities. It is stated at a subsequent meeting, that the Committee of the Society, after being furnished with further details respecting the cultivation, did not feel inclined to refer the subject to the Government. But neither the details referred to, nor the reasons of the Committee for their decision are given, and, therefore, we are unable to ascertain the real causes of failure after several years' trial.

Mr. Henley, an intelligent merchant from Calcutta, to whose observations I have already referred at p. 36, having made some careful experiments on the culture of Flax, has favoured me with the following account:

"I have paid much attention to the fibres during my residence near Calcutta, and, not wishing to conclude from hearsay only, generally cultivated most things myself, having a large piece of ground available. I sent up to Baulpore (an excellent *Flax seed* district), and obtained a considerable quantity of native-grown Flax straw, after the removal of the seed. I had it collected from various fields, so as to obtain an average. This material was in every instance too *bushy* for the proper production of fibre, and the yield was very trifling, and in fact worthless for manufacturing purposes. The bushiness arose from the practice of the natives, who grow several plants, as you are aware, at once, in the same field. The Flax plants were consequently planted too far apart for fibre-yielding purposes.

Not yet fully satisfied on the question, I took a patch of land (three cottahs), the best I could pick out, fine, friable loam, fit for anything—it had been a cauliflower bed, and was therefore deeply spade-cultivated and highly manured—its last crop, cauliflowers, having nothing prejudicial to a Flax crop. I began very early in the season, had it turned up and laid for a fallow; two months after, again pulverized and weeded; and again—four times in all; with the addition of a large supply of fine old cow-dung. I had it now sown in the proper season, with the best Flax seed, very thickly planted, so as to draw it up as free as possible from lateral branches. Everything promised well. The field grew beautifully, and soon attained a height of three feet. I began to collect the crop, first, as soon as the flower had completed its growth and the seed-vessels began to form; secondly, as soon as the seed-vessels had fully formed, and were filled with green, but immature seeds; and lastly, after the seed was fully ripe. I took great pains in water-retting the samples—generally removing them from the water rather underdone, for fear of occasioning weakness in the fibre from over-retting.

In every instance, the quantity of fibre was small and weak, and very inferior to the samples of Flax deposited at the Agricultural Society's Museum, obtained from Jubbulpore, and other upper-country districts. No Indian Flax, however, which I have seen, equals in nerve and general good qualities those of European growths."

As the above is no doubt a correct account of what occurs with the Flax plant in the moist climate of Bengal, of which the effects may perhaps have been aggravated by too great richness of soil; it might be inferred, that a different result would take place in the drier climate of the upper or North-West provinces of India. This is certainly the case, but though the product is different, it is not, from the shortness and brittle nature of the fibre, more suitable for the ordinary purposes of Flax.

Mr. Hamilton, of Mirzapore, one of the up-country stations alluded to, "sent some bales of the stalks to Calcutta, for the inspection of the Belgians, and was told that the shortness of the stalks would prevent their manipulation."

It is evident, therefore, that there is some difficulty in producing good Flax in India. This difficulty is, no doubt, the climate; while the native methods of culture are the most un-

suitable to the production of good fibre. Mr. M'Adam, Secretary to the Royal Flax Improvement Society, has, in his Prize Essay on 'The Cultivation of Flax,' well observed "that a slow, steady growth is requisite for the quality and yield of fibre; also a temperate climate, that between the parallels of 48° and 55° being the best; and a continued supply of moisture from spring till autumn." He also observes that "the hot summers of Russia and of Egypt cause a dryness and brittleness of fibre, and prevent its retaining that elasticity, pliancy, and oiliness which characterise the Flaxes of Belgium, Holland, and Ireland."

But considered generally, it is not to be expected that a plant which attains perfection in Belgium, and is so successfully cultivated in the vicinity of Belfast, would succeed well in the hot and moist, but sometimes dry climate of Bengal. In fact, if the Flax was not one of those plants which, like the cereal grains and pulses, can be grown in the cold-weather months of India, it could not be cultivated there at all. But with this culture, we have the anomaly, of the seeds being sown in autumn,<sup>1</sup> when the climate is still hot and the ground moist, and the plant has to grow while the temperature is daily becoming lower and the soil drier—no irrigation being usually employed with these winter crops, though dew begins to fall as soon as the ground becomes cooled at night. In some places, the crop attains perfection in about ninety days, is collected in January, the coldest month; in others, not until February or March, when the rapid rise of temperature is favorable to the ripening of seeds, but not to the production of fibre.

Of all parts of India there are none that appear to me better suited to the growth of Flax than the Saugur and Nerbuddah territories, as the soil is rich and prolific, and the climate a medium between the extreme moisture of Bengal and the dryness of the North-West provinces. The Wheat of this district is considered superior to any seen in the English market, with the exception of what comes from Australia. The Gram (*Cicer arietinum*) and the Linseed are also of finer quality than any produced elsewhere in India; while the suitability of the climate for the production of good fibre is proved by the length

<sup>1</sup> In Egypt, also, the seeds are sown about the middle of November, in the plains which have been inundated by the Nile, and plucked in about 110 days.

and strength of the Jubbulpore Hemp, as grown by Mr. Williams; as well as by the specimens of Flax which he has likewise grown.

The Indian method of culture is certainly not suited to the production of fibre, but the seeds abound in oil. "The yield of oil from a bushel of Indian seed is from  $14\frac{3}{4}$  lb. to 16 lb.; of English or Irish,  $10\frac{3}{4}$  lb. to 12 lb." Therefore, it is evident that the Indian ryot succeeds in his object, as well as the Irish farmer, who grows the Flax plant for its fibre, but neglects to gather the seed: though this is not only a saleable product, but one which abounds in nutritious matter for his cattle, and would further afford the means of fertilising his fields. As it has been found difficult to persuade the Irish farmer to gather the double crop, I believe it would be hopeless to induce the Indian ryot to change a culture which is suitable for his purposes, without the aid of successful example in his neighbourhood. You might make him grow less seed, but I much doubt whether we should get him to produce any useful fibre; and without his co-operation it would be impossible to attain any considerable success. Indeed, the Agricultural Society of India have given it as their opinion, in one of their resolutions,—"That the culture and preparation of Flax in India, so as to be able to compete with the Flax of Belgium or Russia, can only be effected by practical European growers instructing native cultivators in the art; and, further, that an entire change in the mode of cultivation, as well as in the preparation of the plant, is necessary to produce the article in a proper state."

It has, indeed, been made a question, whether a good supply of fibre and of seed can be procured from the same crops. One gentleman, in reply to my inquiry, informed me (London, 4th July) that "it has been found impossible to preserve both seed and fibre, *i.e.*, for the better qualities of each; and that the plan pursued is simply to gather before the seed ripens, when the delicacy and softness of fibre form the desideratum, but to leave the plant standing until the fibre is dried and greatly injured, in order to secure the superior seed fit for sowing;" and this is the result of information collected after a residence of many years in the interior of Russia. Another gentleman replies to the same inquiry, from Belfast, on the 8th July: "It is not only quite practicable to have good seed and

good fibre at the same time, but it is the universal rule in all countries except Ireland, where we have only been able to get the more intelligent farmer to abandon the wasteful practice of steeping the Flax stems without removing the seed. The finest Flax in the world is grown in Belgium, yet the seed is saved from it."

But as there is no doubt, from the experiments of the Indian Flax Company, and from other more recent facts, such as the production of Flax as far south as on the Shevaroy Hills, at Jubbulpore, and near Lahore, that Flax can be produced in India, it seems desirable to ascertain whether it cannot, by careful culture and improved processes, be produced as a profitable crop in some parts of the country; because, as I have before said, "I cannot think that that which is done successfully in Egypt, is impossible in every part of India;" and there can be little doubt that, in some places, at least, coarse Flax could be produced, as well as some for the paper-makers.

I am informed that the Messrs. Hamilton, of Mirzapore, propose, this year, attempting the culture of Flax, in the tract of land of which they have a grant, in the Goruckpore district, and which I should consider a more favorable locality than any near Mirzapore. I would suggest, that Mr. Williams, at Jubbulpore, should be requested to make an experiment, to ascertain the quality of the Flax which may be produced in that locality, as well as the quantity obtainable per begah or acre; attempting at the same time to preserve the seed. Mr. Williams has already grown a little Flax, he is accustomed to the preparation of fibre, and the soil and climate are both, I conceive, more favorable than in most parts of India.

I would also recommend that Dr. Jameson, the Superintendent of the Botanic Garden at Saharunpore, should be directed to make a small experiment, both in the plains and in the hills, in order to ascertain the same kind of facts respecting the Flax plant when grown according to European methods for the sake of the fibre. The Agricultural Society of the Punjab are already attempting the culture, as the Secretary has addressed a letter to the Court, requesting an opinion respecting the quality of the Flax which they have already produced; but the specimens have not yet arrived. (Further information has, however, recently been received, and will be afterwards detailed.)

Though I am well aware that Government experiments are not likely to prove profitable where those undertaken by individuals have failed, especially as these had good scientific and practical advice, I am yet sanguine in thinking that experiments conducted in the localities I have indicated, would give information which would be practically of great value for extensive tracts of country. The people are acquainted with the culture and preparation of *Sunn* fibre, and might easily be instructed by the European gentlemen to whom I have alluded, in applying the instructions for the culture of Flax in the 'Proceedings of the Agricultural Society of India' for the years 1840 and 1841, including those prepared by M. Deneef, the Belgian farmer, after practical experience in India, published first in 1840, and then in 1842.

I have not thought it necessary to refer to the opinions respecting the exhausting nature of Flax as a crop. By the methods of steeping the stalks in steam and hot water, it has been ascertained that the time required for the separation of fibre can be very greatly reduced; while the steep-water, where no fermentation has taken place, has been proved to be useful as manure water for the soil. Feeding cattle, moreover, upon a portion of the seed, produces manure which is invaluable in restoring much of what has been taken from the soil. But as these methods are not applicable to the present state of the culture in India, I will only allude to the probability of some of the mechanical methods of separating the fibre from the green flax, as very likely to be of useful application."

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Since, according to some accounts, considerable success attended the experimental culture of Flax in India, while others considered it a failure, it is desirable to ascertain the causes of this discrepancy, and to draw some conclusions which may be of use to other parts of India, if not to the places where the experiments were made. This we may probably effect, by analysing the statements of the different experimentalists.

#### *Shahabad Experiments.*

The cultivation of Flax in India in recent times seems to have begun at Shahabad, in 25° of north latitude, in the year 1837. In the 'Proc. of the Agri.-Hortic. Society,' there is a communication from Mr. G. Leyburn, of



Nunnoa Factory, giving an account of the sale in London, on 17th July, 1838, of some Flax grown by him. "The Flax, per Windsor, is landed round. No. 1 sold for £28 per ton, and No. 2 for £14 per ton—nine months' credit. They are described as harsh, and without the softness characteristic of Russian Flax. Prices of the latter being lower than usual, P. T. R. selling here at this time at £40 per ton."

Mr. Leyburn states that he prepared his first sample of Flax in the common way, from plants which had borne seed. He sent them to Messrs. Truman and Cook, who reported that any quantity of a similar article would find a ready sale, at £35 a ton. In the following year, Mr. Leyburn entered on the cultivation rather extensively, and succeeded in producing an article of lengthened staple, and of a quality vying with the Flax of Russia. A portion of the cultivation was carried on in the bed of the Soane River, and part in the uplands of the district: some of it was prepared before the seeds were ripe. He calculates the probable profits of the culture to be:

PER BEGAH : <sup>1</sup>			<i>Produce.</i>						
	Rs.	A. P.		Rs.	A. P.				
Rent of land . . . . .	1	8	0	Linseed, 5½ mds. . . . .	5	8	0		
Ploughing . . . . .			8	0	Flax, 4 mds., at (say) £35 per				
Seed . . . . .	1	8	0	ton . . . . .	46	10	8		
Pulling, beating seed off,									
watering . . . . .	5	9	3				52	2	8
Packing, cartage, preparation				Deduct expense of cultivation,					
(nearly all hand-labour) .	16	0	0	as per contra . . . . .	25	1	3		
	Rs. 25	1	3	Profit on one begah of land .	27	1	5		

With a factory in full play and effective machinery, Mr. Leyburn considers that the manufacturing price of the article would be three to four rupees a maund, which is equal to about £9 or £12 a ton. But to give effect to the production of this article, the aid of European enterprise is necessary. (It is particularly deserving the attention of indigo-planters). He failed in overcoming the deep-rooted prejudices of the native cultivators, and could not induce them to enter on a cultivation which held out to them a prospect of more than ordinary profit for their labour.<sup>2</sup>

#### *Experiments of the Flax Society.*

We may now proceed to notice the efforts of the London Flax Experimental Society. Mr. Woollaston, in presenting, on their behalf, some specimens of Flax grown in Bengal, and prepared in Calcutta, observed that—

"The object of the Society is not at this time to produce a large quantity, but to ascertain how good a quality can be readily obtained, the growth of India, and such as shall readily compete with the Russian and Belgian Flax in the Home market. This object has been already attained to a con-

<sup>1</sup> The begah of land in Shahabad is something more than the Bengal begah, which is 1600 square yards, or the third of an English acre.

<sup>2</sup> M. Bonnevie, indigo-planter at Rungpore, writes: "Having great difficulty to prevail on these ignorant cultivators to plant it—owing to a superstitious belief that the vengeance of an evil spirit will befall them for introducing the cultivation of a new article. Flax grows remarkably well here, and I have no doubt would succeed well in this district. The Zemindars now commence to show an inclination to improve agriculture in general."

siderable extent. These samples far surpass the Russian Flax," and he regretted that "the Government of India have not responded to the recommendation of the Horticultural Society in granting a bonus to the Experimental Society of 10,000 rupees, to further its objects."

"The seed received from England, Mr. Woollaston further remarks, has been distributed freely to all applicants who were desirous of trying the cultivation. The models of implements were sent out from Belgium, and facsimiles made for any person requiring them at the *bonâ fide* cost of the materials. Private profit or gain has never been allowed to interfere. Every kind of information, as far as possessed, has been freely imparted to all inquirers, and every endeavour made to excite an interest in the experiment.

"Its importance in a national point of view is incalculable. Both as developing the resources of India, in enabling England to supply herself from her own possessions in a most important raw material, and in no longer making her dependent, for what may well be considered necessities, upon a foreign and rival power. These observations, Mr. Woollaston considers, will apply in a great measure to Hemp also, in the cultivation and manufacture of which, the Experimental Society are deeply interested. The successful introduction of these two staples into England, from this country, will not only prove a blessing of the largest degree to *India* generally, but be a severer blow to Russian aggrandisement and encroachment than the destruction of her fleets, or the annihilation of her armies."

The Agri.-Horticultural Society having recommended that the bonus of 10,000 rupees should be given for the furtherance of the objects of the Flax Society, Lord Auckland, who was at that time Governor-General of India and was as warmly interested as any one in the improvement of its resources, was also a political economist: the Secretary to Government was directed to reply:

"His Lordship cannot but regard with interest the public-spirited proceedings of the gentlemen who have come forward to promote the improvement of the cultivation of Flax in India, but it is only in very rare instances, and with the view of exciting a direct and general competition, that he would attempt by encouragement or bounty to influence the course of commercial and agricultural enterprise, and he does not feel that the case before him is one which would justify the special interference of the Government.

"*Fort William, July 29, 1840.*"

Mr. Deneef, the Belgian farmer, and Mr. Bernard, the preparer of Flax who had been sent to India by the Society, were of great use in examining the soil and giving directions on the mode of culture best adapted to the country, as well as in reporting on the different samples of Flax which were grown in the country. Mr. Deneef's directions for the cultivation of Flax, drawn up after he had had practical experience in the country, remain as a valuable document for the guidance of others. These we, therefore, reprint from the 'Journal of the Agri-Horticultural Society' for the year 1842, p. 393.

PRACTICAL INFORMATION ON THE BEST MODE OF CULTIVATING  
FLAX IN BENGAL. BY MR. DENEËF, BELGIAN FARMER.

"In accordance with my promise, I send you as follows, a detailed report of my observations since my arrival in India, on the cultivation of the Flax plant.

I will not enter on an explanation of the mode adopted in the cultivation of this plant in Europe, because nothing is easier than to do so theoretically, but will content myself with informing you, from my own practical experiments, of the means at our disposal in this country, which can readily be made available for the production of Flax and its seed.

1. Such portions of land as are annually renewed by the overflowing of the Ganges, or which are fresh and rich, are the best adapted for the cultivation of Flax.

2. After the earth has been turned up twice or thrice with the Indian plough, it must be rolled; because without the aid of the roller the large clods cannot be reduced, and the land rendered fine enough to receive the seed. The employment of the roller, both before and after sowing, hardens the surface of the earth, by which the moisture of the soil is better preserved, and more sheltered from the heat of the sun. About and near Calcutta, where manure can be obtained in great abundance for the trouble of collecting it, Flax may be produced of as good a quality as in any part of Europe. Manure is the mainspring of cultivation. It would certainly be the better, if the earth be well manured, to sow first of all, either *Sunn* (Indian Hemp), or Hemp, or Rice, or any other rainy-season crop; and when this has been reaped, then to sow the Flax. The tillage of the land, by means of the spade (*kodalee*) used by the natives (a method which is far preferable to the labour of the plough), with a little manure and watering at proper seasons, will yield double the produce obtainable from land tilled without manure and irrigation.

The mode of forming beds of six feet in width with intervening furrows, in use in Zealand and in Belgium, is very inconvenient in India, because great care must be taken to preserve the moisture of the soil; and on the other part, for the purpose of weeding, they are unnecessary. When proper Linseed, freed from mustard seed is sown, I think that the Flax requires no weeding at all in India.

3. The proper time to sow the Flax in India is from the beginning of October until the 20th of November, according to the state of the soil. The culture must be performed, if possible, some time before the sowing. The Flax which I have sown in November, was generally much finer and much longer than that sown in the former month, which I attributed to the greater fall of dew during the time it was growing. The quantity of country seed required to the Bengal *beega* is twenty *seers*, but only fifteen *seers* of the foreign seed, because it is much smaller and produces larger stalks. The latter should be preferred; it is not only more productive in Flax, but, owing to the tenderness of its stalks, it can be dressed much more easily.

4. The Flax must be pulled up by the roots before it is ripe, and while the outer bark is in a state of fusibility. This is easily known, by the lower part of the stalks becoming yellow; the fusion or disappearing of the outer bark is effected during the steeping, which may be fixed, according to the temperature; say, in December at six days, in January five, in February four days, and less time during the hot season. The steeping is made a day after the pulling, when the seed is separated, and then the stalks are loosely

bound in small sheaves, in the same way as the *Sunn*. The Indians understand this business very well, but in taking the flax out of the water it should be handled softly and with great care, on account of the tenderness of its fibres. When it is newly taken out, it should be left on the side of the steeping pit for four hours, or until the draining of its water has ceased. It is then spread out with the root-ends even, turned once, and when dry it is fit for dressing or to be stapled.

5. To save the seed, the capsules, after they are separated from the stalks, should be put in heaps to ferment from twenty-four to thirty hours, and then dried slowly in the sun to acquire their ripeness.

6. When Flax is cultivated for the seed alone, the country Flax should be preferred. Six *seers* per *bega* are sufficient for the sowing. It should be sown very early in October, and taken up a little before perfect ripeness, by its roots, separately, when it is mixed with mustard seed; the Flax seed being intended for the purpose of drying oil, is greatly injured by being mixed with mustard seed, by which mixture its drying qualities are much deteriorated. With regard to the dressing of the raw material, most of the coolies are now acquainted with the process, and I have not therefore alluded to it. Should you desire any further information on the subject, I am ready to afford it."

Mr. Deneef, in reply to some queries circulated by the Agricultural Society, observed that too dry or saline soils were injurious to the culture, but that his own had been a heavy clay soil; also, that the Bengal *begah* contained 14,400 square feet, or one third of an acre, and that he sowed of foreign seed, 28 lb.; of American, 36 lb.; but of plump Patna, or native seed, not less than 40 lb., on account of its larger size. That the foreign seed cost Rs. 8 a maund of 82 lb., while the native then cost Rs. 2 8.

The acclimated American seed he found to succeed well in India. But on a previous occasion (Feb. 10, 1841), he had observed of some samples grown at Entally, from acclimated English seed, from country seed, and some from Saharunpore seed, (from 30° of N. lat.,) that the sample from this last was very superior to the others. Of two samples from acclimated American seed, one grown in rather poor ground, the other in a rich soil—"The former," he observed, "is a most beautiful sample, containing great length of stalk with thinness; the other is of very little value, the goodness of the soil having caused the plant to become stunted and branchy."

Mr. Deneef further observed, that he obtained the longest and finest fibres in sowing from the 25th of October to the 15th of November: this he ascribes to the plant being covered every morning with a heavy dew; while that which he had sown in the beginning of October, in the same soil and the same seed, was much shorter in stalks, but much more productive in seed,—“the rain being very scarce from the first days of October until the end of December, in this part of India.” (But the ground is still hot, and the temperature high at this period.) The *begah* will yield 100 lb. of seed from foreign seed, and about 12 per cent. more from native seed.

He concludes with an approximate account of the cost (amounting to £32) of raising a ton of Flax from Foreign seed, well dressed, and which would be worth £50 in the English market; stating that 80 lb. of Flax for a *begah* of land is a very small product. “When we shall be able to have the seed from our own product, Rs. 60 on that article will be saved.” The account is as follows:

30 begahs' rent for six months—the other six months for other crops	Rs. 45
10 maunds of American or European seed, at Rs. 8	. 80
6 begahs of superior (spade) cultivation, at Rs. 5	. 30
24 begahs, four necessary ploughings, each Rs. 3	. 72
Sowing, malees, recolt, rippling, steeping, carrying, and petty expenses	48
28 maunds dressing, in a very clean way, at Rs. 3 8	. 98
Breaking of flax-tools	. 7
	Rs. 380

*Return* :—1 maund Flax.

19 to 20 maunds Seed.

7 to 9 Codilla.

*Chittagong Flax*.—One of the most southern districts in the Bengal Presidency, where Flax has been prepared, is that of Chittagong. A. Sconce, Esq., at that time Collector of Chittagong, forwarded, in March, 1843, some samples of Flax which he had grown there from acclimated Europe seed; that is, from seed re-produced for two or three years from imported seed, and sown there in the month of November. He suggested to the Society the awarding of small prizes to natives who cultivated the Flax on account of its fibre. His object being “to interest chiefly those who are familiar with the cultivation of Linseed (which is common enough for the purpose of extracting oil) and the country *Sunn*.” He states that he had had an opportunity of observing in that season the very great difference between Flax grown from Europe and from country seed—the latter being softer and finer, but very much shorter, and very much weaker. If this is found to be the case by others, the length might probably be easily increased by cultivation. The samples examined by the Flax and Hemp Committee were reported on as follow :

*Undressed Flax*.—This sample contains more Tow than Flax; it is badly prepared, dirty, and not adapted for the Home market; but the

*Dressed Flax*—strong, clean, of very superior quality, but of short staple: if it were a little longer, say six inches, it would realise a very high price in the Home and Continental markets. Mr. Deneef said of it that the staple, though short, was most beautiful; but the mode of preparation (having been hackled) is “too expensive to admit of its yielding a profitable return, even were it to sell at the value I affix to it, viz., £60 a ton.”

*Burdwan Flax*.—Four samples of Flax grown at Burdwan were presented to the Agri-Horticultural Society, by Mr. J. Erskine, in July, 1844. Of these, Nos. 1, 3, and 4 were the produce of acclimated and up-country seed mixed together—sown in October and November, 1843, and reaped in February and March, 1844. No. 2 was the produce of up-country seed, sown on 15th October, and reaped on the 27th February. Mr. J. Law having examined these samples, considered them all as of a fair quality; and judging from the prices of the different marks of the article then in Britain, valued Nos. 1 and 2 at £32, No. 3 at £34, and No. 4 at £30 per ton, landed in England.

#### *Bullea Experiments.*

Mr. de Verinne, Superintendent of Flax cultivation at Bullea (twelve miles below Benares), in reply to the queries, states, as already mentioned, Sept. 20, 1841, that the experiment of the previous season had been a complete failure. He sowed 130 Duncane begahs, each containing 28,336 square feet, double of the Bengal begah. The soil was not manured, but ploughed seven and

eight times. Somewhat sandy soils are the best. The hard soil which the natives select for growing Flax for the seed remains in clods, and cannot be pulverized. He first sowed one maund of seed (from the Chupra district) per begah. Mr. Bernard, one of the Belgian farmers, thought this too much; he reduced it to 20 seers, or 40 lb., which proved too little (and evidently so, as the same quantity is recommended by Mr. Deneef for the Bengal begah, which is only half the size). He began sowing on the 16th of October, and concluded by the end of the month; the plant was ready for steeping on the 10th of February. He recommends sowing in the beginning of October, as there is moisture enough at the surface of the ground to sow broadcast. Early sowings, also, will in general do away with the necessity for irrigation, which is otherwise indispensable, and expensive. (But is not the greater heat both of the soil and of the sun more injurious than the greater dryness of the soil late in the season, when dew falls?) He states, that from the 10th of September till the 20th of January, when the Flax was in seed, and had ceased growing, there was no rain. About fifty begahs were sown with drill-ploughs, because there was no moisture at the surface of the ground, but as Mr. Bernard disapproved of this mode, the rest was sown broadcast, when they were obliged to irrigate the land.

The plants having been pulled by the 10th of February, and the seeds taken off, the stems were steeped in (indigo) vats. The first vat was steeped nine days; the second and third, ten days; and the fourth and fifth, eleven days, the weather having got cooler from the fall of a shower of rain. Range of thermometer, 60 to 70°. The plant for steeping was not perfectly ripe, but the small plants were left to ripen their seed.

The crop was small, owing to the unfavorable season. Only 1 maund 25 seers of seed, and 70 lb. of Flax per begah, while the Duncanee begah ought to yield from 150 to 200 lb. of clean Flax.<sup>1</sup> The proportion of Flax to the Tow or Codilla, varies according to the weather in which the Flax is cleaned; if prepared in the dry weather or hot winds, or from April to the end of June, the proportion is one third Flax to two thirds Tow; if prepared in damp weather, or from July to October, it is half to half. With regard to the cost, M. de Verinne says: "Supposing the season to be an average one, and the produce of the begah to be 150 lb. of clean Flax, 100 begahs would give 6 $\frac{3}{4}$  tons, and the cost, according to the annexed estimate, being Rs. 2237, will show the cost per ton, landed in Calcutta, to be Rs. 331, or £33. In making up the estimate, I have calculated the expenses according to those of the experiment of last year. Only the produce has been valued at 150 lb. per begah," though 70 lb. only were obtained.

<sup>1</sup> With these Indian returns of the produce per begah (which is at Bulea two thirds of an acre), we may contrast a statement by Dr. Hodges: "From the returns of the Royal Flax Society, and from my own inquiries, I would estimate the average produce of a statute acre in the North of Ireland of air-dried Flax straw, with bolls, at two tons, which, by the seeding machine, are usually reduced to 3360 lb. By the various processes of the rural manufacturer, the amount of dressed Flax or fibre obtained averages from four to five cwt. per acre."

Estimate of the probable expense for the cultivation of 100 begahs of plant, the manufacture, and the despatch of the produce to Calcutta.

Land rent for 100 begahs, at Rs. 4 3	Rs. 450 0 0
Irrigating the lands, if there is no moisture at the surface, at R. 1 per begah	100 0 0
Six ploughings, at 4 annas each per begah	150 0 0
Chikorage, or cleaning the fields before sowing, at 8 annas per begah	50 0 0
150 maunds of seed, at R.1 8 per maund	225 0 0
Plucking the plant, at R.1 per begah	100 0 0
Weeding, at 8 annas per begah	50 0 0
Taking off the seed, at R.1 per begah	100 0 0
Filling the vats, taking the plant out, spreading and turning it, &c., at 12 annas per begah	75 0 0
Breaking the Flax for cleaning, at R. 1 4 per begah	125 0 0
Cleaning the Flax, at 2 annas per pound	468 12 0
Gunny bags, for bales	20 0 0
Making up the bales	14 0 0
Boat-hire, at 8 annas per ton	50 0 0
Chaundar (person in charge of boat)	7 0 0
Carriage of the plant, at R. 1 per begah	100 0 0
Four Zilledars, for six months, to look over the cultivation, at Rs. 3 each per month	72 0 0
	<hr/>
	2156 12 0
Exchange, at Rs. 3 12 per cent.	80 14 0
	<hr/>
	Co.'s Rs. 2237 10 0

### *Monghyr Experiments.*

The culture of Flax was commenced near Monghyr, on the Ganges River, in the year 1839; and specimens were presented to the Agri-Horticultural Society, in May, 1840, and again in the month of September in the same year.

The strength of this Flax, as ascertained by Professor O'Shaughnessy, of the Medical College, Calcutta, was as follows, and as compared with other kinds tried at the same time.

Monghyr, undressed	40,000
Archangel	43,000
Baltic, dressed	42,033
Ditto, undressed	19,075
Irish, dressed	17,075

Mr. Deneef considered it the best sample of India-grown Flax that he had seen.

The sentiments of some of the members of the Flax Committee were as follow:

Mr. Hodgkinson.—The samples of Flax are of middling quality; the fibre fine and strong, but deficient in cleanness and colour. The first defect arises from carelessness in scutching.

Mr. Willis.—The Baltic *rough Flax*, which of all the specimens it is the most legitimate for us to compare with the Monghyr *undressed one*, is superior to it in colour, lustre, mellowness, and cleanliness.

The *Monghyr undressed Flax*, not having undergone the degree of

cleansing, and preparative manipulation which has been given to the *Baltic rough Flax*, being more ligneous, &c., is not exhibited with all the comparative advantage it otherwise would have shown.

The Monghyr *undressed* specimen seems to possess more *tow* in proportion than the rough Baltic one. Its length of fibre seems somewhat inferior to that of the Baltic one. Its strength of fibre seems good. But after all it seems so promising a production that I think the parties engaged in the experiment would do best to send home a good supply of it to the various markets of London, Liverpool, and Scotland, that they may derive the opinion of merchants, brokers, and manufacturers as their most true and unerring guide.

Mr. Wallace again submitted, in August, 1841, two samples of Monghyr-grown Flax, to show the improvement on last year's produce. He stated that they were average samples of thirty-four bales (nearly four tons) which had just been shipped by the *Mary Bannatyne*, for London.

No. 1.—Grown from country seed on a strong black soil, which had been inundated by the river, and retained its moisture through the season. The seed was sown on or about 10th November, 1840. Twenty seers of clean seed to a begah (the begah is rather larger than that of Bengal); the plant was allowed to ripen fully, and the seed come to full maturity. This was all saved by rippling combs, which separate it easily from the stalk. The soil received very little preparation; it was drilled with one plough, another plough following in the same track in which the seed was sown. The plant was pulled about the 20th March, and steeped for three days. The breaking or crushing of the plant was done by machinery; the scutching by hand. A man could clean of this quality of plant five seers a day. The outturn per begah was 9 stone, such as the muster, and  $3\frac{1}{2}$  maunds of seed.

No. 2.—Grown from country seed on a light sandy soil, also inundated by the river; was sown about 8th October, with the same sort of seed; the land was well prepared, having had three or four ploughings; the seed was sown broadcast 25 seers per begah; it was allowed to ripen fully; it was pulled 28th February, and steeped  $4\frac{1}{2}$  days. The outturn of this was about  $1\frac{1}{2}$  stone per begah, and one maund of seed—no rain having fallen from the time of sowing, seven eighths of the crop was lost; the dressing of this was similar to the other. A man could not scutch more than  $2\frac{1}{2}$  to 3 seers per day.

Mr. Wallace, in his reply to the queries of the Society, states that the begah at Monghyr contains 3600 square yards—three fourths of an acre, and that the inundated land is to be preferred. Alluvial land will yield a crop if not too sandy, but that the higher land is preferable if rain fall two months after sowing; that dry soil produces a good plant, but of very coarse quality. He sows at the latter end of September for *seed* only, but from 15th October and all November for fibre, to the extent of 60 lb. to the begah if sown broadcast, and 40 lb. if sown in drills.

The American and Europe seed, he states, produce double the quantity of fibre, half the quantity of tow, and of a finer quality, but only half as much seed as the native. Of this the price in the district was from R. 1 4 to R. 1 8. That he reaps from the 25th of February to the 10th of May. That the average crop is about 9 stone, or 126 lb. per begah; and that sixteen of these are required to produce a ton of Fax; with of tow, first quality 36 lb., and second quality 14 lb. per begah; while there is an average crop of  $3\frac{1}{2}$  maunds of seed. The time of steeping varies from two to three days in the hot months, to four and five days in February, October, and November, and to seven and eight days, in the cold months of December and January; and that one day more is to be added for dry plants of the preceding season; and that the cost of Flax laid down in Calcutta, per ton of 20 cwt., is from £12 to £15, all expenses included.



These expenses consist of rent of land, R. 1 8 to Rs. 2 per begah. If the ryot uses his land in the other months, then four annas less than the above rates. Coolies obtainable at  $1\frac{1}{2}$  annas per day for rippling, steeping, or carrying to the factory; or one rupee for fourteen bundles of  $3\frac{1}{2}$  cubits in girth, tightly compressed. It is steeped in a vat, and taken out when the fibre will separate easily from the wood, and then dried in the sun. It is crushed by being passed under large iron rollers, and then placed on the edge of a board, where the fibre is separated from the wood by striking it with a wooden sword. The expense is Rs. 3 per bazar maund, and the conveyance to Calcutta, Rs. 20 per 100 maunds. Notwithstanding the small cost (£12 to £15) for a ton of Flax laid down at Calcutta, which was pronounced of good quality, and probably similar to the other Indian Flaxes, which were valued in England at various prices, varying from £35 to £45; also stating that the amount realised on the sale of the seed is calculated to have more than covered the expenses of cultivation, rippling, and steeping (Report in 'Agric. Soc. Proc.,' Nov., 1841, pp. 38 and 95): the speculation did not succeed. For we find in the 'Proceedings' of the same Society for February, 1844, pp. 45 and 165, Mr. Wallace, intimating, in reference to his operations for several years past with a view to establish the cultivation of Flax at Monghyr, that he was afraid, from the serious drawbacks he had experienced, that he should be compelled to abandon the speculation unless some encouragement was afforded by Government. The Society having referred all the papers and samples of Flax received from Mr. Wallace to their Hemp and Flax Committee for report, it is stated that one of the members was in favour of an appeal to Government, while the other three were opposed to such a step; but as neither the facts nor reasons for either side are given, we are unable to draw any other general conclusions.

The foregoing rather detailed account of the experiments culture, preparation, and cost of Flax grown in different parts of India, may appear to the reader to have occupied more attention than their importance entitles them to. But without going through this labour, it would be impossible to draw any satisfactory conclusions for the prosecution of any future experiments in the same or in other parts of the country, if such should be thought necessary. But it is first desirable to know what was thought of these fibres when sent to the markets of this country. This we are fortunately able to do, from some of the results having been published, and from some of the specimens having been sent to the India House.

A detailed report is given from Liverpool of the first samples grown, and of which a report had also been made by Mr. Deneef. But he generally rated them higher than they were valued in this country, though we are unable to distinguish exactly the respective specimens in the two reports.

The Secretary next submitted an extract of a letter which he had been favoured with by Mr. Hodgkinson on some samples of Flax (similar to those

so favorably reported on by the Flax Committee of the Society) forwarded by him to Liverpool. (v. 'Report' 1841, p. 41.)

The letter, which bears date January 30, 1841, is from Mr. Grey, and he says: "From what I can judge, and having shown them to a friend here who has probably as much through his hands as any other in Liverpool, a partner of William Jackson, Son, and Co.

"Mr. Murray seemed far from sanguine about them, but I trust they indicate the capability of producing an article of great importance and extent.

"1st. The best is a lot (country Flax, native seed, 26th May, 1840)—this may be worth £40 to £45 per ton here; it is finer, softer, and better than

"2d. The large parcel (country Flax, native seed, 27th May, 1840)—which has a fine broad fibre, and not much inferior; it is worth £40, if in quantity equal to sample.

"The lengths are too unequal, which makes it fall upon the backle, and is a disadvantage. Of these two samples the fibre is by no means weaker than of many other such Flaxes, and probably when this is the case it arises from the preparation.

"3d. (Bengal, May, prepared by Belgians.) Dew-ripening weakens, I understand, the fibre, hurts the colour, and even prevents its bleaching as it ought to do, and for which such Flax would be used. Where water is obtainable for steeping, this method should not be resorted to.

"4th. (Indian Flax, No. 1, grown in the neighbourhood of Calcutta, worth at least £30 per ton.) This is better, but seems, if I mistake not, also to be dew-ripened. It is worth £35 here, however.

"5th. These from imported seed don't seem equal to the produce of native.

"6th. The heckled Bengal Flax, does not show to advantage, being imperfectly dressed, and happens to be of a dry, hard nature.

"7th. (Country Flax, native seed, 26th May, 1840.) This mark is similar to the first, but you will distinguish it, being darker coloured and harsher.

"The first is the best, I think, decidedly. Weakness of fibre is an insuperable fault where it exists, and it may be perhaps avoided by better preparation. The Belgians' is very weak, and some of the others.

"TOWS. One of these (Bengal Tow, native seed, 30th May, 1840), seemingly the clearing or last tow, is a very good thing, worth in Dundee £30 to £33, I should say; the others from firmer tools before this, £20. Another of same mark as first worth perhaps £16. These are of great consumption, as recommended before to your attention. Codillas from £12 @ 16 20 per ton would do well, and could be obtained from the waste in preparing the better Flax, observing always that the staple be good and the fibres strong, though they need not be of great length by any means. In Flax the longer the better, though not required beyond moderation, but the fibres should be *equal* and uniform, so as all to split and yield as much dressed as possible. These Flaxes on the whole resemble most the common Newry Flax, which costs £40 @ 50 per ton, wanting the natural sap, in which all these are deficient.

"The quality I think will not be of the best for some time, but much that would sell largely in Dundee or even Belfast might be obtained; in Dundee every thing is used, down to the coarsest; but Flax worth £40 to £60 per ton is most saleable, and to the most certain and best buyers. The Codillas and Tows there seems no doubt of, and Flax to bring from £30 to £45 per ton also."

The next report we have is on the samples of Flax grown in the following year.

*Agricultural Society of India, 11th Aug., 1841.*

1.—Four specimens of country-grown Flax, prepared in Calcutta.—*Presented by Mr. H. Woollaston on behalf of the "London Flax Experimental Society."*

No. 1.—Is a sample of Flax of last year's growth, from English seed, *not acclimated*. Six hundred pounds of this quality, Mr. Woollaston mentions, were forwarded to London by the *Bucephalus*; and by the last mail Mr. Rogers advises that it was valued at £50 per ton.

No. 2.—Is a sample from *acclimated* English seed, grown in Entally. The seed was sown last November, and the plant gathered in February, having been in the ground 85 or 90 days.

Mr. Woollaston states that this sample is considered much *superior* to No. 1, and that Mr. Deneef attributes its superiority, to the seed being acclimated, which renders the separation of the under-bark much easier, and leaves the Flax finer and softer. Mr. Deneef estimates its value compared with No. 1 at £56 per ton.

No. 3.—Is a sample from the same seed and growth as No. 2—but consists of *picked* portions of plant, so as to furnish a specimen of the degree of fineness that it is possible to produce. This sample is superior even to No. 2, and nearly equal to the best produced in Belgium; much surpassing the Belgian ordinary qualities. Mr. Deneef estimates its value at £60 the ton.

No. 4.—Is a sample of Flax from *country* seed grown and prepared at Bowsing Factory, district of Burdwan; estimated in London at £40 to £45 the ton.

Some specimens of the Flax grown this year having been sent to the India House, and having, in March, 1841, been examined by Mr. Hutchinson, of Mark Lane, he thought them very favorable specimens of so recent an experiment, as they seemed to be equivalent to Russian and Polish Flax, which was selling at that time for £40 a ton; and one of the specimens appeared of a quality which might sell for £45 a ton in the then state of the market.

Mr. Enderby, then of the rope-manufactory at Greenwich, thought yarn made of it very good, and that nothing could prevent both the Flax and Yarn proving valuable articles of commerce, if sent in quantities, and of uniform and sorted qualities. Messrs. Noble have recently informed the Author that they also had received specimens, and thought them equal to the middling and even better qualities of Russian Flax. There seems no doubt, from the concurrence of opinion, that the Flax produced in India was sufficiently good to stand favorable comparison with both Russian and Egyptian Flax, and was, therefore, of the kind which is much required, and

which could be consumed here in the largest quantities. The question, therefore, is whether it can be produced at a cost so as to yield a profit to both planters and the merchants who would export from India to England.

## OBSERVATIONS ON EXPERIMENTS.

On reviewing the accounts and the results of these experiments, it appears that, though abandoned too soon in some situations, they were carried on for a sufficiently long period in others to allow of reliable deductions being drawn from them, if full information on all points had been supplied. The soil does not seem to have been complained of; but though drainage is essential in many parts of Europe, the power of irrigating will be found most useful in the East. The climate is obviously very different from what the plant meets with in Ireland, as not a drop of rain seems to fall from the time of sowing to that of reaping the crop; but heavy dews compensate for this deficiency during a part of the season. But as this dryness of climate prevails over a great part of India during the season of cultivation—that is, from the end of the rainy season to the beginning of the hot weather—it is evident that irrigation is necessary for such cultivation, and must not be too expensive. Perhaps the double monsoon of the Madras Presidency might in some localities afford a suitable climate, if the temperature is not too high. A perfectly appropriate climate may no doubt be obtained at different elevations on the Himalayas, and in some of the mountainous ranges of the South of India; but European superintendence may not be available and the expenses of transit be too great. The Saugur and Nerbuddah territories appear favorable, from their more moderate climate; while some of the districts of the North-West, of Sindh, and the Punjab, may be found suitable, from the command of irrigation and the prevalence of a moderate temperature.

The proportion of seed required having been ascertained by Mr. Deneef, we cannot but observe the unexpected results obtained from the sowing of some native seed—the Flax produced from Saharunpore seed having been considered to be of excellent quality, and, in Liverpool, to be the best of all the specimens sent. American seed was found to be suitable to the country;

but it is remarked that when sown in a rich, it did not do so well, as when sown in a poorer soil. The whole question of what is the best seed for the untried soils and climates of new countries is one of considerable difficulty. It does not follow that seed from a rich soil and the most careful cultivation is necessarily the best for transference to a poorer soil and drier climate; indeed, the converse would, in many cases, appear to be the more suitable course. But even in the case of Wheats, some from Australia and from the Nerbuddah, pronounced the finest in the English market, have never produced good crops in this country, notwithstanding the most careful attention. Indeed, the most advisable course appears to be to grow the best native seed, and as thickly sown as is found to be suitable, for the express purpose of changing the branching nature of the plant, and then making an exchange with the seed of other districts following the same course; in order to insure that interchange of seeds which is so beneficial for all kinds of crops, and is conspicuous in India in the indigo crops of Bengal being grown from the seeds of the North-West. In the directions for culture in Europe, we have seen that early sowing is necessary to produce good fibre, and late sowing for seed; but in India the reverse course is to be followed, for early sowing, in consequence of the high temperature, induces rapid but, from the dryness of the climate, stunted growth, with an abundant production of seed; while later in the autumn the temperature is lower, the growth is slower, but the dews being heavy, there is greater moisture, and this, with the slower growth, produces finer fibre. The early sowing is preferred by some, in order to save the expense of irrigation, but this must sometimes be with the sacrifice of the quality of fibre.

With respect to the cost at which Flax can be produced in India, we find Mr. Leyburn stating that he gets four maunds of Flax, or 328 lb., from about one third of an acre of land, at a cost of £2 10s., or for about £17 a ton; and that this sold for £28 a ton in London; but we do not find that he proceeded with the cultivation. Mr. Deneef calculated the cost of Flax produced by him to be £32 a ton, with a profit of £8, which would afterwards amount to £14. Mr. de Verinne calculated the cost would be £31 a ton, with an average crop; though he

did not get half the quantity. The cost of both is evidently too high, unless the finer qualities of Flax are produced. Mr. Wallace who continued the longest, and produced Flax at the cheapest rate—that is, from £12 to £15—ought to have succeeded, as he states that the expenses of cultivation were paid for by the seed. But we find him, as we have already stated, representing to the Agricultural Society that he should be unable to go on with the culture, from the discouragements he had met with, unless assisted by the Government. Though the difficulties are not specified, they must have been greater than appear from the published accounts, and therefore the facilities and the profit are not so great as they appeared to the Agri-Horticultural Society,—who thus unintentionally induced the Government of Lord Auckland to consider that public aid was not necessary.

It is very evident that such experiments can only be made under the superintendence of Europeans, when, if successful, they may be adopted by natives. In repeating the experiments in more favorable situations, it would seem very desirable at first to ascertain as accurately as possible the quantity of produce of ordinary quality obtainable per acre, with good cultivation in a favorable locality, on an average of years, and then to endeavour to improve the quality. The profits of the two kinds of cultivation and preparation are not very dissimilar (*v. p.* 163) in Europe. Though manufacturers may require more of the coarser qualities of Flax, planters will of course grow that for which they can get the best prices; though it will be safest at first to reckon only on getting the prices of Russian or Egyptian Flax.

We may proceed now to inquire where else Flax may be cultivated in India.

#### CULTURE IN SAUGUR AND NERBUDDAH TERRITORY.

The foregoing experiments were made almost entirely in the provinces of Bengal and Behar; but it has been mentioned that the central province of the Saugur and Nerbuddah territories seems well adapted for the culture of Flax, from the nature of the soil and climate. Here, indeed, some Flax has already been grown by Mr. Williams, of which I have been

favoured with a small specimen, and from whom we shall have further samples as well as information. This being the result of a first experiment, on a small scale, is not, perhaps, calculated to give a fair idea of what is practicable, particularly as we are without any information respecting the mode of culture, or the kind or quality of seed which was employed. But Mr. M'Leod, now Commissioner in the Punjab, mentions in one of his reports, that the growth is very luxuriant there. The Flax is comparatively short, light coloured, and rather dry, and more like Egyptian than any other kind of Flax.

It might be objected to the growth of Flax so far in the interior, that land-carriage for so great a distance would be an insuperable obstacle. But, as Mr. Williams finds it suit his purpose to send his now-famed Jubbulpore Hemp even to Calcutta, there seems no reason why Flax should not be equally able to bear the expenses of culture and of transit. In this direction, there is, moreover, an excellent road, described by the Cotton Committee of the Agri-Horticultural Society, 8th January, 1840. "From Jubbulpore to Mirzapore, on the banks of the Ganges, the great cotton-mart of the North-West provinces, a bridged and metalled road of 239 miles in length, equal to any in England, has been made by Government; at all the stations, the means of transport, and on the river, boats of every description, abound." This road is regularly kept up, and a toll levied at the base of the ghauts. The native princes have, however, without contributing to its expenses, diminished its utility by levying extra duties on the goods passing through their territories. (*v.* 'Journ. Agric. Soc.,' vol. viii, p. 115.<sup>1</sup>) There is a prospect, however, of these being remodelled. The most important consideration, nevertheless, is that of climate. According to the concurrent testimony of different observers, as reported in the Author's work, on 'The Culture and Commerce of Cotton in India,' p. 311, &c., deficiency of moisture is seldom complained of; and there will, probably, be seldom any excess in the season when the Flax would be cultivated—that is, in the cold-weather months. Hence the chief difficulty in India will be diminished, if not entirely escaped.

<sup>1</sup> See also a letter by Montague Gore, Esq., to the same effect, in 'The Times,' in the summer of 1853.

## CULTURE IN THE MADRAS PRESIDENCY.

Though not within the limits of the Bengal Presidency, we may here most appropriately mention that good Flax has been produced still further south, where elevation produces lowness of temperature accompanied with moisture of the atmosphere, as on the Shevaroy Hills and on the Neilgherries. Dr. Cleghorn, Secretary of the Agri-Horticultural Society of Madras, is well qualified to give the best advice on localities where experiments may most fitly be tried; and Professor Mayer is there, to give the benefit of his chemical investigation of the Flax plant and soil. Mr. M'Ivor, in charge of the Public Garden at Ootacamund, is well situated for making experiments on the growth of Flax in the cool and moist climate of the Neilgherries, if the culture should in other respects appear desirable.

Linseed has long been cultivated in the Madras Presidency, though not to any great extent. Dr. Ainslie mentions the seed under the name of *Aliverei*, and states that in the southern parts of the Peninsula, the Mootchie men and oil painters make use of Linseed oil. But we now find Linseed among the Exports: in the year 1850-51, there were exported 801 cwt. of Linseed from Fort St. George, nearly all to the United Kingdom.

## CULTURE IN BOMBAY PRESIDENCY.

In the Bombay Presidency, Linseed is also cultivated, as in all other parts of India, and has of late years been exported in considerable quantities. We observe that in the year 1850-51, 59,076 cwt., and in 1852-53, 162,015 cwt.= Rs. 486,046 in value, were imported into Bombay from the Concan; and that there were exported to the United Kingdom, in 1850-51, 50,102 cwt., valued at Rs. 170,112, and in 1852-53, 114,309 cwt.=Rs. 342,926 in value. We do not observe that any attempts have been made to grow Flax. It is probable that the low country along the coast may be too hot, and the country above the ghauts too dry; but of this those who are located in these parts can most correctly judge, if it should be thought desirable to make the attempt. Col. Sykes describes Linseed as generally cultivated in the Dukhun.



#### CULTURE IN BUNDLECUND AND IN THE DOAB OF INDIA. 189

The export of Linseed from Bombay is now estimated at an annual value of about four lacs of rupees, although five years ago it did not exceed one lac. This the Chamber of Commerce ascribes to the improvements on the Thulghaut road, and to the consequent reduced cost of conveyance in carts instead of on bullocks.

#### PROPOSED CULTURE IN BUNDLECUND.

An article has lately appeared in the 'Benares Recorder' (15th July, 1854), proposing the culture of Flax and of Hemp in Bundlecund; observing that "with less capital than what English merchants now expend in Russia, India can produce Flax which will not be inferior in fibre or colour to the Riga Flax. In Bundlecund the soil is almost free and unoccupied; and the land rent is also so low, that failure in the cultivation of either of these two products—Flax and Hemp—would be impossible. There are numerous hill streams with clear water, over the whole country, that would admirably serve the purpose of steeping." But the great uncertainty is the climate, which, like the parts of the Gangetic valley which have been alluded to, is very dry during the season of cultivation. But it is certainly worthy of inquiry, by those favorably situated for the purpose, whether, by irrigation, or by the aid of the dew which undoubtedly falls in the cold weather, this dryness might not be sufficiently obviated to allow of the production of good Flax.

#### CULTURE IN THE NORTHERN DOAB.

The most northern station from which any Flax was sent during the experiments of the Flax Society was Allygurh, in 27° and 28° of north latitude. Mr. J. Saunders, on the 26th July ('Proceedings,' p. 100) wrote that he had sent a sample of the Flax which he had grown on the banks of the Kote Nuddee. But he described it as prepared with very clumsy tools, and cost him about four rupees a maund for merely breaking; as to scutching, it has had none.

The finest seed was, however, obtained from Saharunpore, in 30° of north latitude—a locality with which the Author is well acquainted, but where no Flax is produced, and where the

soil and climate are dry during the cold-weather months and season of cultivation; that is, from October to March, with the exception of some rain at Christmas time, often called the *chota bursaut*. The district has, however, enjoyed the advantage of canal irrigation for more than twenty years, under the superintendence of Sir Proby Cautley, greatly to the benefit of the country and people. This would give great facilities for Flax cultivation, and would not be expensive.

The experimental culture which has been sanctioned to be made by Dr. Jameson in the Botanic Garden at Saharunpore, as well as in the Himalayas, will no doubt be carried on with his characteristic energy. The experiment will be useful from the information which it will undoubtedly afford for comparison with those which have been made in Bengal and Behar, as Saharunpore is situated near the north-western extremity of the Gangetic valley, and the temperature is such that there is every prospect of the plant being slow in growth, and that, with the aid of canal irrigation, the growth will be such as to insure sufficient length of fibre. Of the temperature in the cold-weather months we may judge from the following, deduced from the Author's observations while he was Superintendent of the Botanic Garden; from which it will be seen that November would be the fittest month for sowing, and the crop could be gathered in February or March, before the heat becomes great.

*Mean Temperature.*<sup>1</sup>

Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.
74	64	55	52	55	67	78

In the Himalayas the season of cultivation is the same as in Europe; for there, as here, the winter months are too cold for the growth of plants—but the spring and summer temperature is exactly suited to the growth of an annual like the Flax plant.

*Mean Temperature.*

March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.
53	59	66	67	67	66	64	57	50

As far as temperature is concerned, there is evidently a long period for cultivation, and different months might be selected

<sup>1</sup> See the Author's Report on the Botanic Garden at Saharunpore, 'Journ. of the Asiatic Society,' vol. i.

for the purpose. But there is a great difference in the moisture of the different months, as the rains come on in the middle of June, and are excessive for three months. But it would be interesting to ascertain the effects of such moisture on the growth of a fibre like that of Flax. It is probable that the plant would require to be supported, to prevent its being laid.

## CULTURE OF FLAX IN THE PUNJAB.

The Punjab, so recently acquired, is already as settled as any of the older provinces, in consequence chiefly of the energy and intelligence of the Service being applied to devising methods of Government suitable to the people and country, instead of attempting to introduce English institutions among foreigners who are unable to appreciate or to take advantage of them. In the Punjab, we see some of those who were fighting against us, now employed in the far East with our own troops; but many being necessarily left without employment, are ready to take to or return to agricultural pursuits. The vigorous measures which have been adopted, while they give security and freedom of communication, will also greatly facilitate agricultural pursuits; especially as some of the public works in course of execution are canals of irrigation.

There, the Kote Kangra valley teems with Chinese Tea shrubs, the first of which were planted in the year 1848, that is, immediately after the conquest of these hills by Lord Hardinge; and the Tea which has been prepared from these plants is considered to be of the first class of China Teas, by such excellent judges as the Messrs. Thompson. The culture of Silk has lately been introduced by the Agri-Horticultural Society of the Punjab—the first specimens having been sent to Calcutta and to this country, were considered to be naturally of good quality, but very indifferently reeled. Mr. W. H. de Verinne having been sent up by the Government with an establishment of silk-winders and -reelers from Morshedabad, and some samples of silk of their winding having been sent to Calcutta and to the India House, the former was pronounced by Mr. E. Kilburn, on 1st September, as “requiring only a little more attention to rank with the product of the best Bengal Filatures,” and which would have been worth in

May about Rs. 12 8 per Factory seer. The specimens sent to the India House were submitted to the Messrs. Durant, who gave a most carefully drawn up report, and pronounced them excellent specimens of Bengal Silk, but requiring a little more care; and worth from 14s. to 15s. a pound in London. Vigorous measures have in consequence been adopted for the prosecution of the culture by plantations of different kinds of Mulberry, besides the kind which is already common in the country, which, in the opinion of Mr. de Verinne, is almost equal to the Bengal Mulberry. It is probable that some difficulties may be experienced from the dryness of the climate in the plains of the Punjab; but there can be none in the hilly districts, where the Tea plant is flourishing. Some of the native Wools also having been highly approved of, twenty-five Merino Rams have been imported by the Government from Australia, for the further improvement of the breed of Sheep.

That some parts of the district are well adapted for the production of fibres, is evident from the Kote Kangra Hemp, to be afterwards described, proving one of the strongest of known fibres. The Agri-Horticultural Society of the Punjab, therefore, have begun their experimental cultures in a very favorable locality, from the great variety of soil and of climate within the command of their members. If the Geography of Plants and of Animals is attended to, as well as the Principles of Culture in new situations, little doubt need be entertained respecting the success of the above cultures as well as of Flax.

Though Linseed is so extensively produced throughout India, we hear nowhere of the fibre being valued and separated. But when we get to the confines of cotton-producing districts—that is, into the Punjab—we find that some Flax, prepared by the natives on their own account, is separated in the neighbourhood of Lahore. For we are told that the stalks of the Linseed plant yield a fibre, which is made into twine, and used for the network of their charpaes or native beds. This information was elicited in consequence of inquiries originated by Mr. Frere, the distinguished Commissioner of Sindh from his desire to promote the culture of Linseed in the province under his charge. The fibre, however, of the Linseed plant is separated in still more northern parts, as some seed

of Bokhara Flax sown in England was found to be that of the common Flax.

The inquiries made respecting the growth of Linseed in the Punjab elicited the following facts :

On the Cis-Sutlej it is stated that three seers to a begah are sown broadcast when alone, or in drills; probably as an edging to other crops. Three maunds of Linseed considered a good crop. The stalks and husks considered refuse and useless. The seed sells for 18 seers for the rupee to oilmen. A maund of seed yields of oil  $10\frac{1}{2}$  seers; of oil-cake  $29\frac{1}{2}$  seers. The oil sells for 5 and  $5\frac{1}{2}$ , and the oil-cake at 60 to 66 seers for the rupee.

In the Jalindhur Doab, Linseed is cultivated, especially in the Khadir or inundated land of the Beas and Sutlej Rivers; but plants always small; seed sells for 20 to 30 seers for a rupee. It is also cultivated in the Sheerwul, or tract of country in which the soil is firm and covered by a deposit from the rains, with the subsoil always moist—ripens before barley, and generally before wheat.

Linseed is also cultivated in the rich loamy soils of the Kangra district skirting the Himalayas, but chiefly in the eastern parts, on account of the seed, which sells for 20 to 100 seers for the rupee—Flax itself burnt.

In the Punjab, sown with barley and mussoor (or lentils) in Katick (Oct. and Nov.), and is ripe in Cheyt (March and April); usually sown intermixed with the above crops, or in separate patches. Never irrigated, but grown along the Sutlej, in Khadir land, or that which is inundated during the rainy season, but never manured.

In the Lahore division, it is grown chiefly about Sealkote and Deenanuggur, and is the only part where the fibre seems to be made use of, as it is stated that the stalks yield a fibre which is made into twine, and used chiefly for the network of their charpaes or native beds. The price of the seed is about Rs. 2 8 per maund. Few localities are stated to be well suited to it, and the seed was in little demand. Twine made of the fibre was sent, but no notice seems to have been taken of its quality.

From the above details of cultivation, it is evident that though Linseed is very generally known, it is nowhere extensively cultivated, as is evident from the price of the seed, which is dear in comparison with that of Wheat. Some of the uses are well known; for instance, the oil is used as a drying oil, and the bruised seed, mixed with flour, is described by Major Edwardes as given as a strengthening food for cattle, and the oil-cake is no doubt employed for the same purpose; while the fibre is sufficiently valued to be separated in some, though burnt in most other places. It would seem much in favour of the production of good fibre that the growth is much slower than in the southern provinces of Bengal.

The Society began some experiments on the culture of Flax, in the cold weather of 1853, with seed obtained from Saharunpore; that is, the same place from which the best seed was

obtained in the experiments in Bengal and Behar, and which produced such good Flax. (*v.* p.p. 176 and 182.) The samples were prepared under the superintendence of Corporal Keenan, of H.M.'s 10th Regiment. Of the opinion formed of these samples when sent to Calcutta, Mr. Wood, Secretary of the Chamber of Commerce, writes: "7th June, 1854. The general opinion regarding the Flax is very favorable. It is considered the finest that has been ever grown in the country; and that the cultivation of it might be encouraged." Some of the special reports are as follow:

Mr. Stalkartt writes:—"This Flax is decidedly the best specimen of this country's growth, and I should say a good merchantable article. It is very difficult to give a thorough report upon it, as we have none from Europe to compare it with. From the test it did not appear very strong, and from its smell I should say that oil had been used in the preparation; perhaps with an improved method it would have greater strength, as oil, generally speaking, deteriorates greatly the strength of Hemp and Flax. I would like to see it in greater bulk; a handful is not a fair sample."

Report from Mr. Haworth.—"Although I am not a member of the Flax and Hemp Committee, I am glad to have had the opportunity of examining the sample forwarded to the Society by Mr. Cope. On the whole, I think, its preparation does great credit to Corporal Keenan; any shortcoming is owing to the finer heckles not being ready. I think the length of fibre is good; the colour of the greater part is bright and healthy—that portion shows good strength; there is, however, a small part of the sample of a dark dull colour, which, I think, is caused by over-retting, and that portion of the sample is, as might be expected, weaker than the rest. If the natives of this country could produce such Flax as this specimen under notice, from the immense fields now grown in Bengal for seed only, what an enormous amount would be added to the value of our exports."

Mr. Stalkartt is a rope-maker, of the firm of Messrs. Harton and Co., of Calcutta, and wished ten maunds to be sent to him by the quickest transit—bullock-train and steam-boat—in order to see what he could do with it in his own business. He wished also for "a couple of maunds of the tow," as he thought "it might be useful for the railway." Mr. Stalkartt's remark about oil being used in the preparation, is referred to by the Secretary of the Society, and contradicted, "as no oil was used." It is probably an accidental testimony to the softness of the fibre, which, in most of the Flaxes from warm countries, is found to be dry and hard.

The Sub-Committee appointed by the Society to draw up a proposition for Flax arrangements, submitted the following—

*Suggestions* regarding the improvement in, and increase of, the cultivation of Flax, or Linseed plant, for the sake of its fibre.

1st.—It is to be made generally known that a premium, of Rs. 500, has been sanctioned by the Supreme Government of India, to be given for the largest area of land that may be appropriated, in the Punjab and the Cis- and Trans-Sutlej States, to the culture of Flax, during the season of 1854-55, being not less than 25 acres in any one village.

2d.—A second premium, of Rs. 350, has been similarly authorised, for the next largest area so cultivated, being not less than 20 acres, in any one village, and—

3d.—A third premium, of Rs. 200, is to be granted for the third largest piece, being not less than 15 acres in any one village; that is to say, the Government will award the first premium to any one land-holder, or village community of land-holders, who may, in his or their own village, cultivate, for the production of Flax fibre, ground aggregating, in the whole, 25 acres, or as much upwards as the owners may choose.

Moreover, the Government of India have sanctioned the purchase, on behalf of the Society, of the entire crop of merchantable Flax, including the fibre, if of the required length, that may be produced in the Punjab, and to pay for it at the current market rate of the Flax seed, with 25 per cent. added for the fibre.

It is to be a condition that not less than sixty Company's seers of Flax seed, be sown on each begah, cultivated with a view to competition; and that the growers be informed that Government is prepared to purchase the whole of the seed, and likewise the fibre, if of the proper quality, on the terms above stated, but that the authorities be instructed not to purchase such produce unless it measure, in the stem, three and a half feet in length or more; that it be well dried, and the seed just on the point of ripening, but not so ripe as to allow of its falling out of the pod by the way.

*The directions for cultivation are as follow:* If the following instructions are strictly attended to, there is no doubt that the Flax will all be of the required length of staple. Not less than sixty seers of Flax must be sown, broadcast, that is with the hand, on each begah, as the thicker it is sown the longer will be the plant, and the more free it will be from branches, which are very injurious. The land must be thoroughly freed from weeds by repeated ploughings, previous to sowing; it must be well manured with the richest manure procurable, such as is given to land for tobacco; be smoothed, and divided into beds as for wheat. The seed must be sown between the 1st and 15th November, but not later. The Flax land must be watered as frequently as wheat-land; and the fields must be kept perfectly free from weeds until the Flax is six or seven inches high. After that, no more weeding will be required. The land selected should be light loamy soil; Khadir land is the best. When the seed begins to show signs of ripening, the Flax must be pulled gently by the root, and laid on the ground to dry in rows. When thoroughly dry, it must be tied up in bundles as large as a man can conveniently span with both hands, and it can thus be easily measured. The seed can be stripped off (rippled) on arrival of the consignment at Lahore, and the final price be arranged according to the current rate of Linseed in the Lahore market. That is, if the successful, or any other, competitor (all Flax will be bought that is of the required length, whether a premium have been awarded for it or not), who may deliver Flax, yielding 125 maunds of Linseed, will, if, as at present, the merik be Rs. 2 8 a maund, receive Rs. 312 8 for the seed, and 25 per cent., or Rs. 78 2, additional, as compensation for the fibre, or Rs. 390 10 in all.

It is to be understood that successful competitors are to be paid for their crop as well as others; but that no cultivators are bound to sell, should they wish to dispose of their crop in any other manner.

It might be explained to the ryuts, that those who are not successful in growing Flax of the required length, will find a ready market for the seed in Mooltan, whence it will be conveyed to Sindh for export to England.

It is further strongly recommended, as a new feature in the proposed measures, for improving the cultivation of this important staple, that the Society be authorised to hire, on behalf of Government, from 30 to 40 begahs of land, in the immediate vicinity of their garden, for the cultivation of Flax, during the coming season, so as to admit of a comparison being drawn between the Flax grown by the zumeendars and the plant reared under probably more favorable circumstances. The seed required for each begah, the purchase of which, it is hoped, the Government will also sanction, will be one maund and a half (at a cost of about Rs. 4), and the land is obtainable at Rs. 20 per begah; for which sum the cultivators undertake to perform all agricultural operations, such as ploughing, watering, weeding, sowing, and reaping, *for one year*—a plan by which the grower can ascertain the expenses of his crop to a rupee. It is strongly recommended to the Meeting that, in confident anticipation of the sanction of the authorities to this measure, which anticipation they venture to rest on the past liberality of Government, and the great importance of the subject, and also on account of the advanced state of the season, the Secretary be, at once, empowered to make arrangements for obtaining land.

The vigorous proceedings of the Agri-Horticultural Society of the Punjab, and the ready patronage of the Government, including the purchase of the produce, ought to produce some decisive results, if the soil and climate are found to be favorable; and of this there can be little doubt, from Flax having been produced there last year, and from the description given of it by the members of the Hemp and Flax Committee of Calcutta. The specimens stated to have been forwarded to the India House have not been received. But while the best method of culture will be ascertained by the Society in their own cultivation, it is to be feared that the length of stem required (three feet six inches) will exclude much of what may be grown by the ryuts. The extension of the culture will no doubt reduce the price of the seed, and enable it to be sold at such rates as to allow of its becoming an article of export to Europe.

The Society having included in these recommendations an application for some tons of the best Linseed (mentioning especially the Belgian) as well as some tools, to be sent them, this was approved of, and forwarded by the Indian Government, in August, 1854; but as it was obviously too late for any large quantity of seed to be sent in time for the sowings of this year, small quantities were sent out by the overland route for the sake of comparison with the native seed, and



also some tools as specimens. But as it is extremely doubtful what kind of seed will answer best in the soil and climate of the Punjab, it has been thought preferable to send the seeds of different kinds—as Riga, Dutch, American, English, and Irish.

## CULTURE OF FLAX IN SINDH.

The province of Sindh, about 360 miles in length, extending from  $23^{\circ} 37'$  to  $28^{\circ} 32'$  N., consists of a delta of extensive alluvial tracts, intersected by numerous canals and water-courses, which enable cultivation to be carried on by irrigation; thus making up for the deficiency of rain. Though the temperature of a great part of the year is high, it is probable that that of the cold-weather months may be sufficiently low to allow of the successful cultivation of Flax and Linseed, at the same time with the Wheat, Barley, and Oil-seeds which form the Rubbee or cold-weather crops of Sindh, as of most parts of India.

Indeed, Mr. Frere, the enlightened Commissioner of Sindh, wrote to the Board of Administration of the Punjab, to have inquiries made throughout that territory on the extent and nature of the Linseed cultivation therein—the result of which inquiry has been given in the preceding pages.

A commercial gentleman, to whom were referred the specimens of the Punjab Linseed, and the prices at which it was sold, observes “that there, as in Sindh, the culture of it is altogether upon so limited a scale as barely to supply local wants, and judging from the Rs.  $2\frac{1}{2}$  per maund quoted as its sale price in Lahore, which, with cost of carriage to Kurrachee, 800 to 1000 miles, would stand in higher than the ruling rates in Bombay.” “The quality of the Linseed” he considered “good, and such as would command the highest prices in Mark Lane, which average about 48s. per quarter.”

Upon this, Mr. Frere justly remarks that “the present prices of an article, which is at present grown in small quantities merely for local consumption, afford no means of judging of the price at which it can be profitably grown in large quantities for exportation; and looking at the way in which it usually flourishes in wheat-land in India, and at the present prices of wheat, I feel little doubt but that it can be grown very cheaply

in many parts of the Punjab and Sindh. The facilities which exist for water-carriage down the Indus will render its transport cheap; while great and constant demand exists for it in Bombay.

“I think, therefore, that it is an article to which attention may be profitably directed in any district where it is desirable to discover articles of produce adapted for exportation.”

The Bombay Chamber of Commerce observe: “Linseed of the quality described as the growth of the Punjab would, under all ordinary circumstances, command a ready sale in this market, at from Rs. 3 4 to Rs. 3 8 per cwt. of 112 lb.; and during the greater part of the past year the price has been as high as Rs. 3 12.”

The Author has been favoured with a letter (dated 19th August, 1854) from Mr. Frere, in which he states that—“For the last two seasons attempts have been made, with very satisfactory results, to introduce the culture of Linseed into Sindh. It grows well in the ordinary wheat-lands, and under every disadvantage, there has been no failure traceable to soil or climate. I have no doubt but that, in a few years, it will become one of the staple articles of export.”

He also states that attention has begun to be directed to the fibre, and that Mr. Harvey, who was in early life practically engaged in Flax farming in Ireland, and who has now been some years resident in Sindh, has commenced some experiments, and hopes to be able this season to send to this country some specimens of Flax grown in Sindh. In a previous page it was mentioned that Mr. Burn, who had been some years in Sindh, had seen some thick-sown Flax growing there luxuriantly, and which he had no doubt would produce Flax, though it had only been cultivated on account of the seed.

Some Europe seed, for the sake of comparison with the native seed, and some heckles, which Mr. Harvey wished for, have been, at Mr. Frere's request, forwarded, by order of the Court of Directors, by the overland route to Kurrachee. There seems no doubt of success to at least the same extent as in Egypt, if the culture is persevered in until the proper methods of cultivation and of preparation have been carefully ascertained.

## SEPARATION AND PREPARATION OF FLAX FIBRE.

We have already seen that the stem of the Flax plant consists of a central wood-like part, called shove or boon, and of the tough fibres called bast or harl covered by cuticle, all cemented together by gummy and azotized compounds. These parts are so closely adherent to each other, and the fibres to one another and to the cellular tissue, that they are with difficulty separated from each other, and the fibres obtained for economic use. But it may be observed that if green vegetable matter be exposed to the continued influence of wet or of drought, disunion of the adherent parts takes place; and that they may then be readily separated from each other. The same effect takes place if some of the constituent parts are dissolved out by the agency of a chemical solvent, or water at different temperatures, the rest being set free, the fibres may then be easily separated. All these methods have been and are employed for the separation of Flax fibre in different localities. These are fully detailed in various works, as well as in the papers of the authors we have referred to, in the 'Journal of the Royal Agricultural Society of England.' The directions of the Royal Flax Society are full and detailed, and include most of the essentials given in Mr. MacAdam's Prize Essay.

The oldest method, probably, is that called *Dew-retting*, when the Flax straw or stems are spread out on the grass, and exposed to the action of the atmosphere, combined with that of dews or rain, or, in the absence of these, they are carefully watered. This, though an effectual, is an uncertain, and also a very tedious process, requiring from three weeks to a month for its completion. Archangel Flax is thus prepared. Mr. MacAdam informs us that it is practised among the Walloons, and also in the United States of America, and that Flax thus prepared requires a shorter time for bleaching.

The most generally adopted plan is that of *steeping* the Flax stems, either in slow currents of water (and that of the River Lys is particularly celebrated) or in pits or pools of water. The action of water is useful, partly, by giving origin to fer-

mentation, which loosens the adherence of the constituents, or, at certain temperatures, by dissolving some of the constituents and setting free the others. Both methods are practised in India, in different parts; but the steeping so as to produce fermentation is that generally adopted, and, according to Mr. Deneef, well understood by the natives of India—who, indeed, must have long, as they now largely practise the art, from the quantities of Jute and of Sunn which they prepare by this method. Though not applicable in all points, especially in the time required, from the difference of temperature, the instructions of the Royal Flax Society are so full, that we reprint them here, for comparison with the other directions.

*Watering.*—This process requires the greatest care and attention. River water is the best. If spring water has to be used, let the pond be filled some weeks, or months, if possible, before the Flax is put in, that the sun and air may soften the water. That containing iron or other mineral substances should never be used. If river water can be had, it need not be let into the pond sooner than the day before the Flax is to be steeped. The best size of a steep-pool is 12 to 18 feet broad, and  $3\frac{1}{2}$  to 4 feet deep. Place the Flax loosely in the pool, in one layer, somewhat sloped, and in regular rows, with the root end underneath; the tie of each row of sheaves to reach the roots of the previous one; cover with moss sods, or tough old lea sods, cut thin, laid perfectly close, the sheer of each fitted to the other. Before putting on the sods, a layer of rushes or ragweeds is recommended to be placed on the Flax, especially in new ponds (or packed in crates which are weighted down). As sods are not always at hand, a light covering of straw may do, with stones laid on it, so as to keep the Flax just under the water; and as the fermentation proceeds, additional weights should be laid on—to be removed as soon as the fermentation ceases, so as not to sink the Flax too much in the pool. Thus covered, it never sinks to the bottom, nor is affected by air or light. A small stream of water, allowed to run through a pool, has been found to improve its colour. In this case, if the pools are in a line, the stream should be conducted along the one side, and run into each pool separately, and the water of each pool run off, along the opposite side, in a similar manner. It will be sufficiently steeped, in an average time, from eight to fourteen days, according to the heat of the weather and the nature of the water. Every grower should learn to know when the Flax has had enough of the water, as a few hours too much may injure it. It is, however, much more frequently *under-watered* than *over-watered*. The best test is the following: Try some stalks of average thickness, by breaking the *shove*, or woody part, in two places, about six or eight inches apart, at the middle of the stalk; catch the broken bit of wood, and if it *will pull freely out, downwards, for that length, without breaking or tearing the fibre, and with none of the fibre adhering to it*, it is ready to take out. Make this trial every six hours after fermentation subsides, for sometimes the change is rapid. Never lift the Flax roughly from the pool, with forks or grapes, but have it carefully handed out on the bank, by men standing in the water. It is advantageous to let the Flax drain twelve to twenty-four hours, after being taken from the pool, by placing the bundles on their root ends, close together, or on the flat, with the slope; but the heaps should not be too large, otherwise the Flax will be injured by heating.

*Spreading*.—Select, when possible, clean, short, thick pasture ground for this operation; and mow down and remove any weeds that rise above the surface of the sward. Lay the Flax evenly on the grass, and spread thin and very equally. If the directions under the head of rippling have been attended to, the handfuls will come readily asunder, without entangling. Turn it two or three times while on the grass (with a rod about eight feet in length, and an inch and a half in diameter), that it may not become of different shades, by the unequal action of the sun, which is often the case, through inattention to this point. Turn it when there is a prospect of rain, that the Flax may be beaten down a little, and thus prevented from being blown away.

*Lifting*.—Six to eight days if the weather be showery, or ten to twelve if it be dry, should be sufficient on the grass. A good test of its being ready to lift is to rub a few stalks from the top to the bottom; and, when the wood breaks easily, and separates from the fibre, leaving it sound, it has had enough of the grass. Also, when a large proportion of the stalks are perceived to form *a bow and string*, from the fibre contracting and separating from the woody stalk. But, the most certain way is, to prove a small quantity with the handbreak or in a flax-mill. In lifting, keep the lengths straight and the ends even, otherwise great loss will occur in the rolling and scutching. Tie it up in small bundles; and, if not taken soon to be scutched, it will be much improved by being put up in small stacks, loosely built, with stones or brambles in the bottom, to keep it dry, and allow a free circulation of air. Stacks built on pillars would be the best.

*Drying*, by fire, is *always most pernicious*. If properly steeped and grassed, no such drying is necessary; but, to make it ready for breaking and scutching, exposure to the sun is sufficient. In some districts, it is put to dry *on kilns*, in a damp state, and is absolutely burned before it is dry, and the rich oily property of the Flax is always greatly impaired. On this point, the Society can scarcely speak too strongly, as the Flax is either destroyed, or rendered not worth one half of what it would be, if properly dried.

As success in the above processes depends in a great measure upon the quality, as well as on the temperature of the water, and this being frequently cold in northern latitudes, led to the invention by Schenck, in 1846, of his patented process in which the requisite degree of temperature could be obtained, and, of course, maintained, as well as increased. This, though apparently a new process, has long been adopted in the East; as the natives of Sumatra, and likewise of the district of Rungpore, have employed warm water, as well as some chemicals, for the separation of the fibre of different plants, as we shall see under the head of Sunn and of Nettles.

In *Schenck's process* the temperature of the steep-water is kept at 80° to 90°, but may be increased to that which is favorable to the process of fermentation—for the effects depend upon the destructive power of fermentation quite as much as in the old process. A great saving of time is effected—as not more than seventy-two hours is required for the fine, and about

ninety-six hours for the coarse qualities; and a more uniform fibre is, moreover, produced.

A disadvantage of this process, in comparison with some others, is that, during the process of fermentation, the same kind of gaseous exhalations are given off as in the ordinary method. These gases have been stated "by chemists to consist chiefly of carbonic acid and hydrogen, in nearly equal parts." Dr. Hodges has clearly shown that the fermentation is of a peculiar character, traces only of acetic acid being found, while butyric acid is generated in large quantities.

Other objections have been stated—such as that the fibre was weakened when over-heated; and another, that a most offensive matter adhered to the straw, and that, in the process of scutching, the scutchers could not bear the smell of the irritant dust which flew off. With regard to other objections—such as that the yield of fibre would be less, that it would be weakened, and that the linen made from it would not bleach properly—a Committee of the Royal Irish Flax Improvement Society, after carefully conducted experiments, reported, first, that the uniformity of temperature had the effect of increasing the yield of fibre. With regard to the weakening of the fibre, the Committee ascertained that the Flax steeped in the ordinary way spun to 96 lea yarn, and that by Schenck's system to 101 lea yarn'. In the second, the cold-steeped gave 60 lea and the hot-steeped 70. The third objection was submitted to an extensive bleaching firm, whose evidence in favour of the hot-water process was very decided. The heated water of the ordinary Indian tulaos, at some seasons of the year, will be sufficient for this purpose, and will not be injurious to the fibre, if it is otherwise good. The process only requires to be more narrowly watched than in Europe.

But we observe in the 'Journ. of the Chemic-Agricul. Society of Ulster,' for January, 1853, it said, that—"In Ireland, great expectations were entertained that by the plans for this purpose, which were introduced by the late Mr. Schenck, the preparation of Flax for the spinner would be made entirely a factory operation." "In Ireland, however, the establishments erected under Schenck's patent, have not, generally, given satisfaction." "In England and Scotland, we are aware that the system has been more successfully carried

out;" but "Schenck's process, which is, in fact, merely the ordinary method of the farmer, regulated and accelerated, was, however, adopted by many persons but imperfectly acquainted with the various requisites for success." But Mr. MacAdam, at the late meeting of the Royal Flax Improvement Society, November, 1854, seems to consider it still as the best method.

Having, at pp. 146-7, given Professor Hodges's analysis of the Flax plant, we will here subjoin his further observations on his experimental crop, and his analysis of the steep-water. He first observes that the crop, having been air-dried, was removed to the steeping works at Cregagh.

It was there placed in stacks, and after some time prepared for steeping. The first operation for this purpose is the removal of the valuable bolls or capsules. This, in these establishments, where the cost of labour is carefully considered, is usually most expeditiously and perfectly effected, by means of a machine composed of two cast-iron rollers, to which motion is communicated by a belt from the steam-engine. Between these the Flax is passed and the capsules bruised, so that the seed can be readily shaken out. Having been deprived of its bolls, by this machine, it was found that the 7770 lb. (v. p. 146) of Flax were reduced to 52 cwt., or 5824 lb.

Of the portions of the plant removed by the seedling machine, 910 lb. consisted of clean seed, 1036 lb. of husks, leaves, and sand. The loss experienced by the Flax in steeping was 13 cwt. From the 52 cwt. of seeded straw, the produce of the experimental crop, there remained 6 cwt. 1 qr. 2 lb. of marketable fibre.

The taste of the steep-water, at first, is rather agreeably acid, but followed by the peculiar plant-like taste of the Flax. By the addition to the liquid of carbonate of lime, its acidity is destroyed. Contrary to what has been stated, in some reports on this subject, the liquid, I found, at the conclusion of the process, yields merely a trace of acetic acid, and in numerous experiments, no trace of the evolution of sulphuretted hydrogen could be detected at any stage of the fermentation. When the Flax is allowed to remain in the vats after the usual time, a new series of changes, and a fresh and rapid extrication of gas, take place. I have made, during the last three years, numerous experiments, with respect to the composition of the steep-water, from several establishments, and, also, from the common steep-pools, which afforded me some interesting results, and satisfied me that the fermentation which is induced by steeping Flax in water resembles the so-called butyric acid fermentation; merely traces of acetic acid, and invariably large quantities of butyric acid having been detected in every case. In fact, the fragrant butyric ether, so extensively employed in the preparation of pineapple rum, and in flavouring confectionery, might readily be obtained, in large quantities, from the stinking waters of the Flax pool.

To ascertain exactly the effect produced by steeping, and the composition of the steep-water, I obtained from the works at Cregagh, a sample of Flax straw unsteeped, a portion of steeped straw taken from the same lot, and a gallon of the steep-water taken from the vat immediately after the removal of the Flax. The composition of the ash obtained by burning the extract of the steep-water, and the samples of the straw, is given in the table. The spring water employed at the works is moderately hard, indicating, on Dr.

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Clarke's scale, 8 degrees. It was not considered necessary to deduct the ingredients supplied in it, as these would add but little to its fertilising value. An imperial gallon of the liquid of the vat was found to contain in grains and tenths—

Organic matters . . . . .	136·7
Inorganic matters . . . . .	131·4
	268·1 grains.

*Composition of the Ash of the Flax Straw before and after Steeping, and of the Inorganic Matters of the Steep Water.*

100 parts of each respectively contained—

	Unsteeped Flax.	Steeped Flax.	Ash of the Steep-water.
Potash . . . . .	13·88	11·40	19·31
Soda . . . . .	5·33	4·17	—
Chloride of Potassium . . . . .	—	—	3·83
Chloride of Sodium . . . . .	6·47	3·28	21·24
Lime . . . . .	18·86	17·69	8·23
Magnesia . . . . .	4·10	5·50	10·18
Oxide of Iron . . . . .	5·40	5·76	2·02
Sulphuric Acid . . . . .	11·16	4·07	6·10
Phosphoric Acid . . . . .	9·63	11·87	3·77
Carbonic Acid . . . . .	10·37	20·06	23·30
Silica . . . . .	15·23	15·78	1·12
Sand . . . . .	—	—	0·60
	100·43	99·58	99·77
Ash per cent. in the Straw . . . . .	3·89	2·59	—

100 grains of the dried extract of the steep-water contained 1·56 nitrogen, =1·89 grains of ammonia: therefore, an imperial gallon would be capable of supplying five grains, and a vat, containing 3000 gallons of water, 2 1·10 lb., worth about 1s. 2d. to the farmer; while the same amount of liquid, placed on his field, would convey to them about the same amount of phosphoric acid.

By the kindness of the proprietors of the Steeping Works, at Cregagh, who have liberally given me an opportunity of inspecting the books of their establishment, I am enabled to give the following statement of the changes which 100 tons of Flax undergo when treated by Schenck's process.

100 tons of air-dried Flax straw yield—

	Tons.
1. <i>By Seeding</i> —33 tons of seed and husks, leaving of seeded Flax . . . . .	67·00
2. <i>By Steeping</i> —67 tons of seeded Flax yield of steeped straw . . . . .	39·50
3. <i>By Scutching</i> —39½ tons of steeped straw yield of dressed Flax . . . . .	5·90
" " of tow and pluckings . . . . .	1·47

*Watt's Patent Process.*—The advantages of Schenck's method of preparation, are sufficiently considerable to ensure its adoption at once in an uncertain climate like that of the British Isles. But it was yet to be proved whether the process of fermentation was essential to the separation of the fibre; and whether, if it was got rid of, we might not obtain an equally good fibre, avoid the noxious exhalations, and even



utilise the products of the steep-water, which had previously always been a nuisance. All this has been done by Watt's method of preparing Flax, and which I had the advantage, in September, 1852, of viewing, through the kindness of Dr. Hodges, before all the works at Messrs. Leadbetter's were quite completed; but even in this state, the Author saw enough to be at a loss whether most to admire, the skill with which the principles of science had been brought to bear on the perfecting of a practical art, or the success with which mechanical contrivances had been applied to the completeness of every part of the process. We subjoin the following account from the 'Journal of the Chemico-Agricultural Society' of Ulster, for January, 1853. To this, we have added Dr. Hodges's analysis of the steep-water, obtained by this patent process.

"At the meeting of the British Association of Science in this town, in September, the details of a new and totally different process for the separation of the Flax fibre was, by permission of the patentee, Mr. Watt, first made known to the public, by Dr. Hodges, and excited much interest. Since that time, trials of the new process have been made on a most extensive scale, at works erected for the purpose in Belfast. As various imperfect accounts of Mr. Watt's process have been published, the following account of the apparatus, and operations connected with it, will be interesting to our readers.

"In Mr. Watt's process the solution of the cementing matters of the Flax straw, and the separation of the fibre, is effected, not by the ordinary methods of fermentation, but by exposing the straw to the action of steam, in a chamber of peculiar construction, and afterwards subjecting it to pressure, applied by means of heavy metal rollers. The first operation consists in placing the seeded Flax in a chamber, formed of plates of cast iron.

"The chamber used measures about twelve feet in length, and is about six feet broad and six feet in depth, and contains about fifteen cwt. of Flax. On the top is a tank for containing water, also of cast iron, about eighteen inches deep, the bottom of which forms the roof of the chamber, and through which passes a tube, furnished with a valve. There are two doors in the ends of the chambers, through which

passes a tube, furnished with a valve. There are two doors in the ends of the chamber, through which the Flax is introduced, and these, when the steam is admitted, are secured by screws. A false bottom, formed of perforated iron plates, such as are used in malt-kilns, is raised about six inches from the bottom of the chamber; and, resting on this, there is an upright throw-pipe, the use of which we shall presently describe. The chamber being filled with Flax, and the doors secured, steam is admitted, and when the straw has been thoroughly saturated with moisture and softened, a weight is placed upon the valve on the top, so as to confine the steam, which, as it strikes against the cold bottom of the water-tank forming the roof of the chamber, is condensed, and made to descend in streams of distilled water, which dissolve the soluble matters of the softened straw, washing them into the lower part of the chamber. The liquid, as it accumulates, is conveyed into a reservoir, and employed as food for cattle. The analysis of this liquid is given at p. 208. Towards the conclusion of the process, when nearly all the soluble matters have been removed, the liquid is allowed to collect until it rises above the false bottom, and, by placing a weight upon the safety-valve in the roof, the pressure of the confined steam causes it to ascend in the throw-pipes, by which it is discharged in showers over the straw. The throw-pipes, it may be mentioned, are not essential, and in some of the vats they are not used. In their stead, a square iron reservoir is placed on the top of the chamber, and communicating with it by a pipe with a stop-cock, into which the liquid accumulated in the chamber is pumped, and discharged occasionally over the straw.

“In from twelve to eighteen hours, the steaming process is completed, and the straw, when withdrawn from the chamber, is immediately subjected in small parcels to the successive action of two pair of heavy iron rollers, by which it is pressed into flat tape-like bands, and deprived of nearly all the moisture contained in it; the longitudinal pressure also removes a considerable portion of the epidermis, or outer envelope, and facilitates the removal of the woody matter in scutching. Each pair of rollers used exerts a pressure equal to 10 cwt.

“The after-treatment of the pressed straw does not present

any remarkable difference from the system pursued in the hot-water steeping establishments. The straw is secured between rods, and suspended in a drying chamber, heated by the waste steam of the engine. The arrangements for this purpose at the Bedford Street works of Messrs. Leadbetter consist of rooms with floors formed of spars. Below this flooring passes a pipe conveying steam, by which the air admitted by openings at the bottom of the chambers is heated, and made to ascend through the Flax. The circulation of the air is ingeniously effected by a series of revolving beaters kept in action below the steam-pipe."

The following extract from the Report of a Committee of the Royal Flax Society gives the results of an experiment made at Messrs. Leadbetter's works:

In this experimental trial, a quantity of Flax straw, of ordinary quality, was taken from the bulk of the stock at the works, weighing  $13\frac{1}{4}$  cwt. with the seed on. After the removal of the seed, which, on being cleaned thoroughly from the chaff, measured  $3\frac{1}{2}$  imperial bushels, the straw was reduced in weight to 10 cwt. 1 qr. 2 lb. It was then placed in the vat, where it was subjected to the steaming process for about eleven hours. After steeping, wet-rolling, and drying, it weighed 7 cwt. 0 qr. 11 lb.; and on being scutched, the yield was 187 lb. of Flax; and of scutching tow, 12 lb.  $6\frac{1}{2}$  oz. fine, 35 lb. 3 oz. coarse. The yield of fibre, in the state of good Flax, was, therefore, at the rate of  $13\frac{1}{2}$  lb. from the cwt. of straw with seed on; 18 lb. from the cwt. of straw without seed;  $26\frac{1}{4}$  lb. from the cwt. of steeped and dried straw.

The time occupied in actual labour, in the processes from the seeding of the Flax to the commencement of the scutching, was  $13\frac{1}{4}$  hours, to which, if eleven hours be added for the time the Flax was in the vat, twenty-four hours would be the time required up to this point. The scutching, by four stands, occupied six hours sixteen minutes. But, in this statement, the time required for drying is not included, as owing to some derangement in the apparatus, no certain estimate could be made of the actual time required in that process. It would appear, however, that about thirty-six hours would include the time necessary, in a well-organized establishment, to convert Flax-straw into fibre, for the spinner.

The cost of all these operations, in this experiment, leaving out the drying, for the reasons noted, appeared to be under £10 per ton of clean fibre, for labour, exclusive of general expenses.

A portion of the fibre was sent to two spinning mills to be hackled, and to have a value put upon it. The valuation of the samples varied from £56 to £70 per ton, according to the quality of the stricks of fibre sent, and the yield on the hackle was considered quite satisfactory.

Appended to this report is a note of the time occupied in the different processes during the experiment, and of the number of persons employed in each.

It is to be hoped that so promising a plan may, on more extended experience, be found fully to warrant the high anticipation formed from what is already known concerning it. (Signed on behalf of the Committee,)

RICHARD NIVEN, Chairman.

Belfast, 3d Nov., 1852.

*Appendix.*

Note of the time occupied, and of the number of persons employed in each of the processes witnessed by the Committee, on the experimental trial of Mr. Watt's system of preparing Flax fibre :

	No. of Persons employed.		Time occupied.	
	Men.	Women & Boys.	Hours.	Minutes.
Seeding . . . . .	4	8	1	15
Placing in vat . . . . .	3	4	0	15
Cleaning seed . . . . .	1	0	3	0
Taking out of vat . . . . .	2	3	0	30
Wet-rolling and putting in drying room . . . . .	1	16	2	20
Rolling for scutching . . . . .	0	11	1	8
Striking for ditto . . . . .	0	7	4	47
Total . . . . .	11	49	13	15
Scutching . . . . .	4	0	6	16

*Analysis of the Liquid obtained in Watt's Patent Flax Process.*

At a meeting of the Chemico-Agricultural Society of Ulster, Dr. Hodges gave an analysis of the liquid obtained in Watt's Patent Flax Process, and an account of the new process of preparing Flax, patented by Messrs. Watt and Leadbetter, which, he said, offered the only practical method of economising the matters which are separated from the Flax plant in its preparation for the manufacturer, which had hitherto been proposed. The liquid which remains in the flax-vats employed in the new process possessed none of the disagreeable qualities of the ordinary steep waters. It was free from smell, and in taste and colour somewhat resembled an infusion of senna leaves. It was, in fact, a strong tea, containing, unchanged by fermentation or putrefaction, the soluble matters of the stem of the Flax plant. It was, at the present time, advantageously used at Messrs. Leadbetter's works in feeding pigs. As it was desirable to ascertain the exact composition of this liquid and its nutritive value, he had procured a sample of it from the Bedford Street works, and had it submitted to chemical examination. The following were the results: One gallon evaporated to dryness gave—

Of Organic matters . . . . .	353·97 grains.
„ Earthy and Saline matters . . . . .	161·49 „
Total amount of solid matter . . . . .	515·46 grains.

The organic matter afforded on analysis 14·79 grains of nitrogen.

The earthy and saline matters were found to possess the following composition :

*Composition of the Ash of the Steep-water of Flax.*

	Per cent.	In a gallon
Potash . . . . .	27·17	44·63 grains.
Soda . . . . .	3·18	5·12 „
Chloride of Sodium . . . . .	21·58	34·61 „
Lime . . . . .	5·91	9·49 „
Magnesia . . . . .	4·60	7·40 „
Oxide of Iron . . . . .	0·83	1·33 „
Sulphuric Acid . . . . .	15·64	25·11 „
Phosphoric Acid . . . . .	5·66	9·01 „
Carbonic Acid . . . . .	12·43	19·96 „
Silica . . . . .	3·00	4·83 „
	100·00	161·49 grains.

Dr. Hodges stated that the Flax liquid possessed considerable feeding qualities; and Mr. Leadbetter in reply to his inquiry said that it had not been found to exhibit any purgative effect—the pigs at his works received it mixed with turnips and the husks of the Flax, and were in a thriving fattening condition.

The vat liquid, Dr. Hodges observed, could be drawn off in a more concentrated form than the sample examined, and it would be easy for the manufacturer, by employing a hydrometer, to supply it of uniform strength.

*Composition of the Ash of Flax Shoves.*

The shoves, or refuse woody matters, which are separated in scutching Flax, are at present employed in the steeping works as fuel. Dr. Hodges, in the course of the extended investigation of the Flax plant, in which he is at present engaged, found that the ash which remains on the incineration of these matters had the following composition, and might, therefore, advantageously be economised for use as manure. 100 parts of ash afford:

Potash . . . . .	7.73
Soda . . . . .	5.91
Chloride of Sodium . . . . .	1.78
Lime . . . . .	20.15
Magnesia . . . . .	5.46
Oxide of Iron . . . . .	5.60
Sulphuric Acid . . . . .	6.50
Phosphoric Acid . . . . .	10.43
Carbonic Acid . . . . .	20.10
Silica . . . . .	16.00
	99.66

1000 lb. of shoves yield, on combustion, 19½ lb. of ash.

Upon this, Professor Wilson remarks: “Here then we have a process which presents the following advantages over the ordinary methods: 1st. Great saving in time. 2d. Economy of fibre. 3d. Avoidance of any nuisance, and beneficial application of waste products.” All proving that a great advance had been made in principles in this process.

As closely connected with Watt’s, we subjoin Professor Wilson’s account of another process. “No sooner, however, had the spinners given their testimony in favour of Watt’s fibre, than another process was patented by Buchanan, which appears to be an improved application of the same principle as Watt’s—for the solvent power is clearly not due to the steam, as made use of by him, but to the hot water occasioned by its condensation. In this, the steeping is effected by *repeated immersions* in a tank of heated water, arrangements being made by which the temperature is never allowed to exceed a certain degree—a point of great importance, both as regards

the abstraction of the azotised extractive matter, and also the quantity of fibre produced. It is well known that albuminous solutions, containing even a very small proportion of albumen (1 in 1000), coagulate at a temperature of 180°, and then become insoluble; and it is always considered that fibre is more or less injured if exposed beyond a certain temperature. These two important points have been taken advantage of in Buchanan's process: the temperature of the steep-liquor is kept between 150° and 180°, and the operation, both as regards time and produce, more satisfactorily performed. The process is quite *automaton*—thus saving labour and the risks consequent upon carelessness; and the mechanical arrangements by which it is effected are very simple and inexpensive.”<sup>1</sup> So far as the experiments have gone, it has been found that by ten immersions, the whole of the colouring matter of the Flax has been removed. By this process, the Author concludes we have all the advantages obtained by water; economy of products, increased economy of time—only four hours being required instead of twelve; and, in addition, great economy of labour. Another great improvement is claimed by Buchanan—his method of drying the steeped shive preparatory to scutching. The process in Watt's method is also very perfect, but Professor Wilson had been unable to obtain, at the time he wrote (16th May, 1853), any results of the working of the process on a commercial scale.

Mr. C. Fane, referring to the difficulties experienced in the fermentative processes, has given a graphic account of another method by which the fibre of the Flax, as no doubt of other plants, may easily be separated. Subjecting the wet fibres to heavy pressure is now adopted in most of the improved processes.

“At this juncture, an English gentleman, a Mr. Pownall, in endeavouring to work out Mr. Claussen's idea of obtaining from Flax a fibre that would spin on cotton-machinery, made a most valuable discovery, as to the preparing Flax for the common linen purposes, which was this, that if the Flax straw, when taken out of the water in which it had been steeped and fermented, were *instantly, and before drying*, subjected to *severe pressure* and a *stream of cold water*, the pressure would press

<sup>1</sup> Professor Wilson's paper in 'Journ. of Agric. Soc.,' vol. xiv, p. 204.

out, and the water would wash away almost all the gluten remaining in the plant not removed by the fermentation.

“ It is impossible to over-estimate the value of this discovery. The grand difficulty in the management of the Flax plant had always been the difficulty of hitting the happy mean between *over-fermenting* and *under-fermenting* the straw. If the straw were not fermented enough, the gluten was not sufficiently discharged, and then the woody parts of the plant stuck to the fibre so strongly, that nothing short of violent blows of the scutching instrument would remove it, and violent blows broke much of the fibre into short lengths, called tow, of little or no value. On the other hand, if the straw were fermented too much, then the gluten was, indeed, sufficiently discharged, and moderate blows sufficed to remove the woody matter; but in that case the fibre was weakened, and the blows, moderate as they were, again broke the fibre into tow. In either case the yield of valuable fibre was unsatisfactory, and the reed and quality deteriorated, and it was only in those cases where the exercise of the greatest care and judgment had enabled the steeper to trim most happily between fermenting *too much* and fermenting *too little*, that a satisfactory yield of fibre was obtained. Mr. Pownall's discovery at once triumphed over this hitherto almost insuperable difficulty, because it enabled him to stop short in the process of fermentation before he arrived at the *point of danger*, and yet remove the gluten even more effectually than *excessive* fermentation had previously done; from which there resulted the following advantages:

“ 1st. The squeezing and washing so completely cleansed the fermented straw, that the objection to Schenck's hot-water system, arising from the putrid matter re-adhering to the straw, and flying off from the straw in dust in scutching, at once disappeared; and hence the mills erected for hot-water steeping resumed work, and no impediment now exists to steeping being carried on *all the year round*.

“ 2d. Fermentation need never be carried beyond the perfectly safe point, and hence the fibre is not weakened.

“ 3d. The woody matter is easily removed by moderate blows of the scutching instrument, because the sticky matter no longer impedes the operation, and hence the yield of fibre is much greater.

“4th. The fibre obtained is of a singularly soft and pliable character, and is much preferred by the spinner.

“5th. The subsequent process of bleaching is greatly facilitated, because it is the gluten which remains in the fibre which resists the action of bleaching ingredients, and under Mr. Pownall’s process the gluten is effectually removed.

“The use is spreading more and more every day, and the results are universally acknowledged as most satisfactory. The process adds from £10 to £30 to the value of the ton of Flax, according as the raw material is of inferior or superior quality; and the expense is the merest trifle.”

These methods of preparing the fibre from Flax stems which have been dried and stacked, afford considerable advantages, as the seed becomes more ripe, and the farmer can choose a leisure time for the preparation of his Flax—or, better, he may confine his attention to growing the Flax, and then send it for careful preparation to the factory or rettery.

*Steeping green.*<sup>1</sup>—With the above methods of separating Flax which has been stacked, we may contrast that of steeping the stems when green, and of which Professor Wilson says, that “when the quantity is small and can be worked up at once, would appear to be the most advantageous.” M. Dufermont, cultivateur à Hem (département du Nord), found that when the Flax was used green, the steeping only required from six to seven days; and that six days’ grassing gave the Flax a finer colour than could be obtained by any other means. It was dried and ready for scutching in three weeks; whereas the ordinary time in the district averaged from a year to a year and a half. He found also that it yielded 5 per cent. more fibre, which was worth fully 10 per cent. more money in the market. The Flax was pulled before it was quite ripe, the seed-bolls removed by rippling, and the straw immediately placed in the pits. The seed, however, was reduced about two francs per hectolitre in value. The details of the experiments he gives thus:

<sup>1</sup> The steeping of Hemp when in a green state, was strongly recommended by the Abbé Brulles; and the natives of India insist upon its being the best mode for *Summ*, q. v.



FIRST EXPERIMENT.

	Value.	Original value.	Dried.	Steeped and dried.	Scutch'd	Value per kilom.	Value of Seed.	Gross value.
	Francs.	Kilogs.	Kilogs.	Kilogs.	Kilogs.	Francs.	Francs.	Francs.
Green Flax . . .	222	4·030	—	826	191	1·70	27	357·70
Dried do. . . .	222	4·030	1·142	178	178	1·55	31	305·90
Difference . . .	—	—	—	—	—	—	—	51·80

SECOND EXPERIMENT.								
Green Flax . . .	6·05	100	—	26·000	6·350	1·90	—	12·06
Dried do. . . .	6·05	100	30·250	22·500	5·500	1·65	—	9·07
Difference . . .	—	—	—	—	—	—	—	2·99

The practice of steeping green is carried on to a large extent in the Waes district in Belgium.

CHEMICAL PROCESSES.

The action of water and the production of fermentation may truly be considered chemical operations, but the term is usually applied to other processes in which the action of soap, of acids, or of caustic or of carbonated alkalies, or of some salts, is employed to effect the separation of the fibres from each other, as well as from the cellular tissue and accompanying glutinous secretions. The natives of India have long been in the habit of bleaching their muslius by boiling them in a ley of carbonate of soda, and then washing them in a weak solution of citric acid obtained from the juice of limes or of lemons. So in other parts they boil the bast of certain plants in a ley of wood-ashes, in order to facilitate the separation of the fibres (see Nettles). Some of the chemical methods which have been invented in Europe are similar to these.

In the 'Jury Report' of Class IV, by Professor E. Solly, for the Exhibition of 1851, we have an account of the old German process, called "Molkenrost," sometimes used in preparing the finer sorts of Flax. This was steeped for four or five days in a warm mixture of milk and water, and thus the desired degree of fermentation in the Flax stems was produced. This is distinct from the more modern process in

which linen was boiled by the Dutch in a weak alkaline ley, and subsequently treated with sour buttermilk, of which no doubt the lactic acid was useful in removing the alkali, as well as in dissolving some of the impurities of the fibre, and thus was nearly identical with the Indian process of bleaching. Subsequently, salt of sorrel (that is, an oxalate of potash, or the same salt which is so abundant in the leaves of the *Gram Cicer arietinum*,) and sulphuric and muriatic acids were employed, but were found to be too costly. The careful experiments of Hermbstaedt at the beginning of this century threw much light on the chemical principles involved in, and on the influence of temperature on the separation of the fibre of Flax.

These chemical processes have again attracted much attention, since the process patented by M. Claussen has shown how much the nature and appearance of fibre may be changed by the action of such agents. But this, like many other inventions, has many points of similarity with what had been done long before without attracting much attention. Of it we have the following account in the above 'Jury Report,' p. 97: "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, consisting of 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."

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, it was proposed to convert Flax into cotton by boiling

it 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. It appears that the fibre was boiled in an alkaline ley, 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. Some of it was spun into cloth for gowns, and also for waistcoats; but her Ladyship complains that the spinners were hostile to the discovery, for fear of its injuring the cotton trade, and the poor of the North of Ireland, to whom it was supposed it would be beneficial, were indifferent about the merits of the invention. Specimens of the Flax cotton and of the fabrics woven from it are still preserved in the Museum of the Society of Arts.

Several attempts were subsequently made in Germany to convert, with the action of alkaline solutions, Flax into a fibre resembling cotton, which could be used, either alone or together with cotton, in the manufacture of cotton goods, But there, as in Ireland, the manufacturers probably set themselves against the introduction of Flax cotton, and the work-people determined not to use the new material. The matter was subsequently investigated by Berthollet, by Gay-Lussac, and by Giobert, who employed alternately steepings in hot solutions of soap, alkali, and sulphuric or muriatic acid; and Berthollet observes that equally fine cotton is obtained from the commonest refuse tow as from the best Flax. (*v.* 'Jury Report,' p. 98.) More recently, in 1842, M. Rouchon, of l'École Polytechnique, at Paris, has devised a method for preparing Flax by means of immersion in a weak acid solution for a short period, and then placing it in a mass kept moist by occasional waterings. These are repeated daily until the desired effect is produced. The Flax is kept tied up in small bundles, and a man and a boy could attend to two tons per day. (Wilson.)

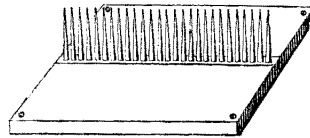
As carbonate of soda is very abundant and cheap in most parts of India, as well as the vegetable acids, and as the

natives are in the habit of employing both in one of their processes for bleaching muslins, they could easily be induced to apply this method to the improved preparation of Flax or of any other fibre.

MECHANICAL PROCESSES BY HAND.

In the preceding account, some processes have necessarily been hinted at and supposed to have been performed, because without them Flax could not have been prepared for sale. But these have not yet been noticed in detail. As they require tools for their due performance, and these cannot be well understood from mere description, we annex some woodcuts, for the use of which the Author is indebted to his publisher, Mr. G. Smith. They are the same which were used in the pamphlet published by the Indian Flax Society, and which was compiled from the then best authorities. Many improved methods of preparing Flax have since then been discovered, and are now employed in Europe, and will, no doubt, be found useful in an extended state of the culture in India. But at present the simplest tools are the most suitable, such as those formerly very generally employed, and still used in many places in this country, and such as are required for cleaning by hand instead of by machinery.

Of these we add, first, a figure of the instrument used for separating or rippling seed,—a process which is recommended to be performed by the farmer.



The ripple has already been described at p. 158.

The best ripples are made of half-inch square rods of iron, placed with the angles of iron next to the rippers, 3-16ths of an inch asunder at the bottom, half an inch at the top, and 18 inches long, to allow a sufficient spring, and save much breaking of Flax. The points should begin to taper 3 inches from the top.

But in the Courtrai system the crop is stoked and ricked

in the field, and afterwards stacked or conveyed to the factory or rettery.

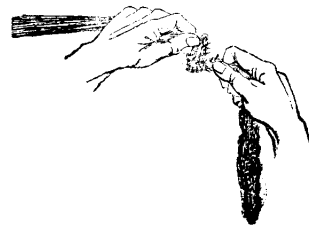
*The Courtrai System.*—This is the mode in which Flax should be saved for steeping on Schenck's or Watt's patent systems. It requires to be very carefully done, as inattention will reduce the value of the straw, and yield inferior fibre. The Flax stems should be put together in bunches, about one half larger than a man can grasp in one hand, spread a little, and laid on the ground in rows after each puller; the bunches laid with tops and roots alternately, which prevents the seed-bolls from sticking to each other in lifting. It should be stooked as soon after pulling as possible, and never allowed to remain overnight unstooked, except in settled weather. The stooking should go on at the same time as the pulling, as, if Flax is allowed to get rain while on the ground, its colour is injured.—It is then ricked, and allowed to stand in the field until the seed is dry enough for stacking.—The rick, if properly built, will stand secure for months. It can be stacked at leisure, or put in a barn, the seed taken off during the winter, and the Flax steeped in the following May; or it may be kept stacked, without receiving any injury, for two or three years, or even longer.

If the capsules or bolls are brittle, or the stems have been stacked according to the Courtrai system, the seed is beaten out with a small wooden stick shaped like a cricket bat; a bundle of Flax is laid on a board, and the bolls are broken with the bat and fall on the cloth below; or they are separated by thrashing with a stick, the foot being kept on the root end of the Flax to prevent its turning about. In some factories or retteries, the stems are passed between plain rollers, by which means the bolls are crushed, and the seed falls out, as mentioned at p. 159.

“*Breaking* is simply crushing the bark and breaking the wood-like part of the stalk into fragments, in order to facilitate the separation of the fibre; this is performed in various ways.

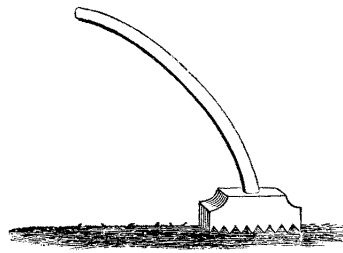
“In order to give the boon such a degree of brittleness as to make it part readily from the fibre, whereby this process is rendered easy, the Flax should be well dried in the sun.

“*Primitive mode of breaking.*—The woody part and bark are broken by twisting a bundle of stalks as it is passed along between the hands, taking care not to ravel or entangle the fibre. The fragments of the stalk, &c., are then shaken, scutched or beaten off by a wooden knife eight or ten inches broad. The fibre thus cleared is the un-



dressed Flax of commerce, worth 6*d.* to 8*d.* per lb., or 6 to 8 annas per seer.

“ Another simple mode of breaking is by taking a handful of stalks in one hand, laying them upon a table or block, beating them with a wooden mallet or bat; afterwards drawing them forcibly over the edge of the table with both hands, and scutching, in order to free them from the fragments and stalks.



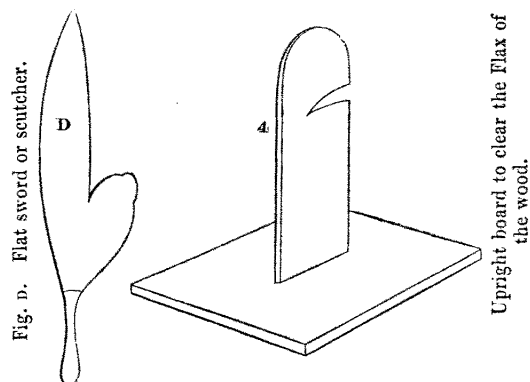
“ Another method. The *Bottle-hammer* is a wooden block (something of the size and shape of a denkee), having on its under face, channels or flutings, five or six deep lines, and it is fixed to a long bent helve or handle. In using it, a bundle of the dried Flax stalks is spread evenly upon the floor, then powerfully beaten with the hammer, first at the roots, next at the points, and lastly in the middle. When the upper surface has been well beat in this way, it is turned over, that the under surface may get its turn. The Flax is then removed, and well shaken to free it from the boon.

“ By the hammer the whole wood is never separated from the textile fibres, but a certain quantity of chaffy stuff adheres to them, which is removed by another operation. This consists either in rubbing or shaking. The rubbing is much practised in Westphalia, and the neighbouring districts.”

The common brake consists of four wooden swords fixed in a frame, and another frame with three swords, which play in the interstices of the first, by means of a joint at one end. The Flax is taken in the left hand, and placed between the two frames, and the upper frame is pushed down briskly upon it. It breaks the Flax in four places, and by moving the left hand, and rapidly repeating the strokes with the right, the whole handful is soon broken. An improved form of brake is worked by a treadle, and motion given it with the left foot.

“ *Scutching-block which may be used with either of the methods of breaking.*—Fig. 4 represents a board set upright in a block of wood so as to stand steady, in which is a horizontal slit about three feet from the ground, the edge of which is thin.

The broken Flax held in handfuls in the left hand is inserted in this slit, so as to project to the right, and a flat wooden sword, eight or ten inches broad, generally of shape of fig. D ;



the breadth of this knife is important; when too narrow it easily causes the Flax to twist round it, and thereby tears a portion of the fibres. With this knife the Flax is repeatedly struck, parallel to the board (and close to the slit), with perpendicular blows, to scrape off its wooden asperities. The part which lies in the slit is continually changed by a motion of the left hand.

“In flax-mills, the operation of breaking is performed by passing the stems between three fluted cylinders, one of which is made to revolve by horse or water power, and carries the other two round. That of scutching is accomplished in the same mill, by means of four arms projecting from a horizontal axle, so as to strike the stalk or boon in a slanting direction, until the useless parts are beaten away. The operation of these mills was at first much objected to, on the ground that they destroy much of the fibre before the woody part is all separated; but their mode of action has been greatly improved, and such mills are now very generally established in Ireland.”

So great is the importance of properly made scutch-mills, that the Royal Irish Society have always made the state of the machinery employed for scutching Flax a principal object of attention. In the year 1852 an Act was passed by Parliament,

extending the provisions of the Land Improvement Act to buildings for scutch-mills. Several have been reported on by the above Society, and a section of one is given in Mr. MacAdam's paper in 'Journ. Agric. Soc.,' vol. viii, p. 304. Messrs. MacAdam have lately invented a scutching mill which has the great advantage of being able to do without skilled labour.

These processes probably form the best introduction to the mechanical methods of separating the fibre.

#### MECHANICAL PROCESSES BY MACHINERY.

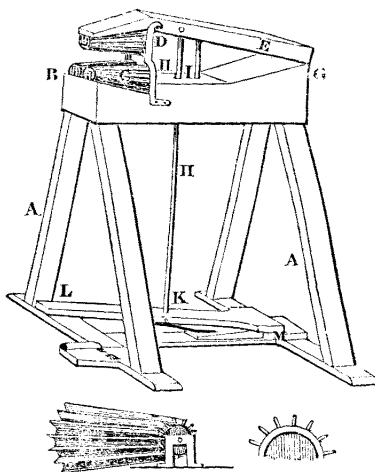
We have already observed that the intimate union between the constituent parts of plants may be dissolved by the action of water, by the fermentative process, or by chemical reagents, as well as in many instances by the mere absence of moisture. Thus we may see the union of the leaves with the parent plant ceasing on the approach of winter; or, more to the point, we may see the cuticle of the Birch bark peeling off, as well as the bark of other trees; or, if we take a cut branch of the Linden or Lime tree, some time after it has been cut, we may see the layers of bark separating from the branch and from each other. The herbaceous parts of leaves may also be reduced to powder, when the fibrous parts still remain; or we may take the dried bark of some fibre-yielding plant, and observe that, by rubbing it between the hands, the cuticle may become separated from the fibres, and these from each other. All facts proving that the fibres of plants may be separated, in some instances at least, by simple drying and by mechanical means. Several machines have of late years been invented for this purpose with more or less success. It is generally considered that such processes are fitted only for such fibres as are required for coarse purposes, such as for rope-making and coarse canvass. But the Author has seen some specimens lately, which seem to prove that such methods are capable of greater perfection than is supposed. They will be of certain advantage where nature has produced a good fibre, and the carelessness of man is liable to destroy its structure by over-retting, or any other inattention.

The first of these patents was taken out by Mr. James Lee



for his method of separating the fibre by mechanical means, and without the aid of water-retting. His discovery was thought of such importance, that Parliament granted him the peculiar privilege, that the time for the specification of his patent should be extended from six months to seven years. The Irish Linen Board expended a large sum in introducing the method into the Flax districts, and Mr. Wilson informs us that one of the machines is still preserved in the White Linen Hall at Belfast. Before the time, however, for specification arrived, Messrs. Hill and Bundy took out a patent for their machine for breaking and preparing raw Flax and Hemp.<sup>1</sup>

In this machine the frame is made either of wood or metal, which supports two conical rollers. These revolve independently of each other in proper brass bearings, a third conical roller being similarly supported under the top piece of the machine. All these rollers are *frustra* of cones made of cast iron. Whatever form of teeth be adopted, they must be so shaped and disposed with regard to each other, as to have considerable play between them, in order to admit the quantity of Flax stem which is intended to be broken and prepared. The upper piece of the machine, which carries the upper conical roller, is attached to the main frame by a moveable joint at its upper end, and is connected near its other



<sup>1</sup> Several of these machines appear by the following extract from a despatch, to have been sent to India by the Court of Directors: "A principle has lately been discovered for producing the fibre of Hemp, Sunn, Caloe, and other similar plants, in a most improved state, without steeping or dew-retting. We have judged it advisable to send you several of the machines, with some printed directions to assist in the use of them; and as very little tuition is necessary, so we have judged it proper only to have two men instructed in its operations, who belong to the ship in which they came, and who will attend to instruct those you may appoint to be taught." (Public Department, May 8th, 1816.)

end with an iron rod, which is attached below to a treadle with a spring, to which motion is given with the foot, while the Flax is held by the hands between the cones. The operation may be commenced and continued for some time with the larger part of the rollers, and finished with their smaller ends: this forming one of the advantages of using conical rollers.

If it is intended that the Flax shall be bleached before it is spun, then recourse is had to certain trays in which are contained the water or other fluid used for bleaching the Flax or Hemp. Then each small parcel is worked separately, while wet, through a machine, similar to that in which the Flax has been broken; but here the rollers should be cylindrical and made entirely of wood, with metal axles, and the teeth, which will be parallel, should be similar in form to those in the lower right hand section (p. 221). This operation will loosen the gluten and colouring matter, for the rinsing and wringing which must follow, and which is preceded by soaking the Flax in a weak solution of soap.

The above machine and process, though not now in use, are interesting, as among those which were the earliest employed, and as indicating the points which require to be attended to; though, in getting rid of one set of difficulties, others are encountered. But the powers and mechanical contrivances of the later inventions have surmounted many difficulties as well as given much greater facilities.

Another process, for which a Mr. Olcott obtained two patents in the year 1840, is interesting, as showing the power of rollers and the cleansing effects of water. This invention consists in taking the sun- or kiln-dried Flax in the stem, spreading it out upon a wide feeding cloth, from whence it passes through a series of long fluted wooden rollers, say thirty sets, that is, sixty altogether, viz., thirty upper and thirty lower rollers, which so crush and break the stalk, that most of the wood drops from the fibre, and renders the process of cleaning it easy.

The Flax, when separated from the wood, is twisted into a rope; the rope should be rove about the thickness of a stout man's arm. This rope is then passed through another series of fluted rollers about six inches wide, and made either of wood or metal; the ends are twisted together, and an endless

rope thus made. The rollers, a series of twenty or thirty sets, are then put in motion, and a stream of water set flowing over them. The rope passing through in an endless round, the remaining particles of wood, or shoves, as they are technically called, are rapidly separated from the fibre, the gluten and colouring matter washed out, and the fibre itself reduced and divided into smaller and finer fibres. After the process has been continued a few hours, the rope is withdrawn, much diminished in size, and quite white. On untwisting it, when dried, the product is "Flax cotton." This article is much more beautiful than the finest cotton: it is almost as soft as silk, and exceedingly glossy, but when closely examined, presents many imperfections.

In the year 1851, Mr. T. Routledge completed a machine, consisting chiefly of peculiarly formed rollers, under which were passed the leaves of the Agave, Plantain, New Zealand Flax, &c.—that is, of all such plants as are arranged under the class of Endogens—then washing and separating the fibre. The machine was capable of turning out two or three tons of fibre per diem; and trials were made with it at Messrs. Pontifex and Co.'s.

Mr. Dickson, of the Flax Works at Grove Street, Deptford, has for some years been engaged in perfecting a machine which will break, scutch, and heckle Flax, as it is taken from the field, without being retted or steeped by any process; and if the Flax be afterwards boiled in his patent flax-steep, it will not only remain strong, but become white.

By this the expense of separating the fibre by hand is saved: this amounts to from 2s. to 2s. 4d. per stone of 16 lb., on an article the average price of which is from 8s. to 9s. per stone. It also supersedes the necessity of employing skilled hands, called scutchers, at 2s. 6d. or 3s. per day.

In a recent statement, Mr. Dickson observes that "his machines produce in one day out of one ton of green Flax stalks, 920 lb. of fibre; that is, 5 $\frac{3}{4}$  lb. out of 14 lb. of stalks. This, when prepared by his liquid, has produced 2 lb. 6 oz. of very fine fibre, or in all 515 lb. of fibre fit for spinners' use." Mr. Dickson further contrasts his process with that of others, stating that, from many experiments caused to be made by that most important and useful body, the Belfast Flax Society, and who recommend Schenck's process, it appears that Mr. Andrews,

a gentleman of great practical knowledge in Flax culture, seems to be only able to obtain 9 lb. of Flax, and 15 oz. of Tow, out of 100 lb. of Flax stalks. Mr. MacAdam, the Society's Secretary, says that improvements have now been made, which enable parties working on Schenck's system, to produce 14 lb. out of 112 lb. of Flax stalks; but by a much more profitable process (that of Watt's), where 10 cwt. 1 qr. 21 lb. of stalks had been operated on, the result was 234 lb. of Flax and Tow; while his own process, Mr. Dickson states, produces 268 lb. of marketable fibre. Mr. Warner, of Trimmingham, the advocate of hand-scutching, commonly obtains 20 stone of scutched Flax out of one ton of stalks, at a cost of 2s. per stone.

The correctness of these conclusions, and the carrying them out on a large scale, are of course dependent upon a variety of circumstances. The Author can only vouch, as he has already done at p. 134, for the greatly improved appearance of some of the Indian fibres which have been subjected to Mr. Dickson's treatment, and he has been assured by good practical judges, that some of them might, in the state to which they have been brought, be at once used for many of the purposes of Flax. He therefore believes that much practical good will arise out of the mechanical method of separating the fibres of Exogens when in a dry state, and of those of Endogens when still moist and green.

The Author has lately had an opportunity of seeing some specimens of Flax from Northumberland, and of Hemp from Italy, prepared by Mr. Dickson, with his machines and liquid, and without steeping. One half of each specimen is in the dried state of the stems, so as to give every facility for comparison. These clearly prove the practicability of this method, and therefore of the preparation of fibre, for many purposes at least, without any steeping.

The Author has also seen some specimens of Indian fibre beautifully prepared by Mr. W. Gardiner.

At the meeting of the Royal Agricultural Society held at Lincoln this year (July, 1854), a machine, manufactured by Messrs. Ransome, was exhibited and worked by Mr. E. Davy, of Crediton, in which Flax fibre was separated from the cuticle and boon by mechanical means, and without any steeping. This was favorably mentioned in 'The Times' (July 20th, 1854),

and the instrument was afterwards sent to Leeds for trial, though the Author has not seen any subsequent account of its performances.

The Author further observes it stated in the annual report for this year of the Royal Society for the Promotion and Improvement of the growth of Flax in Ireland, under the head of "Unsteeped Flax fibre," that "the plan of preparing the fibre without steeping has, on former occasions, been alluded to. It is now being carried out practically, on a very large scale, by Mr. Roche, M.P. for County Cork; and the fibre is stated to find a ready market in England, for certain coarse purposes. The price obtained is considerably under that of steeped Flax, but, as the expense of steeping is avoided, it is stated to be sufficiently remunerative." (Belfast, 24th Nov., 1854.)

*Heckling*.—Among the operations which have been incidentally mentioned, but not described, is that of *heckling*, also called *hackling*. This, however, is more a spinner's than a planter's business, though the latter do sometimes like to send their produce in the best state to market, as noticed even in some of the communications from India. It is, at all events, useful to know the degree of subdivision of which a fibre is susceptible. In this process, the fibres are not only split into their finest fibrils, but are also cleaned, and arranged parallel to each other; while those which are too short for spinning are separated, and form the finer kinds of tow. The *heckle* is a sort of comb, with several rows of teeth fixed into round or oblong blocks of wood; the whole resembling the *hand cards* formerly used for carding cotton, and for which the jaw-bone of the *boalee* fish is a substitute in carding cotton for the *Dacca muslins*. The teeth of the heckle are of iron or steel, differing in length according to their fineness, beautifully polished, tapering, and having the points exceedingly sharp. Heckles of different degrees of delicacy are employed in bringing fibre to the required extent of fineness.

Mr. Tomlinson has given the following clear account of the process: "In heckling Flax, only one card or heckle is used at a time. The workman with one hand seizes a strick or lock of Flax by the middle, throws it upon the points of the coarse heckle, and draws it towards him; at the same time with the other hand spreading the Flax, and preventing it

from sinking too deeply among the teeth. By this operation, the Flax is divided into two parts; viz., the short fibres forming *tow*, which remains between the points of the heckle, and is from time to time removed; and the long fibres, called *line*, which remains in the hand of the heckler. One half of the length of the strick being properly heckled, the other half is turned round and prepared in a similar way. The process is then repeated upon the fine heckle, and continued until the required fibre is produced. It is calculated that 100 pounds of well-cleaned Flax will yield from forty-five to sixty pounds of line; the remainder consisting of tow, boony particles, and dust. Considerable force and dexterity are required to heckle well, for in the hands of an unskilful operative, the best Flax, instead of being separated into fine, delicate, parallel lines, will nearly all be converted into tow, which is much less valuable than line; but a good heckler throws the Flax more or less deep among the teeth, according to circumstances, feeling the amount of resistance required, and drawing it with the proper degree of force and velocity.

“To assist the heckler in splitting the filaments, the Flax is sometimes, between the first and second heckling, folded up into a bundle, and beaten upon a block with a wooden mallet, after which it is well rubbed with the hands. A similar object is gained by bruising it upon a smooth board with a stiff brush, and also by boiling it with potash ley.

“Machines have been contrived for the purpose of superseding heckling by hand, and in all of them the Flax is not drawn through them as in working by hand; but, on the contrary, the sharp points or heckles are moved through the Flax, properly secured.”

It has been already mentioned, that applications had been made, both from Sindh and from the Punjab, for some heckles. A few of them have been forwarded by the overland route, also breaks and scutchers, of the excellent manufacture of Mr. Perry, of Hunslet Old Mill, Leeds.

In connection with the foregoing process of heckling, may be mentioned that of dividing the Flax into lengths, as Mr. Tomlinson saw practised in the extensive mills of Messrs. Marshall, of Leeds. “The length of the Flax varies from twenty-six to thirty, or thirty-six inches; the part nearest the root is

coarse and strong, the middle part fine and strong, and the upper part still finer, but not so strong. The Flax is therefore divided into three lengths, and the parts from the bottom, middle, and top being collected into separate heaps, or stricks, as they are called, several qualities of thread are afterwards formed from them. Sometimes, however, the whole length of the Flax is divided into four or five parts, which are called middles, ends, and middle and end middles."

This process it is especially desirable to notice, as showing the great importance of having the Flax of uniform quality.

EXPORTS OF LINSEED FROM INDIA.

The large exports of Linseed from India have frequently been mentioned. It is desirable, therefore, to give some of the details. By these we may observe, that though comparatively a recent trade, the article is already known to other countries besides England. The first Export of Linseed was made from Calcutta by Mr. Hodgkinson,

	In the year 1832, to the extent of 10 bushels, and increased	
"	1833	" 2,163 maunds.
"	1834	" 2,826 "
"	1837	" 32,327 "
"	1839	" 167,601 "
"	1850	" 765,496 "

As the details of this export may be interesting, we subjoin the following table of the Imports of Linseed and Linseed Oil into, and Exports from, the three Presidencies :

LINSEED OIL IMPORTED (1850-51) INTO	Calcutta.	Fort St. George	Bombay.
From United Kingdom . . . .	Rs. 7,984	—	—
" Amsterdam . . . . .	805	—	—
LINSEED IMPORTED—			
From Concan . . . . .	—	—	Cwt. 59,076
Value . . . . .	Rs. 8,789	—	Rs. 201,035

LINSEED EXPORTED (1850-51) FROM	Calcutta.	Fort St. George	Bombay.
To United Kingdom . . . . .	Ms.298,005	Cwt. 797	Cwt. 50,102
„ North America . . . . .	421,407	—	—
„ France . . . . .	44,986	—	—
„ Guam . . . . .	56	—	—
„ Rotterdam . . . . .	500	—	—
„ Mauritius . . . . .	60	—	—
„ New South Wales . . . . .	74	—	—
„ Trieste . . . . .	384	—	—
„ Penang . . . . .	24	—	—
„ Ceylon . . . . .	—	4	—
„ Concan . . . . .	—	—	10
Total . . . . .	Ms. 765,496	Cwt. 801	Cwt. 50,112
Value . . . . .	Rs1,530,902	Rs. 2271	Rs. 170,539

But the commerce of Linseed has since then much increased; amounting in 1852-3, for Bombay, of Linseed imported to 162,015 cwt., and of exported to 114,309 cwt.

*Quality of Linseed Oil of India.*—It may appear remarkable that Linseed Oil should be imported into Calcutta, when so much Linseed is exported for the express purpose of yielding its oil. This is in consequence of the Linseed Oil of India being considered as not possessed of the full drying properties of the oil prepared in Europe. But there is no doubt, this is owing entirely to the Indian Linseed being expressed before the Mustard seed has been separated, with which it is commonly mixed, in consequence of the two plants being often grown together. Mr. Bowen informed the Author that, when connected with one of the lighthouses in India, he had at one time under his charge some plate glass. This he made use of to separate the two seeds, by placing it on a slope: the round seeds of the Mustard rolled off, while the Linseed merely slipped down. These, when expressed, yielded as good drying oil as any he ever obtained from Europe. The same fact is confirmed by the following statements.

In a report from Mr. W. Ewin, Branch Pilot, to Capt. W. Hope, Master-Attendant at Calcutta, he acknowledges the receipt of five gallons of Linseed Oil, made at the Gloucester Mills, situated below Calcutta.

“I beg leave to say I painted my boat inside green with the above oil, without the assistance of turpentine, and it dried



within the space of twenty-four hours ; and do not hesitate to say if the above oil agreeable to the muster be given, that it is equal to the Linseed Oil received from the Honorable Company's Marine Yard, said to be Europe.

“Sandheads, H.C.P.V. *Sea Horse*, 2d January, 1837.”

So Mr. W. Clark, commanding H.C.F.S.V. *Hope*, writes, 14th Dec., 1836 :

“I have to report, for the information of the Master-Attendant, in reply to his letter (No. 39) of the 7th ult., that I have painted the *Hope*, outside, with the Gloucester Mill oil on one side, and that supplied by the Naval Store Keeper on the other,—both laid on at the same time ; and of the two I must give the preference to the former, in drying and bearing a better gloss.”

IMPORTS OF FLAX, TOW, AND LINSEED INTO GREAT BRITAIN.

In the following table we may see the immense quantities of Flax and of Linseed which are imported into Great Britain.

*Account of the quantities of Flax, Tow, and Linseed, imported into the United Kingdom during the year 1851, distinguishing the countries whence they were imported, and the quantities brought from each. (M'Culloch's 'Com. Dict.')*

	Flax & Tow.	Linseed.
	Cwt.	Cwts.
Russia . . . . .	818,676	417,950
Prussia . . . . .	135,825	58,179
Hanseatic Towns . . . . .	14,925	2,352
Holland . . . . .	83,121	14,779
Belgium . . . . .	79,973	55
France . . . . .	3,802	36
Italy and the Italian Islands . . . . .	1,885	1,667
Egypt . . . . .	48,038	36,410
British Territories in the East Indies . . . . .	48	93,814
United States of America . . . . .	6	1,152
Other parts . . . . .	7,885	4,077
Total . . . . .	1,194,184	630,471

In reference to the expected deficiency of Flax during the year 1854, it has been observed, in the Report of the Irish Society : “So far, however, events have turned out differently from what was anticipated, the permitted import of Russian produce, through the ports of Prussia, having secured even a larger supply than usual of Flax, the quantity received, during the year ended the 5th of October last, being 86,837

tons from all countries, against 74,418 in the same period of 1852-53."

With regard to the cultivation in Ireland, the same Society observes :

From the returns which had been obtained, by order of the Lord-Lieutenant, it appears that the entire area under Flax in Ireland, in the present year, has been 150,972 acres, against 174,579 acres, in 1853. There has thus been a diminution, on the year, of 23,607 acres, or about 14 per cent.

The average annual growth from 1847 to 1853 inclusive, was 101,939, so that the crop of 1854 is about 50 per cent. above the average of the previous seven years.—From the very indifferent yield of the crop of 1853, there is reason to believe that the quantity of marketable fibre this year will be equal to that of the previous crop; and its value may be roughly estimated at about two millions sterling.

So late as 1850, the export of Irish Flax and Tow was but 3166 tons. Of the crop of 1853, the large amount of 7486 tons of Flax and 2763 of Tow—in all 10,249 tons, value £505,989—were shipped from Ireland to England, Scotland, and France.

A very important consideration is the price at which Flax sells. In the year 1840, fine French Flax sold for £90, and ordinary at £80 a ton; Flemish at £80; Friezland at £60; and varieties of Riga at about £48 a ton; at the same time that Jute was selling for £15. At present (Dec., 1854) the prices of Riga Flax vary, according to different marks, from £39 to £48; St. Petersburg, 12 heads, £51; 9 heads, £45 10s.; 6 heads, £40 10s.; Archangel crown, from £54 to £59; and the cheaper kinds of Russian and Memel, from £31 to £45; Jute being at the same time sold at Dundee for from £19 10s. to £23 10s. Egyptian Flax sells for from £33 to £44. The seed is generally sold by the bushel, which weighs from 52 lb. to 54 lb., usually sent from Odessa in bulk, from Italy in sacks; the Riga and Dutch in barrels.

The marks by which several of these Flaxes are distinguished in M'Culloch's 'Dictionary,' are thus explained :

The best Marienburg is called simply Marienburg (M) or Marienburg clean; the second quality, cut (G M); and the third, Risten Dreyband (R D). Of the three other provinces, the first quality bears the name of *rakitzer*; as Druania *rakitzer* (D R), Thiesenhausen *rakitzer* (T R), and Lithuania *rakitzer* (L R). The cut Flax of these three provinces is the second quality, and to the third quality belong the *badstub* and *badstub cut* (B and B G), the *paternoster* (P N), and *hafs three band* (H D). *Badstub* and *paternoster* are the refuse of the *rakitzer* Flax, and the three band again the refuse of the former sorts, and consequently very ordinary. The Revel and Fernau consist of Marienburg, cut, risten, hafs three band, and three band. The Liebau and Memel growths are distinguished by the denomination of four and three band. These two sorts, as well as the Oberland Flax, come from Königsberg, Elbing, &c., and are little esteemed in the British markets.

In the imports of Flax, the terms *Codilla* and *Tow* are very often used as synonymous, but *Codilla* forms the first workings in the dressing of Flax, and is longer than *Tow*; it is more or less dirty, and in consequence sometimes cheaper than *Tow*. The fixed charges on twelve-head Flax at St Petersburg, are 73 roub. 63 cop.; on nine-head Flax, 80 roub. 50 cop.; and on six-head Flax, 91 roub. 61 cop. The charges on Flax in England, taking the price at £45 per ton, are £6 13s. 8d. (*v.* M'Culloch's 'Com. Dict.')

Since the foregoing parts of this article have been printed, the Author has received a letter from Lahore, dated 21st Oct., 1854, stating that they were led to believe, from various letters, that the production of Flax in the Punjab this year would be "considerable, and that we may look forward to a yield of from 200 to 300 tons of Flax, besides a large quantity of seed."

Dr. Jameson, to whom one of the Flax experiments has been assigned (*v.* p. 190), and whose opinion, from his extensive experience in the culture of Tea and knowledge of the country, is particularly valuable, wrote to the Author from the Himalayas, 6th Nov., 1854, to the following effect: "For some years I have been cultivating Flax on a small scale, from seed procured from Russia, and its fibre has been pronounced by parties in Calcutta, of a very superior description. I have already made arrangements to grow it more extensively this season, in two or three different situations. There is nothing to prevent this country supplying both Flax and Hemp on a vast scale. It possesses immense advantages in abundance of land and cheap labour. In the Punjab thousands of acres are available; and from the means of producing both Hemp and Flax cheap, this part of India will always be able to compete with other countries."

#### CONCLUSION.

The account of Flax has extended to a much greater length than is perhaps suited to the nature of the work. This is owing, partly to our having taken the opportunity of treating rather fully of the different points connected with the culture and preparation of this fibre, and partly to our having treated in detail of the attempts which have been already made to cultivate Flax in India. This we have done, in order to ascertain, if possible, the causes of failure, or rather of the want of commercial success; while the examination of the various questions connected with the analyses of soils, of the Flax and

its products, as well as of steep-water, and the various methods which are now adopted for separating this fibre, cannot fail to suggest to cultivators in the East some methods of improving their own practice. Having already made some observations (*v. p.* 185) on the results of their experiments, we need now only observe that the chief want, seems to have been that of moisture during the season of cultivation. Therefore, we cannot but think, that when this deficiency is supplied, either by canal irrigation, or by the nature of the climate, as in the present experiments (*v. pp.* 188—195), that success will attend the efforts, and that the example will be useful to other districts. Considering the prices at which Indian-grown Flax formerly sold for in England, and the cost of growing such fibres as Jute and Sunu, which have long been sold at from £15 to £20, it appears quite possible to grow Flax as a profitable crop, especially as it is said that in some situations even the seed pays for the expenses of cultivation. But in case the fibre should not be good enough as Flax, some would be available as tow, and some for paper-makers, especially if reduced to the state of half-stuff by the use of the Indian dhenkee. The extra labour required for the preparation of the fibre can certainly be supplied as cheaply and as profitably in India as in any other country of the world. But if any difficulty is experienced, it would be easy for planters to induce native cultivators to grow the Flax in any particular manner and to sell it at certain rates, as they now do the Indigo plant. This the European now manufactures into Indigo of such excellent quality, as to hold the first place in all markets. Much of the same success might attend the culture of Flax if the climate were equally suitable; but it is yet sufficiently favorable in many parts to admit of at least as much success as has been attained in Egypt. It is only requisite that Rectories according to some one of the improved methods should be established in a few central situations, to which the ryuts could bring the results of their cheap agricultural labours, and where a due subdivision of labour and manufacturing cheapness could be substituted for a mixed system, suited only to early states of society.

LINDEN, JUTE, &c., of the family of *Tiliaceæ*.

The *Tiliaceæ* or Linden tribe are so named from the well-known European tree—a favorite in parks and public walks, and the source of an extensive commerce, inasmuch as the mats which are imported in such enormous quantities, are formed of the bark of this tree. But in the same family with the Linden tree, botanists place also the genus *Corchorus*, species of which yield the now well-known Jute of India, as well as the genera *Grewia* and *Triumfetta*, both of which contain species remarkable for the tenacity of their bark. The *Tiliaceæ* are also remarkable for mucilaginous properties. The leaves of many are edible, and the fruit of some afford pleasantly tasted acid berries.

LIME OR LINDEN TREE (*Tilia europæa*), and RUSSIA MATS.

The Lime tree abounds in the forests of Europe, but especially in those of Russia; and is esteemed for its sweet-scented flowers. The wood of the tree is white and light, and employed for making furniture, for turning, and for carved works. The bark of these trees when steeped in water soon separates into thin layers, which are employed for making a coarse kind of rope, for making matted shoes much worn by the Russian peasantry, and also for making the mats which are so largely exported from Russia, and which are so extensively used in this country for packing furniture, as well as for gardening purposes, and for covering the floor. A Linden shoot growing in moist situations, is stated by Mr. Tooke as not fit for peeling, for the purpose of being platted into shoes, in less time than three years. To every pair of shoes, from two to four young Linden stems are requisite; and though these grow faster as they are cut, yet the consumption is enormous, and the destruction of the Linden tree is in consequence immense. For the better, larger kind of mats, trees of from eight to sixteen years are cut down when full of sap, and the bark is immediately separated both from the tree and the branches. It is first cut longitudinally, then raised with an instrument made of bone, and then torn off with the hand. When the bark has been removed, it is stretched on the ground to dry,

two or three strips being laid one over the other, and kept straight by being tied down to long poles. They are employed for making ropes in some parts of England, and for well-ropes in France. When required for use, they are steeped in water, and the cortical layers readily separate from each other. The best of these layers are those which are in the interior, while the coarser layers are on the outside.

The manufacture of mats is nearly confined to Russia and to some parts of Sweden. Trees of from six inches to one foot in diameter are selected in the woods, and in the beginning of summer the bark is stripped from the trees in lengths of from six feet to eight feet. These are afterwards steeped in water, till the bark separates freely into layers; it is then taken out and separated into ribands or strands, which are hung up in the shade—generally in the wood where the trees grew from which they were taken; and in the course of the summer they are manufactured into mats. The fishermen of Sweden make fishing nets out of the fibres of the inner bark.

The trees from which the bark is taken are cut down in the summer, and, properly cut, are burnt in heaps into charcoal.

The sap is drawn off, and, when evaporated, yields sugar. The honey of the flowers is much sought after by bees.

The Lime tree is principally produced in the government of Vialka, Kostroma, and those immediately contiguous; and in the months of May and June—the period when the bark is most easily detached from the stem—the villages in the governments in question are almost deserted, the whole population being then in the woods employed in stripping the trees. The academician Köppen, who has carefully investigated this curious subject, estimates the average annual production of mats in European Russia, as follows:

Government of Vialka	.	.	.	6,000,000	pieces
„ Kostroma	.	.	.	4,000,000	„
„ Kasan	.	.	.	1,000,000	„
„ Nijni Novgorod	.	.	.	1,000,000	„
„ Vologda, Tamboff, Simbirsk, and Penza	.	.	}	2,000,000	„
Total	.	.	.	14,000,000	„

Köppen further estimates that about a fourth part of this

vast quantity, or  $3\frac{1}{2}$  millions, are exported, the rest being consumed at home.

Archangel is the principal port for the shipment of mats, and it appears that on an average of the years 1851 and 1852, the export of mats from that port amounted to 615,360 pieces a year. Large quantities are also shipped from Petersburg, Riga, and other ports. (M'Culloch's 'Com. Dict.')

The extent of the Imports of Russia Mats into this country may be judged of by the following statement furnished to the Author by Messrs. Wrench :

1832 . . . 840,000	1847 . . . 520,359
1840 . . . 817,772	1848 . . . 397,553
1841 . . . 508,485	1849 . . . 576,565
1842 . . . 532,401	1850 . . . 359,223
1843 . . . 861,565	1851 . . . 734,659
1844 . . . 449,817	1852 . . . 333,008
1845 . . . 634,041	1853 . . . 657,040
1846 . . . 898,619	

The price in Jan., 1834, was £4 10s. per 100, the duty included; in 1848, 95s. to 100s.; and in 1849, under 80s. In 1850, 90s.; 1851, 87s. 6d.; 1852, 85s. to 100s.; and in 1853, 120s. per 100.

## INDIAN SUBSTITUTES FOR RUSSIAN BAST.

As stated above, botanists place in the same family of plants the European *Tilia* and the species of the Indian *Grewia*, from resemblance in points of structure. So, if we inquire into the uses of these plants, we shall find, that as Lime leaves used to be, and still are, employed in some parts of Europe, both in a green and dry state, as fodder for cattle, so in the Himalayas, cattle are fed with leaves of *Grewia didyma*, and some are stacked for winter use, for cattle, sheep, and goats; as the Author, when travelling there observed. As the inner bark of the Linden yields bast for mats, so is the inner bark of *Grewia oppositifolia*, called *bihul*, employed in the same mountains for making ropes.

The inner bark of many trees is employed in other parts of India for the same purposes, though it is not easy to identify

the plants, from only local names being usually given by travellers. Thus, in the following account given by Capt. Biddulph in a letter to the Agri-Horticultural Society of India, in the year 1843, he states that, near Darjeeling, "the Lepchas make rope from the fibre of the Kullyhain, and stout bowstrings and sewing thread from the fibre of the Ruffickee tree." "Nothing can be more simple," Capt. Biddulph states, "than their mode of manufacture: the bark is torn off the Kullyhain when from five to fifteen years' growth; the inner bark or fibre is then detached, as shown in the specimen, washed for a few minutes in water, and when dry, pared or pulled into narrow strips, and twisted by the hand into rope of any thickness. The bark of the Ruffickee is taken off the plant when five or six feet high, and treated in the same manner as the former, except that the outer bark only requires to be scraped off with a knife. All the Lepcha fishing nets are made from the Ruffickee, and are remarkably light and strong."

Among the Mallow tribe (or *Malvaceæ*), and some allied families, as we shall afterwards see, there are several other instances of the same kind. To the Great Exhibition of 1851, specimens of several kinds of Bast were sent, both from Assam and from Arracan. Of these, the specimens sent from the latter were so promising, that the Author was induced to send them for examination and trial to the Horticultural Society's Garden at Chiswick; and as the opinion formed respecting them was favorable, he included the information in the following report:

"Having been lately much engaged in examining and showing to practical men the various fibres which were sent to the Great Exhibition of 1851, as well as those which have recently arrived from Assam, I was induced to turn my attention to the subject of Bast. Of this, large quantities are imported into this country, in the form of mats, from Russia, chiefly for the use of gardeners, who use them for covering pits and frames, or protecting plants, and afterwards, when pulled to pieces, for tying up plants and vegetables. The mats are also extensively used for packing cabinet-work and furniture in general.

"The subject may appear trifling, but it is calculated that



about 3,500,000 mats are exported from Russia, and about 500,000 to 800,000 are annually imported into this country. They are made of the bark of the Lime or Linden tree, which, when stripped off, is also made into shoes, cordage, sacks for corn, &c. The Linden tree is not found in India; but there are many which belong to the same family of plants found there, some of which probably yield similar products, possibly one or two of those to which I now wish to draw attention.

“Among the raw products sent from the province of Arracan, there were six kinds of Bast (which there seems to be called *Shaw*), with specimens of rope made with them. They were named—1, Theng-ban shaw; 2, Pa-tha-you shaw; 3, Shaw-phyoo; 4, Ngan-tsoung shaw; 5, Shaw-nee; 6, Eee-gywot shaw. Observing that some of these, from their strength, flexibility, and softness, were well calculated to answer the purposes of the Bast in ordinary use, I sent some specimens to Dr. Lindley, and requested him to have their useful properties ascertained in the Horticultural Society’s Garden at Chiswick. As he informed me that both the Superintendents, Messrs. Thompson and Gordon, reported very favorably of them, I requested the latter to give me a detailed report, including all such information as would be useful to merchants in Arracan. The kinds sent to him were No. 2, Pa-tha-you shaw; 3, Shaw-phyoo; and one marked *Sansevieria zeylanica*, was probably a specimen from Cuttack.

“Though well aware that the freight must always operate against a bulky article of low price brought from so great a distance, yet there are occasions when, from a stoppage of, or a deficient supply from, ordinary sources, a rise of price ensues, which might be taken advantage of at a place on the coast like Akyab. I would, therefore, beg to suggest that the accompanying report should be sent to India for the information of the merchants in Arracan, or for publication in the journals in India. At all events, a knowledge of the good qualities of these Indian Basts might lead to their employment in India, and to their export to less distant countries than England. As it is possible that merchants in Arracan might wish to make mats in imitation of the Russian, I would suggest that a piece of one of these might be sent there; as by this the thickness

of the transverse and the pliability of the longitudinal pieces of the Bast of which they are composed might easily be imitated.

“ East India House, Jan. 16, 1854.”

*Report upon new kinds of Bast-matting from India.*

“ Hort. Soc. Gardens, Chiswick,  
January 11, 1854.

“ Sir,—The three pieces of Indian Bast sent appear all the same, at least I cannot detect any difference in their qualities or appearance; and I think, when it is made into mats, will prove an excellent substitute for Russian mats. It is very strong, is in broad strands, very pliable and tough when wetted, easily divided into small portions for the purpose of tying, &c., and is entirely free from knotty places; and when worked into mats in the Russian way, will be an excellent winter covering for pits and frames. The material, also, seems more firm and tough, and, I have no doubt, will last at least twice as long (in wear) as the best Russian mats; and, if sold at a less price, will in time supersede them.

“ The price of Russian mats is now from £7 10s. to £8 per 100, wholesale; and from 2s. to 2s. 6d. each, retail.

“ A full-sized Russian mat weighs about 5 lb. when new and quite dry, is 7 feet long and 4 feet broad, and is made with the rougher and worst strands worked crossways, and the thinner and longer strands longways in the mats.

“ In making mats, it should be observed never to have any of them under the regular size, for small mats (either shorter or narrower) greatly detract from the value of full-sized ones when mixed with them.

“ I remain, sir, your obedient servant,

“ GEORGE GORDON.

“ To Dr. Royle, &c. &c.”

The appearance of these basts may be thus described. All were sent in the state of bast, and twisted into rope, from Akyab in Arracan. The price of all stated to be one rupee a maund, or about 3s. a cwt.

1. *Theng-ban shaw*.—Coarse-looking, and of a reddish-brown colour, but divisible into a number of very thin layers, with a good deal of flexibility, and some toughness. A portion twisted into rope.

2. *Pa-tha-you shaw*.—Strips seven feet in length, and fine in texture, light-coloured, formed of several easily divisible layers; the outer layers rather dense and compact, and the inner cancellar. A *Musæ* species (?).

3. *Shaw-phyoo*.—Long, thin, smooth layers, light-coloured, tough, and flexible; easily divisible into still finer layers.

4. *Ngan-tsoung shaw*.—Fibres and rope sent, but mislaid.

5. *Shaw-nee*.—Of a reddish-brown colour, rough and coarse, but twisted into rope.

6. *Eee-gywot shaw*.—Strips five to six feet in length, composed of several layers; of which one side is smooth and compact, but the layers on the other side thin but cancellar, all having a considerable degree of toughness.

Mr. Ripley, in 'Journ. Agri-Hortic. Soc.,' viii, p. 147, describes three barks under the names *Shaw-ne*, *Shaw-phrus*, and *Batharan shaw*. These may be Nos. 5, 3, and 2. But the spelling differs much. He also mentions several useful Rattans at Akyab.

There are no doubt a great variety of other basts, which might easily be procured from trees in Assam, Arracan, and all along the Malayan Peninsula, as well as on the Malabar Coast. In an account by Mr. Fenwick of the vegetable products of the Tenasserim he mentions a bast rope of considerable strength, and also that plantains and pine-apples are very abundant there. All the above places are on the sea-coast, or accessible by river. But Akyab, where so many are already produced, seems the most favorable situation for their export to Europe, if it should be found desirable. It is probable that several might be much improved by a little steeping in water, as practised with the Russian bast.

Some of those sent to the Exhibition of 1851, and of which the plants are unknown, may here be mentioned.

*Patoo* or *Asta* is a bast from Beerbhoom, is like the Putwa from Bhagulpore, and will be noticed with it.

*Chehoor*, a pale, brownish-coloured cordage from Beerbhoom, coarse, and of moderate strength.

*Bark string*, made by Hill tribes of Rajmahl, of useful size and strength.

*Bark rope*, with the coarse but strong fibre of which it is made: also from Rajmahl.

Several Bark cloths from the Islands, &c., will be mentioned with the Paper Mulberry, formerly *Morus*, now *Broussonetia papyrifera*.

There is a remarkable cord without name, which seems to be formed of a salvage of fibre, with a yellowish bark folded or

laid round it, and of these, two threads so made up are twisted into a cord.

A bark like some sent as that of *Odina Wodier*, is full of fibrous material.

One of the best of the basts, and seemingly as like one of those from Arracan, was sent from Assam; the strips are from six to seven and eight feet in length, consisting of several layers, easily separable, tough, flexible, and strong. They have the number on them of the box in which was conveyed, and in which were contained Pine-apple fibre; but their appearance is totally different.

Several of the basts of different plants which are used by the natives, and of which the names have been ascertained, will be mentioned under the heads of *Hibiscus arboreus*, or *tiliaceus*, *Sterculia villosa* and *guttata*, *Bauhinia racemosa* and *scandens*, *Celtis orientalis*, *Antiaris Saccada*. Capt. Thompson reports upon a bast rope made by the Munneeporees, and on another from Singapore. ('Journ. Agri-Hortic. Soc.,' viii, p. 45.)

JUTE, JEW'S MALLOW (*Corchorus olitorius* and *capsularis*,  
*Tiliaceæ*).

Sans., *Putta*; Beng., *Pat*; fibre, *Jute*; cloth, *tat*, *cholee*, *megila*.

The name Jute is now so familiarly known, and this fibre is so extensively employed in some of our manufactures, that one is apt to think that it must have long been established as an article of commerce. This is far from being the case, for we find no notice of it even in comparatively recent dictionaries of commerce; and it is not above fifteen years since that it has come to be much employed in the manufactures of this country, though it has long been so employed in India, and its fibres much used for making both cordage and cloth.

Under the name of Jute, however, the fibre of two very distinct plants is included, though no recent accounts have been published by any of the present growers of Jute. Both plants are common in almost every part of India; the leaves of both are used as pot-herbs, and the stems of both yield fibre, and are cultivated on both these accounts; and both are placed by botanists in the genus *Corchorus*, which is so

named from the *Korkhoros* of the Greeks, which also was a pot-herb, and, indeed, is by many supposed to have been one of the very plants which we have now to describe. This is the species called *Corchorus olitorius*, which is still cultivated in the neighbourhood of Aleppo, and is described by travellers in the East as eaten for a pot-herb in Egypt and Arabia, as well as in Palestine. Rauwolf saw the Jews about Aleppo using the leaves as a pot-herb; hence the old name of "Olus judaicum" in old authors; which by the French is translated Mauve de Juif, and by us "Jew's Mallow." It is supposed to be the plant alluded to in 'Job,' xxx, 4.<sup>1</sup> It is the same plant which, small and herbaceous in the dry soil of Syria, grows to a height of four or five feet in the North of India; but in the hot, moist climate of Bengal, attains a size that allows fibres of twelve feet in length to be separated from it.

The other plant, which we suppose also yields some of the Jute of commerce, is *Corchorus capsularis*, easily distinguished from the other by the form of its seed-vessels being globular instead of elongated and cylindrical. It is also more remarkable for an east and west, than for a north and south distribution. We have stated that it is to be found in most parts of India, and likewise in Ceylon. It is curious that Rumphius, in his 'Herb. Amboinense,' v. 212, t. 78, describes it under the name of Ganja (but this may be pronounced Gania), which is that applied in India to the true Hemp. By Malays it is called *Rami Tsjina*, that is, Chinese Rami; a name which we shall find is also applied by them to other fibre-yielding plants, as to the true Hemp, according to Rumphius, and also to the *Urtica nivea*, as we shall see under the head of China-grass. It is no doubt cultivated in China, where Roxburgh states it is called *Oi moa*.

This so-called Chinese Hemp—but a true *Corchorus*—was at one time supposed to be superior to the true Hemp, and attempts were made to introduce it into England; the account of which is detailed in the 'Phil. Trans.,' vol. lxxii. It is there stated, that seeds sown in England produced plants fourteen feet high, and nearly seven inches in circumference, though few produced mature seeds. But some, however, which came to maturity in the second season produced a crop

<sup>1</sup> 'Malluach,' in Kitto's 'Cyclopædia of Biblical Literature.'

of good Hemp, greater by one third than was ever known to be obtained in England. We may easily believe, therefore, that this may grow to a great height in the congenial climate of Bengal.

As both these plants seem to yield the fibre called Jute, we may describe both, before proceeding to treat of their culture or the mode adopted by the natives of India for separating their fibre.

*Corchorus olitorius*, Pot-herb, or Jew's Mallow, as seen in the Mediterranean region, is an herbaceous annual plant, only a foot or two, but in India of several feet in height, and erect in habit. The stem is smooth, cylindrical, and more or less branched. The leaves are of a lively green colour and smooth, alternate, on footstalks, oval or ovo-lanceolate in shape, with the margin dentate, and with the two lower dentilures terminated by a slender filament. The stipules are simple, awl-shaped, and reddish coloured at their base. The peduncles or flower-stalks are one- to two-flowered. The flowers are small, having the calyx consisting of five pieces or sepals, and the corolla of five yellow petals. Stamens numerous. Torus, or nectary cup-shaped, with glands at the base of the petals. Ovary solitary, ripening into a long, nearly cylindrical capsule, ten-ribbed, six to eight times longer than it is broad, five-celled, and formed of five valves, with five terminal points. Seeds numerous, with nearly perfect transverse partitions between them.

This is called *Putta* in Sanscrit, and *Pat* in Bengalee; flowers in the rainy season, and fructifies in October and November. Cloth made of it is called *Tat*, the fibre *Jute*.

Dr. Roxburgh states that there is a reddish variety of this, which the natives call *Bun Pat*, that is, Wild Pat.

*Corchorus capsularis*, or Capsular Corchorus, is also an annual, with a straight, smooth, and cylindrical, afterwards branched stem, from four and five to eight and ten feet in height. The leaves have long footstalks, and are oval, acuminate, thin, and of a light green; serrated at their margins, with the two lower serratures terminating in narrow filaments. The flowers are small, yellow, and like those of the other species in the number of their parts. The capsules are short and globose, wrinkled and muricated, with five cells, and composed of five valves; seeds few in each cell, and without transverse partitions. It flowers in the rainy season, and the fruit is ripe in September and October.

This is the *Ghi-nalita pat* of the Bengalese, and its fibre sometimes called *Nalta jute*. It is called *isbund* in North-West India. It has been called Chinese Hemp (*Rami tsjina*) by the Malays, and its fibre *China pat* by Roxburgh. The kind called *Teetah pat* is said to be a variety of this species.

It is cultivated both in Bengal and in China, on account of its fibre, which is separated by maceration, and used as cordage, both for agricultural purposes and for river navigation, as

well as for making paper. It is also employed for making the coarse kind of cloth called Megila in Bengal; and another kind called *tat* or *choti*, whence, probably, has been derived the name *Jute*. This kind of cloth is now well known by the name *gunny*, and used for making *gunny bags*; a name derived either from the Ganja or Gania of Rumphius, or from *goni*, a name of *Crotalaria juncea* on the Madras side, (Buchanan); there the name Jute is in some places applied to its fibre, and also to that of *Hibiscus cannabimus*.

There are several other species of *Corchorus* common as weeds in every part of India, but all may easily be distinguished from the last by the roundish form of its capsules. The Author has found species at as great an elevation as 5000 feet in the Himalayas, but only in the rainy season.

Dr. Buchanan found both the above species cultivated in the districts of Dinajpore, Rungpore, and Purneya. In the last he was informed, that the *Corchorus* which is used for cordage is the species called by botanists *olitorius*, while that used as a pot-herb is the *capsularis*; just the reverse of what is the case in some other places, showing the probability of both species being cultivated for their fibres.

The fibre is long, soft, and silky, and well fitted for many of the purposes to which Flax is applied, as it is divisible into very fine fibrils, which, like those of the other species, are easily spun. It is possessed also of some strength and durability, even after 116 days' maceration, as in Dr. Roxburgh's experiments. Under the microscope, the fibres of the two species seem exactly alike.

It is generally stated that the fibres of Jute, or of those employed in making gunny bags, cannot be bleached. This is incorrect; they may not be bleached by ordinary methods. Indeed, a paper-maker mentioned to the Author, having discovered Jute in some rope, because it would not bleach. But the late Col. Calvert brought several specimens of beautifully bleached Jute to the India House, as well as some furniture damask made of it; and we observe that Mr. Rogers presented some of his bleached specimens to the Agri-Horticultural Society, in May, 1846.

Dr. Roxburgh has described the species *C. olitorius* as the **Pat** of the Bengalese, and as partially grown for the leaves and

tender shoots, which are used by the natives—both Hindoos and Mussulmans—as an article of food. When wild it shoots out many lateral branches, which renders it a difficult matter to separate the fibres from the woody parts. In preparing the filaments, the plant requires much longer steeping in water than Hemp—a fortnight or three weeks being scarcely sufficient for its proper maceration. (*v. p.* 248.) He called attention to it as a substitute for Flax, from the length and fineness of its fibre.

The gunny bags, in which sugar and similar commodities are brought to this country from India, are made of this material. These are now sent to America for packing their cotton. Though only made known in the beginning of the century, it is now imported in immense quantities, and used for a variety of purposes, as it spins so easily, and being cheap, is therefore used for mixing. It used to be employed for mixing with Codilla; this is now used for mixing with Jute.

A description of the cultivation and manufacture of Jute was given by Baboo Ram Comul Sen (in 'Trans. Agri-Hortic. Soc.,' vol. ii, p. 91), where he mentions that the principal places where it is cultivated are Malda, Purnea, Natore, Rungpore, and Dacca—where both land and labour are cheap. He mentions four kinds—*Pat*, *Tasa*, *Mestah*, and *Coshta*—but without describing them; and quotes Roxburgh's descriptions of *C. olitorius*, *C. capsularis*, and *C. fuscus*.

Other names are given in other districts, as at Jungypore: 1, *Ghore Sun*; 2, *Paut*; 3, *Cooch-murda Paut*; 4, *Amleeah Paut*. The first and fourth may be *Crotalaria* and *Hibiscus*, and the second and third species of *Corchorus*. These may also be included under the names of *Amrah Sun*, *Chunduna Sun*, and *Putooa Sun*. Some Jute sent to the Exhibition of 1851, from Rungpore, was distinguished by the names of Suffed (white) Hemanty Pat; 2, Lal (red) Hemanty Pat; and 3, Lal Petrie Pat.

*Culture.*—The seeds are sown in April or May, when there is a sufficient quantity of rain to moisten the ground, which is generally low, and harrowed in the same manner as paddy (rice) land (in any land that will produce summer rice, which requires to be well ploughed and smoothed). The field is weeded after the plants are a foot and half high. When it has flowered, which happens about July and August (to 14th



Sept.,—B.), it is cut. The plants are three to twelve feet high, and the circumference of the stalk is about one inch. As the seed is not ripe when the plants are cut, some of them are left, to allow the seeds to come to maturity.

After the plants are cut down close to the roots, their tops are clipped off, and fifty to a hundred are tied together; ten to fifteen of these bundles are laid in a shallow tank or reservoir of water, like rafts, over which a quantity of turf and clods of earth are laid to make them sink under the surface of the water; it is allowed to remain there for eight or ten days, during which the cultivator daily visits it, in order to see that it is properly laid, and the trunks are not unduly rotted. When the bark separates, and the stalk and fibres become soft, the weight upon the raft is removed, and the stalks are unbundled. The dresser descends into the water knee-deep, and takes up five to eight sticks at a time. He breaks off two feet of them at the bottom; the bark, which is become soft like thread, is held in both hands, and the stalks are taken off. The fibres thus separated (and by mere washing are brought to the state of separated fibres,—B.), are dressed, and exposed to the sun, by hanging the bundles of fibres over bamboos to dry; they are afterwards partially cleaned, and finally made up into bundles of from one to two maunds for the market.

After the Pat has been removed, the fields of which the soil and elevation are suitable grow a winter crop of tobacco or mustard seed. The produce is differently stated to be from 400 lb. to 700 lb. per acre. The harvest price, according to Dr. Buchanan, was, in his time, about 12½ annas per 100 lb. Mr. Henley informs the Author that “Jute used to be sold some years ago for R. 1 8 for the bazar maund; but the demand in this country had had the effect of raising the price of Jute to double its old Indian value. At present, any fine, long, silky Jute is eagerly bought up at Rs. 2 8; still for inferior Jute I should say, dealing face to face with the village dulals, the price would not exceed R. 1 8 per bazar maund.”

The culture of Jute has of late years been greatly improved in many places, as may be seen in much of that sent to market, and of which we have an instance in the sample of Jute presented for report by Mr. P. Carter of Bhojepore Factory to the Agri-Horticultural Society. This having been

submitted to the members of the Flax Committee, the following favorable opinion has been expressed on it :

Mr. Hodgkinson.—This is the finest specimen of Jute I have ever seen—being bright, clean, strong, and of excellent staple ; the root ends particularly well freed of the hard woody bark which characterises bazar Jute, and deteriorates its value.

I should say that £16 to £17 could be obtained for Jute of similar quality at home, being fully £2 per ton more than the ordinary descriptions now fetch.

Mr. Fergusson.—It is very good Jute, worth £3 to £4 per ton more than what is generally shipped.

Dr. Buchanan and Ram Comul Sen describe the Pat as spun by two kinds of spindles, the Takur and Dhara. A bunch of the raw material is hung up in every farmer's house, or to the protruding stick of a thatched roof, and every one who has leisure, forms with one or other of these spindles, some coarse packthread (sutoli), of which ropes are twisted for the use of the farm. The Dhara is a reel, on which a thread when sufficiently twisted, is wound up. The Takur is a kind of spindle which is turned upon the thigh or the sole of the foot. Ghurghurea is a third kind of spinning machine. It is only the lower Hindu castes, called Rajbongsi, Konget, and Polya, that form this packthread for being woven into sackcloth, and spin a finer thread from which the cloth called Megili, or Megila, is woven. By far the greater part of the cloth that is used dyed, receives the colour in the state of thread.

The coarse cloth, called Megili, is woven by the women of the lower class of people. Most families have a loom, and the people, especially the women in the afternoons, work a little occasionally, and this serves to clothe the family. The pieces consist of three or four narrow cloths sewed together, some four or five cubits long, and from two to three cubits wide, and are worth from two to eight annas each. Some have red and black borders. It is said to be more durable than cloth made of cotton.

## CHATEE, OR JUTE CLOTH FOR GUNNY BAGS.

The kind of cloth called *chatee* is made from the same material, and is made of three different kinds, and always woven in pieces from three quarters to one cubit wide, of which two or three are sewn together into one piece before it is sold. The first kind, intended for bedding, is from four to five cubits long, and from two and a quarter to three cubits wide, and sells at about 8 rupees per 100 pieces. Secondly, that intended for covering bales of cloth is of the same dimensions, but is thicker than the former kind. The 100 pieces cost from 6 to 10 rupees. Thirdly, that intended for making rice- and sugar-bags is four cubits long, and one and a half or one and a quarter cubit wide, and ten bags cost 4 or 5 rupees. These are sewed or doubled and made into bags. The value of the manufacture in the Dinajepore district amounted to 160,000 rupees. (Buchanan.)

The principal places where Chatees are manufactured are Malda, Purnea, Natore, Rungpore, and Dacca; where the cultivation of Jute is extensive, and the price of labour and land very cheap. Ram Comul Sen says, "If the labour of spinning the Jute and weaving Chatee, are to be done according to the rules of labour at Calcutta, the price of gunny would be more than double that for which it is sold."

The greater part is cultivated by those who use or manufacture it; for almost all the small Hindu farmers weave cloth of this material, and every farmer requires some for the use of his farm.

On all the eastern frontier a great proportion of the women are clothed in the coarse cloth made of the Corchorus, which also gives them much employment. The value of the material consumed in those days was about 70,000 rupees. In the cold weather the poor cover themselves by night, and often by day with a sackcloth rug; and the rich usually put one under their bedding. Some is required for the packing of tobacco and for some grains, but much even in those days was exported to Calcutta, Patna, and other places. In the north-west part of Bengal a great proportion of the people used to be clothed with Megili or Pata. Specimens of this Pat clothing were sent to the Exhibition of 1851.

Since the foregoing remarks were written, indeed, since they have been in type, the Author has been favoured with the accompanying remarks from Mr. Henley, who has already been mentioned at pp. 36 and 168, and whom he had asked for some recent information respecting the culture and preparation of Jute.

The plant in question is by far the most extensively cultivated of all the fibrous family throughout the delta of Bengal. Its easy culture, rapid growth, and comparatively large produce present advantages not to be overlooked by that eminently practical and economical people, the natives of Bengal. Had it combined along with these advantages, the qualities of strength and durability, it would probably have superseded all other fibrous materials; but, rapid in its growth, it is again remarkably rapid in its decay—being in fact the most perishable of fibres. It is generally grown as an after-crop, during the rainy season, on high land, or land not subject to submersion, like rice land. A hot and moderately rainy season suits it best; excessive rains or bad drainage injure and deteriorate it. In this point of view it is a precarious and delicate crop; otherwise it presents the advantage of affording a more valuable return from land at that season, than any other crop which the cultivator can employ. It is sown broadcast, requires careful weeding when young, but soon acquires strength enough to keep off all intruders. The young leaves are eaten by the natives as a sort of spinach; they have, however, a coarse, weedy flavour, little suited to our European palates. No plant is more grateful for good cultivation than the one in question, in a good, loamy soil, well manured, or which has been well manured under a former crop. It attains a height of ten or twelve feet, with stems of three quarters of an inch in diameter. A poor crop, or one which had suffered from excessive rains, would have a height of only from three to six feet.

The crop being ripe, the stems are cut down close to the roots, made up into bundles, and laid to steep in some neighbouring ditch, where lumps of mud are placed on them to keep them submerged. Here they are carefully watched from day to day, the operator trying the bark with his nail, until he finds the decomposition arrived at the proper point. In preparing Jute intended for export, he will push the water-retting process to its utmost limits, short of actually destroying the fibre by excessive putrefaction. This is done in order to obtain that thoroughly detached silky character of fibre, according to which it is valued in the export market. Such Jute has always suffered more or less in strength.—Jute or Paut prepared for native consumption is much more durable than that prepared for export. It is likewise cheaper, as the yield per acre is much larger. It is much darker coloured, and not so clean. The natives are very particular in the selection of Jute for such purposes as pack-saddle bags for their transport oxen; or for their store-grain bags—great packages of six or eight feet diameter, erected on bamboo stages, and looking like our European brewery tuns. There are also a multitude of manufactures in this fibre, many of them possessed of considerable strength, some again of very fine texture.

To return to our water-retting process. The proper point being attained, the native operator, standing up to his middle in water, takes as many of the sticks in his hands as he can grasp, and removing a small portion of the bark from the ends next the roots, and grasping them together, he strips off the whole with a little management, from end to end, without breaking either stem or fibre. Having prepared a certain quantity into this half state, he next proceeds to wash off: this is done by taking a large handful; swinging

it round his head he dashes it repeatedly against the surface of the water, drawing it through towards him, so as to wash off the impurities; then, with a dexterous throw he fans it out on the surface of the water, and carefully picks off all remaining black spots. It is now wrung out so as to remove as much water as possible, and then hung up on lines prepared on the spot, to dry in the sun.

Jute is never so beautiful as at the first moment of its preparation; for such is its proneness to decay—a true *eremacausis* of Liebig—that it changes colour from day to day, gradually descending from the beautiful pearly white, through shades of fawn colour and brown, with proportionate loss of strength. These changes, also, are occasioned or accelerated by causes which hardly affect other fibres; hence, one of the difficulties of bleaching, and the tendency to become brown, of all fabrics consisting of this material. That portion of the hank of fibre next the root, or where it has been held in the hand, being always more or less contaminated with bark and impurities, is cut off for about nine inches. These ends are sold to the paper-makers, and for mixing and making up various thick, coarse fabrics, of which whole cargoes, amounting to tens of thousands of pieces, are now annually taken off by the Americans from Calcutta, for cotton bagging and similar purposes, forming an entirely new trade.<sup>1</sup>

But the great trade and principal employ of Jute is for the manufacture of Gunny chuts or chuttees, *i.e.*, lengths suitable for making bags. This industry forms the grand domestic manufacture of all the populous eastern districts of Lower Bengal. It pervades all classes, and penetrates into every household. Men, women, and children find occupation therein. Boatmen in their spare moments, husbandmen, palankeen-carriers, and domestic servants; everybody in fact, being Hindoos—for Mussulmans spin cotton only—pass their leisure moments, distaff in hand, spinning Gunny twist. Its preparation, together with the weaving into lengths, forms the never-failing resource of that most humble, patient, and despised of created beings—the Hindoo widow—saved by law from the pile, but condemned by opinion and custom for the remainder of her days, literally to sackcloth and ashes, and the lowest domestic drudgery in the very household where once, perhaps, her will was law. This manufacture spares her from being a charge on her family—she can always earn her bread.—Amongst these causes will be discerned the very low prices at which Gunny manufactures are produced in Bengal, and which have attracted the demand of the whole commercial world. There is, perhaps, no other article so universally diffused over the globe as the Indian Gunny bag. All the finer and long-stapled Jute is reserved for the export trade, in which it bears a comparatively high price. The short staple serves for the local manufactures, and it may be remarked, that a given weight of Gunny bags may be purchased at about the same price as a similar weight of raw material—leaving no apparent margin for spinning and weaving.

The stems or stalks of the Jute crop are of almost equal value with the fibrous portion. They are beautiful white and straight stems, of a light, brittle wood, somewhat like willow switches, and have a multitude of uses amongst the natives, such as for the manufacture of charcoal for gunpowder and fireworks, for the formation of fences and enclosures, for pea and similar cultivation, and for the construction of those acres of basket-work which the traveller may remark near every native village. These are the enclosures in which the betel-pepper vine is cultivated, the leaf of which is

<sup>1</sup> The manufacture of Jute whiskey from these ends was tried experimentally, by subjecting them to the process of conversion into sugar with sulphuric acid, and afterwards fermenting. The produce had much resemblance to grain whiskey.

universally consumed by the million—peer or peasant. These stems have another extensive employ which cannot be passed unnoticed—that of furnishing a peculiar quality of fuel suited to the native process of careening boats on the banks of the rivers. Great flaming fires may be observed at night under the bottoms and sides of the native craft; men running to and fro with bundles of flaming faggots, applying them assiduously, as if they were occupied in trying to burn the craft. Looking at the structures themselves, built up of mats and thatch, and appearing like slovenly, ill-conditioned hay stacks, that an accidental spark would ignite, it appears surprising that such a determined effort should not produce that result. The only object, however, is to effect the destruction of the myriads of worms or teredæ, who, if not destroyed, would in a very short time have eaten up the whole fabric.

Bengal Jute has now attained such an important position in the commerce of the world, that any suggestion for its improved production merits attention; and there can be no doubt but that the application to it of the process of preparing the fibre without water-retting, would effect the most signal improvement in its qualities. Such could never make it equal to Flax or Hemp; but the method would increase the qualities of strength and durability, and fit it for all purposes in which moisture took no part, for to this agent it is peculiarly obnoxious. In reference to this point it may be worth noticing, that in cases in which it is desirable to ascertain the amount of Jute adulteration in such fabrics as sail-cloth (in which it appears to me to be a highly criminal fraud), a very good test may be found in high-pressure steam. A piece of such sail-cloth, kept for four hours in steam of 30 lb. pressure, lost on simple washing thereafter, 22 per cent.—the decomposed Jute actually washing out, and with little injury to the remaining fabric.

Besides being used in India and exported to England, it is sent to America, and will probably be required on the Continent; but it is necessary for the people, if they wish to retain or extend their trade, to keep up the quality of their produce, which is complained of in the following extract from a letter from America to the Author:

“The article of Gunny bagging for cotton is imported largely into this country from India; in fact, is superseding all other descriptions of cloth for that purpose. I have been asked several times what it is made of, and where manufactured. On both points I am ignorant, and should be much obliged if you will give me the information. It is superior to and liked better than any other bagging; but the manufacturers are already commencing to make it inferior, by mixing ordinary (Indian) Hemp or tow with it. They will spoil their market unless they desist from such practices, for the planters will not use an inferior, if they can procure a good article.” (Georgia, 15th April, 1853.)

Some of the Jute lately imported has been twelve feet in length, in bales of about 4 cwt., bound round with Gunny cloth. The exports of Jute have already been alluded to when referring to the great increase which has taken place in this trade. Many other Indian fibres are possessed of equally good

properties in some respects, and of very superior ones in others, and which require only to be known to be very generally appreciated in Europe.

JUTE, GUNNY CLOTH, AND GUNNY BAGS EXPORTED FROM CALCUTTA, IN THE YEAR 1850-51.

EXPORTS.	Jute.	Gunnies and Gunny Cloth.
To United Kingdom . . . . .	Ms.768,945	Nos. 69,636
„ France . . . . .	13,931	—
„ Hamburgh . . . . .	128	2,180
„ North America . . . . .	9,242	2,290,427
„ Coast of Coromandel . . . . .	598	1,955,150
„ Malabar . . . . .	—	2,054,075
„ Penang and Singapore . . . . .	—	1,043,600
„ Ceylon . . . . .	—	357,290
„ New South Wales . . . . .	54	32,125
„ Trieste . . . . .	401	—
„ Java . . . . .	—	242,550
„ Pegu . . . . .	—	672,950
„ Mauritius . . . . .	—	213,980
„ Cape of Good Hope . . . . .	—	82,750
„ Guam . . . . .	—	15,000
„ Arabian and Persian Gulfs . . . . .	—	4,000
Total . . . . .	Mds. 793,299	9,035,713
Value . . . . .	Rs. 1,970,715	Rs. 2,159,782

The following statement shows the proportion of Gunnies and of Gunny Cloth; and also that a decrease took place in the former, and an increase in the latter in the two years given:

Exports from Calcutta.	1849-50.	1850-51.
Gunnies . . . . .	12,961,441	8,759,185
Gunny Cloth . . . . .	238,039	276,528
Total . . . . .	13,199,480	9,035,713
Value . . . . .	Rs. 2,683,551	2,159,782

Besides these there were exported from the Madras Presidency 58,950 gunny bags; but there is reason to believe that these are made of *Sunn*, or *Crotalaria juncea*.

Bombay being in a small island, cannot export any of its own growth; but as Gunny cloth is much required for packing

cotton, it is imported in large quantities, as 167,820 pieces, valued at Rs. 397,097 (but in 1849, to the value of Rs. 548,384), from the United Kingdom, Ceylon, East Coast of Africa, and Soumeeancee, but chiefly from Calcutta; also from Cutch, Malabar, and Canara, Aden, Sindh, Concan, and Guzerat. But we also find the places mentioned after Calcutta as those to which Gunny cloth was exported, but not in any quantity, except 296,757 pieces to the Concan—the whole export for that year amounting to 391,279 pieces, and the re-exports to 3,403,453, valued at Rs. 468,177, therefore greatly exceeding the imports, and hence probably including some brought by the Causeway.

#### INDIAN HEMPS, OR THOSE SO CALLED, AS SUNN, &c.

In various notices of Indian fibres we frequently meet with the word *Sunn*, as indicating a particular kind of Indian fibre. Sometimes we find it called *Indian Hemp*, and we may often see *Hemp* enumerated as one of the exports from India. At other times we may see either the same or another fibre mentioned by the name of *Brown Hemp*. Now these various names are sometimes applied to the fibre of one or of two different plants, or they may be employed to distinguish the fibre of three distinct plants, all of which are grown for their fibres, and have been, and might be exported from India, though only two of them are now usually to be found among the exports from that country. Hence, to avoid ambiguity, it is necessary to notice the plants to which these several names are correctly applicable.

The true Hemp (*Cannabis sativa*) is everywhere cultivated by the natives in the plains of India, not on account of its fibres, but for the intoxicating property of its leaves and their secretions. In the Himalayas, however, the fibre is separated for economic purposes, and was exported from India to England during the last war, but we believe it has not been so for many years.

The fibre of the *Sunn* or *Taug* (*Crotalaria juncea*) is often called Indian Hemp, but incorrectly. It is the kind most generally cultivated all over India on account of its fibre, and is that



usually mentioned in the exports from Calcutta under the name of Hemp, but also as Sunn. The plant may be distinguished by its flowers being of a bright yellow colour, and of the form of the Pea and of the Laburnum, while the leaves are entire and lanceolate.

The *Ambaree* (*Hibiscus cannabinus*), *Mesta paut* of Bengal, and *Palungoo* of Madras, is also very generally cultivated all over India, and exported of very good quality from the west side of that country. Its leaves are both entire and lobed, its flowers are large, and in shape resemble those of the Mallow, the Hollyhock, and the Cotton plant, of a sulphur-yellow colour with a dark brown centre. The fibre of this plant is, like that of Jute, sometimes called *paut*, and also *Indian Hemp*. It is often confounded with that of the Sunn, as it is one of the kinds of Brown Hemp of Bombay, though the two plants differ much from each other.

In the exports from the different Presidencies of India, it is very difficult to distinguish these two different kinds of fibre, inasmuch as the same name, Hemp, is applied to the exports from all the three Presidencies; but we believe, speaking generally, that the *Sunn* (*Crotalaria juncea*) is chiefly exported from all the three Presidencies, and one kind of Brown Hemp (*Hibiscus cannabinus*), along with the other kind, *Taag*, from Bombay.

#### OF MALVACEOUS AND OTHER FIBRE-YIELDING PLANTS.

As many plants have flowers and seed-vessels which closely resemble the Mallow, they have been united by botanists into a natural family of plants, which they have called *Malvaceæ*, or Mallow-worts. Some other families, such as the *Tiliaceæ* just described, and the *Sterculiaceæ* and *Byttneriaceæ*, to be immediately noticed, having also a considerable resemblance to each other and to the *Malvaceæ*, have been further grouped into a larger class which has been called *Malvales*. These groupings are interesting to us, inasmuch as they bring together, though in these different families, a number of plants which resemble each other in properties; for the greater number of the species not only abound in mucilage, but their barks in fibres which are manufactured into cordage. Of these, numerous instances will be mentioned in the following pages, but still more will

probably remain to be enumerated and reported on by subsequent observers; and, therefore, colonists in tropical countries may search among these for fibre-yielding plants with considerable certainty of finding many possessed of very valuable properties.

The family of Malvaceæ or Mallow-worts is extremely numerous in species, which abound chiefly in tropical parts of the world in the form of trees and shrubs, though species, as the Mallow and Marsh Mallow, do extend to temperate climates. The known fibre-yielding plants belong to the genera *Malva*, *Hibiscus*, *Sida*, *Althæa*, *Lavatera*, *Urena*, &c.; besides *Gossypium*, the genus yielding Cotton. Of these we shall find many employed in different countries for yielding fibre for cordage and for other purposes.

AMBAREE, OR HEMP-LIKE HIBISCUS (*Hibiscus cannabinus*,  
*Malvaceæ*).

*Ambaree* in Western India; *Palungoo*, Madras; *Pooley Numajee*, Coimbatore; *Gongkura* of the Telingas; *Maesta paut* of the Bengalese; *Sunnee* at Saharunpore; *Wilaitee* (or foreign) *Sunn* at Muttra; *Deckanee Hemp* of Bombay.

From the variety of synonyms which we have given of this plant, it is evident that it must be generally known all over India; but from its having several distinct names of its own on the west, we should infer that it was a native of that side of India, or of the southern part of the Peninsula, as on the Bengal side its names are modifications of those of some of the other fibres. In Bombay, besides *ambaree*, its fibre is sometimes called Deckanee Hemp, to distinguish it from the *taag* or Conknee Hemp (*Crotalaria juncea*). But it is very generally cultivated by the natives, though not in large quantities.

This plant, found as yet only in a state of cultivation, is a herbaceous annual of about three months' duration. The stem is straight and simple, of from three to seven feet in height, with here and there a few inoffensive prickles, otherwise smooth. The leaves are spreading, alternate, with long, slightly prickly footstalks; all are smooth, with their margins serrated; but the lower leaves are heart-shaped; those about the middle of the plant three-, four-, or five-lobed, with lanceolate acute lobes; while the leaves at the top are simply linear-lanceolate. Stipules awl-shaped. The flowers are solitary, with short peduncles in the axils of the leaves; very large: of a pale sulphur

colour, with a deep purple centre. Of the double calyx, the outer is seven- to eight-leaved, each subulate, spreading, and inserted near the base of the inner calyx. This is five-cleft, divisions sharp-pointed, bristly, and glandular near the margins, and with a large gland on the middle of each division. The stamens numerous, with their filaments united into a hollow column. Anthers one-celled, bursting by a transverse chink. Styles equal in number to the ovaries, and rising through the staminal columns. Carpels joined into a five-celled, five-valved capsule, with few seeds in each cell.

Dr. Roxburgh says of this plant, in his 'Coromandel Plants,' vol. ii, p. 48, tab. 190, where a beautiful plate is given :

"It is much cultivated by the natives. Its leaves are in general used as an esculent vegetable, and taste something like sorrel. The bark is replete with strong and tolerably soft fibres, and is employed as a substitute for Hemp, to which it is much inferior both in strength and durability.

"The usual time of cultivation is the cold season, though it will thrive pretty well at all times of the year, if it has sufficient moisture. A rich loose soil suits it best. The seeds are sown about as thick as Hemp, but generally mixed with some sort of small or dry grain, rendering it necessary to be sown very thin, that the other crop (which is one of those grains that does not grow nearly so high) may not be too much shaded. It requires about three months from the time it is sown, before it is fit to be pulled up for watering, which operation, with the subsequent dressing, is similar to that hereafter described for *Crotalaria juncea*."

Dr. Roxburgh states, that he found the fibres to be stronger when obtained from full-grown plants that had ripened their seed, than when cut from plants in blossom. On the Coromandel coast he found it cultivated, and a coarse sackcloth made of its fibres.

In the Purneya district, Dr. Buchanan found it called *Ambya Pata*, on account of the acidity of its leaves, but in other parts *chandana*. In the southern parts the common cordage of the country was almost entirely made from its fibre. It was said to be sown in fields, which produce nothing else; a practice which Dr. Buchanan had observed nowhere else in India. It appeared to him a coarse material in comparison with the fibre of the Corchorus, but he had no opportunity of trying its strength. In some places a few of the

seeds are scattered about among other crops on account of its leaves.

In Behar he found it called *Kudrum*, and cultivated only for being made into ropes, and not as an acid seasoning. About 2000 begahs were occupied with it. In Bhagulpore he found it cultivated nearly as much as the Corchorus. The natives considered ropes made of it stronger and more durable than those of the Jute; but its fibres are harsher, and, as he thought, could be reduced to fine thread.

In Goruckpore it was cultivated to the greatest extent, but always intermixed with the *urhur* or *Cytisus Cajan*, and ropes made of it were used for agricultural purposes.

In the Dinajepore district, Dr. Buchanan found it called *Mesta*, but its bark never used for making ropes; the leaves only being used as an acid green, the taste being pleasantly acid, and not unlike sorrel.

We find it equally cultivated in Central and Western India. It is mentioned as one of the plants employed for cordage at Hyderabad.

Colonel Sykes, in his 'Statistical Report of the Dukhun' (British Assoc., 1837, p. 241), enumerates it as one of the plants cultivated in the wet season; and among his drawings of cordage plants there is an excellent one of this plant, as well as of *Agave vivipara*, there called *gayal*. Among dry or spring season cultivation, the Colonel enumerates the *Taag* or *Crotalaria juncea*, its fibres being employed for ropes and for coarse canvas.

In the Madras Presidency, a number of fibre-yielding plants are mentioned by their native names, but as these differ in every district, and are not accompanied by Botanical names, it is impossible to determine to what plants they refer. We know that Dr. Roxburgh found *Hibiscus cannabinus* in cultivation on the Coromandel coast, and that a coarse sackcloth was made of its fibres. In Vizagapatam it is called Gunny fibre, and coarse sackcloth and rope made of it. So Dr. Ainslie says, "with the nar, or tough stringy fibre of the bark of the Hemp-leaved Hibiscus, a valuable kind of cordage is made, of various thickness." In a late Minute (19th Sept., 1854) by the Madras Government on the subject of fibres, we find it stated, that "the fibres of the roselle (*Hibiscus cannabinus*),

which is known to grow readily and without much care all over the Madras territories, have been found to be an excellent substitute for tow, now imported from Europe." As the plant is so universally cultivated over a vast tract of country for home consumption, nothing would be easier than to obtain a very large supply of its fibres, if they were required for any of the ordinary purposes of cordage. The natives would have nothing to do but to increase a cultivation to which they are already well accustomed in all parts of the country.

Dr. Buchanan states, as the result of his experience in the lower provinces, that it is cultivated everywhere in India, on account of its leaves, which are eaten as a vegetable, and for its bark, which is most useful for making cordage. The Author has seen it in the same way very generally cultivated in the North-Western provinces, chiefly for cordage for domestic and agricultural purposes.

Though so generally cultivated, its fibre is hardly if at all known as a distinct article of commerce,—the exports of Indian fibres from the three Presidencies being entered as Hemp, those from Calcutta only being sometimes distinguished as Sunn. With regard to its strength, it may be said that, speaking generally, the fibres of the species of Hibiscus are not so remarkable for strength as for fineness.

Dr. Roxburgh, in his experiments, found that a line made of this fibre, from plants in blossom, broke with 115 lb., but with 110 lb. when the seeds were ripe; Sunn fibre, under the same circumstances, breaking with 130 and 160 lb. So in Dr. Wight's experiments, the fibre of *Hibiscus cannabinus*, which is sometimes called the Jute of Madras, broke with 290 lb., when Sunn (*Crotalaria juncea*) broke with 404 lb. Both these, like Dr. Roxburgh's specimens, were probably grown in the same climate. But in the Author's experiments, Sunn broke with 150 lb., when Brown Hemp broke with 190 lb.; but the Sunn was from Bengal, and the Brown Hemp from Bombay. There is, however, some uncertainty about this, because though no fibres can well appear more distinct than these two, yet the Author has in his possession fibres of a *Crotalaria* which are hardly to be distinguished from Hibiscus Brown Hemp. The Sunn fibre of Bombay was, even in Dr. Roxburgh's time, remarkable for its dark colour. But some specimens of *Ambaree* fibre,

sent by Dr. Gibson as those of *Hibiscus cannabinus*, and which closely resemble those of some kinds of ordinary Brown Hemp, were favorably reported upon as follows, by Messrs. Enderby, then of the rope-manufactory at Greenwich. The Author has lately received an equally fine, if not finer, because softer specimen, from Messrs. Noble; but this is probably the produce of *Crotalaria juncea*. Unfortunately the best specimens of fibre come tied up in the same bundle with some ordinary Brown Hemp, and with some dirty, uncleaned fibre.

September 26th, 1844.

We have received your samples of Indian Hemp, and are pleased to observe that we are likely to obtain an article from thence, that will go far to make England independent of Russia for the supply of that important commodity. The samples supplied have much the character of Italian Hemp, but is inferior to it in colour and softness of fibre. It will not, therefore, in its present state be applicable for fine purposes.

We send you a sample of some of the East Indian Hemp we have had dressed; it appears very good, but not equal in strength to the generality of Russia Hemp; we feel, however, assured that it is capable of being got up in better condition.

The present price of Italian Hemp is £32 per ton; Russia Hemp, £28 per ton; Manilla, £23 per ton; New Zealand, £15 per ton; and Jute, about £13 per ton. The Indian Hemp, as per sample, £20 per ton; at which price we should at this period be prepared to purchase.

Yours very truly,

C. H. G. ENDERBY.

To Dr. J. F. Royle.

The Ambaree Hemp is stated by Dr. Gibson to be treated like the Tag or *Crotalaria*, being cut in November, and stored away until leisure time arrives for stripping the bark. It is in common use for plough and cart ropes, and is esteemed by the natives as very inferior to that of the *Crotalaria juncea*.

Some of this fibre sent to Hull to be reported on in the year 1840, was thus spoken of: "A greater part of that by the 'Wanderer,' which is of similar quality to your Umbarree, or *Hibiscus cannabinus*, cannot be sold for £16 a ton in the Hull market, when Baltic Hemp meets a ready sale at £40. You will perceive how much depends on colour and staple. Prejudice is not wanting,—but that is giving way." (Agric. and Hortic. Soc. of Western India, 1842.)

The length of the fibres of carefully cultivated Ambaree Hemp is from five to six feet; they are of a paler brown than ordinary Brown Hemp, harsher in feel, and stick more together, as if all the gum had not been washed out; but they are divisible into fine fibrils, possessed of considerable strength, and well

calculated for rope-making, as also for coarse fabrics. But, though esteemed by some of the natives of the West of India, it is not so good as the best Brown Hemp of Bombay—to be mentioned in connexion with Sunn.

As the fibres of this Hibiscus and of the *Sunn* are not distinguished from each other, or from others, in the account of the Exports from the Ports of India, we shall give these under the head of Sunn, and reserve also to that article some observations on the preparation of these Exogenous fibres in India, as well as on their prices, and the quantities in which they may be obtained.

#### OTHER MALVACEOUS FIBRE-YIELDING PLANTS.

In connexion with *Hibiscus cannabinus* we may appropriately mention the other fibre-yielding species of the same genus. Among these we find those which are also used as articles of diet; as, for instance,—

*Hibiscus esculentus*, the *Okhro* of the West Indies, with which is now united the *H. longifolius* of the East Indies, the *Bandikai* of Madras, the *Ram turai* and *Dhenroos* of Bengal; and from both of which the *Bammia* of the west coast of Africa probably does not differ essentially. Of all these, the long, young pyramidal pods are filled when green, with a large proportion of mucilage, on which account they are gathered when green, and cooked as a vegetable, being much esteemed by many, though considered too viscid by others. The fruit is also used to thicken soups in the countries where it is indigenous and in the South of France and in the Levant. The seeds may also be added like barley to soups, and have been recommended to be roasted as a substitute for coffee. The bark of these plants also abounds in fibre, which is of fine quality, as in many others of the same genus. Dr. Roxburgh cut the stems when the seed was ripe, and committed them to the steep a few days after. (For results see p. 268.)

*H. Abelmoschus*, so named from the Arabic *hub-ool-mooshk*, in Hindee *mooshkdana*, or musk seed, is called *calee kustooree* in Bengal. The seeds have been so named on account of their odour. The plants abound in mucilage, and are much employed

in the North-West of India in clarifying sugar. The stems were cut when in flower by Dr. Roxburgh, and steeped immediately: the result of his experiments is given in p. 268.

*H. Sabdariffa*, said to be so called from its Turkish name, while in the West Indies it is called Red Sorrel, and in the Madras territories *rozelle* and *rouselle*. It is cultivated in most gardens, because its calyxes as they ripen become fleshy, are of a pleasantly acid taste, and are much employed for making tarts, as well as an excellent jelly. Browne states that they are employed in the West Indies for making refreshing drinks. The stems having been cut when in flower, and the bark stripped off, and steeped immediately, display a mass of fibres in Dr. Roxburgh's specimens, some of which are still in the India House, with the ultimate fibres of a fine silky nature. The name *rouselle* is said to be a corruption of *oseille*.

The dietetical uses of these species have been mentioned, in order to show, that if cultivated on account of their fibre, they would also be useful for other purposes.

*H. strictus* was a new species described by Dr. Roxburgh, and which seems to be a native of the Rajmahl Hills, with a straight stem of from 6 to 14 feet in height, and a very smooth bark. It thrives luxuriantly with little or no care; seed-time the beginning of the rains; it is in blossom about their termination, and the seed ripens in December and January, soon after which the plants perish.

"Like many other of the Malvaceous tribe, the bark of this species abounds in flaxen fibres; but in none have I found so large a quantity, equally beautiful, long, glossy, white, fine, and strong, as in this. To these promising qualities may be added the luxuriant growth, and habit of the plant, rendering it an object deserving of every care and attention, at least until the real worth of the material is fairly ascertained.

"From several years' experience, I find the best season for sowing the seed in Bengal, is just when the first rains begin, which is generally in May, in beds; and when the plants are about six inches high, transplant them out in rows, about nine inches asunder, and about as much from each other in the rows. In 1801, I had forty square yards planted in this man-



ner, which yielded thirty-three pounds weight of the naturally very clean fibres." Dr. Roxburgh's original specimens, still in the India House, are 9 and 10 feet in length, a fibrous mass, apparently easily stript off, and composed of fine and easily divisible fibres. (For strength, *v.* pp. 268-9.)

*H. tiliaceus* is the *Bola* of the Bengalese, common also on the Malabar coast, and supposed not to differ from *H. arboreus*, the *Maho tree* and *Mohaut* of the West Indies. These grow abundantly both in the West and East Indies.

Forster states, that the bark of this species is sucked in times of scarcity, when the bread-fruit fails. The mucilage with which all these plants abound, will no doubt afford some nourishment. The fibres of its inner bark are employed for cordage by the inhabitants of the South Sea Islands, and by the American Indians: it is said to gain in strength when tarred.

The Otaheitans make fine matting from it, and likewise manufacture it into ropes and cords. Voyagers relate that these filaments are adapted to any kind of cordage, even for the rigging of vessels, but rope thus made is not nearly so strong as that prepared from Hemp. The whips with which the negroes in the West Indies used to be punished, are said to have been made with the bark of this species. (*v.* p. 269.)

*H. furcatus*, a native of the interior of Bengal, growing to a height of from 6 to 8 feet. The bark yields abundance of strong white flaxen fibres, but the prickliness of the plant renders it very troublesome to handle. The stems were cut when in flower, and steeped immediately. (*v.* p. 268.)

*H. mutabilis*, a native of China, but common in gardens in India, and remarkable for the change in the colour of its flowers during the day. The fibres of the bark were found to be of a hard nature, and of a bad colour. (*v.* p. 269.)

*H. collinus* (*eriocarpus* of D. C.), a native of the mountainous parts of the Circars, where it is called *kanda-gang*, and where the natives use the bark as a substitute for Hemp. Under the head of this plant, Dr. Roxburgh states that he has often observed that most of the Indian plants of this family might be employed for the same purposes as Hemp, as the bark is tough, and may almost always be stripped off in long slips.

*H. ficifolius* is a species which Dr. Roxburgh so named, and of which he received the seeds from the Moluccas. It was an

annual, growing very tall, often 12 to 14 feet high, growing straight, with few branches. The fibres he describes as uncommonly beautiful, and rather stronger than Sunn.

Besides these, other fibres of species of Hibiscus have been separated in India, as mentioned in 'Journ. Agri-Hortic. Soc.,' vi, App., 3, and vii, 193, though it is not easy to determine the plants intended; but this only proves how much the genus abounds in fibre-yielding plants.

So other species of this genus are similarly employed in other countries, as *Hibiscus clypeatus* and *elatus* in the West Indies; as *H.* (now *Thespesia*) *populneus* and *H. tiliaceus*, already mentioned, in the Society and South Sea Islands; *H. Manihot* in Japan; *H. heterophyllus* in New Holland; and *H. verrucosus* in Senegambia.

*SIDA* is a genus of Malvaceous plants, which like others of the family contains many plants abounding in mucilage, and others with bark containing tough fibres, employed for cordage in different countries. One species, *S. tiliæfolia*, referred at first by Dr. Roxburgh to *S. abutilon*, is cultivated for this purpose in China. Some of its seeds were received many years ago at the Calcutta Botanic Garden, under the name of *King ma*, from Pekin, in the neighbourhood of which the plant is cultivated, for the sake of its fibre. Seeds were similarly received a few years ago by the Horticultural Society, and the Author saw a fine crop of the plants in their garden at Chiswick, which seemed about eight feet high. Some of these Dr. Lindley had steeped, in order to separate the fibres, and some were sent to Mr. Routledge in the year 1850, in order to try in his machine.

Dr. Roxburgh notices "the fibre of this plant as strong and pliable, very silky in its nature, and the plant of very rapid and luxuriant growth, three crops being obtained in one year. It may be brought into this country at the estimated price of £8 per ton, which is now about one fifth of the price of Hemp of the best quality." According to Dr. Clarke Abel, this plant is preferred for cordage in China Proper.

*S. rhomboidea* and *S. rhombifolia*, the *sufet* and *lal bariala* of the natives of Bengal, where the plants are indigenous in the rainy season. The bark of both, according to Dr. Roxburgh,

yields abundance of very delicate flaxy fibres, which he thought might be advantageously employed for many purposes. When the seed is sown thick on a good soil, the plants grow tall and slender, without branches, and are every way fit for such purposes.

Major Hannay sent from Assam to the Agri-Hortic. Soc., in Dec., 1851, some of the fibre of *Sida rhomboidea*, which grows luxuriantly in that valley. Capt. Thompson thought from its length, its similarity to silk, and its great strength, that it would fetch a high price in England. The line (only half an inch in circumference) sustained, after exposure to wet and sun for ten days, 400 lb.

*S. periplocifolia*, a native of the Malay Islands, was also one of those subjected to experiment by Dr. Roxburgh, and who describes the plant as flowering and ripening its seed in the Botanic Garden at Calcutta, a great part of the year. "Its bark abounds in serviceable flaxen fibres, and as it shoots quickly into long, simple twigs, particularly if cut near the earth, it answers well for procuring the fibre of good length for most purposes."

Some of Dr. Roxburgh's original specimens, marked July, 1804, are still in the India House; the fibres are from four to five feet in length, and display a fine soft and silky fibre, as well adapted for spinning as the Jute, but are apparently superior.

Various species of *Sida*, as *S. asiatica*, *indica*, *graveolens*, and others, are extremely common in every part of India in the rainy season. Many of them, no doubt, contain fibre which might be turned to useful account.

*Urena lobata* and *U. sinuata*, two weeds also belonging to this family, the one called *bun-ochra* and the other *kungia*, and common in most parts of India, also abound in strong and a tolerably fine substitute for Flax.

If the common Mallow (*Malva sylvestris*, &c.) of Europe, or the Marsh-mallow (*Althæa officinalis*), are examined, it will be found that they abound in fibre; others of these genera are valued for their fibres in different countries, as *Malva crispa* is said by Cavanilles to have its fibre separated in Syria, and *Althæa cannabina*, is sometimes so employed in the South of Europe; so *Lavatera arborea*, or Tree Mallow, will be found to abound in fibre.

COTTON CORDAGE AND CANVAS (*Gossypium indicum*, &c.;  
*Malvaceæ*).

Though Cotton is a substance which is cellular in structure, and not fibrous, also sold by the pound, and not by the cwt or ton, as the articles we have been treating of, yet it cannot be entirely omitted from a work on the Cordage and Clothing plants of India. But the Author may be excused from dilating on the subject, as he has so recently treated of it fully in his work on the 'Culture and Commerce of Cotton in India.'<sup>1</sup> Cotton, though used chiefly for clothing, is, in India, also employed to a considerable extent for cordage, as, for instance, for tent-ropes, of which so many are required for the use of the army, and made entirely of Cotton, as are the tents

<sup>1</sup> The Author has in the above work treated, first, of the Commercial causes which influence the irregular imports of Indian Cotton: secondly, of the Cultivation of Cotton, including the varieties of Commercial Cotton, and the species of *Gossypium*; Chemical Analyses of Cotton, its seed, and of Cotton soils; Climate of Cotton districts; and the Principles and Practice of Cotton Culture: thirdly, Experimental Culture of Cotton in India, in which all the different districts have been successively noticed. Some additional information has been published respecting Malwa, &c., in vol. vii of the 'Journ. of the Agri-Hortic. Soc. of Calcutta.'

There is only one point to which the Author wishes to refer, and that because it has been the subject of discussion, and because he ventured to doubt (pp. 449 to 454) the correctness of Mr. Davies's calculation of the cost of a candy of Cotton (20 begahs being required to produce it, or 784 lb.) in the district of Broach, which he made to be above seventy-five rupees. Mr. Landon, established as a cotton-merchant in Broach, and cleaning native Cotton by his saw gins moved by steam power; and who has lately taken out machinery for spinning Cotton, has stated by letter, and since, verbally to the Author, the following facts:

"About fifty patells and ryots who are now at my elbow with kuppas to sell, have this moment unanimously stated that the *average* cost of cultivating a bhar of kuppas in this district, including *rent* and *all* charges, is Rs. 15. The *average* quantity of kuppas which yields a candy of Cotton is  $2\frac{1}{2}$  bhars (this season it is  $2\frac{8}{20}$  bhars). Therefore, the cost of a candy of Cotton does not exceed, on an average,  $\text{Rs. } 15 \times 2\frac{1}{2} = \text{Rs. } 37\frac{1}{2}$ ! While the average price which I have paid the ryots, for a candy of Cotton in the seed, during the last six years, is Rs. 88 $\frac{3}{4}$ ! or Rs. 35 $\frac{1}{2}$  per bhar. This I am prepared to show from my books, and to make oath of it if necessary. Again, I recently asked a ryot how many begahs of Cotton he cultivated: he replied forty; and that they produced ten bhars of kuppas. At the rate of Rs. 15 per bhar, the total cost to him of these ten bhars, including rent and *all* charges, was Rs. 150. The price which I *paid* him for it was Rs. 360! Others have repeatedly made similar statements to me, as to the produce and cost of production, in respect to greater and less quantities of land."

themselves. So, Cotton ropes are also employed for many domestic purposes. Specimens were sent to the Exhibition of 1851, both from Calcutta and Madras, and have considerable strength. Some of the native shipping, also, and even a few American ships, are rigged with Cotton ropes; while Cotton canvas is also employed for sails, especially on the coast of Cutch, where some very good is made, and sells for about three and a half annas per yard.

SILK COTTON TREE, and others (*Byttneriaceæ*).

The natural family of *Byttneriaceæ*, which includes such genera as *Bombax*, *Sterculia*, *Abroma*, *Guazuma*, &c., like that of the Mallow-worts, inhabits hot parts of the globe chiefly, and also like it contains a number of plants remarkable for abounding in mucilage and in fibrous bark. Of these some are employed for cordage in different parts of the world, and of them a few, as *Abroma augusta*, might probably be grown with greater profit, and yield a better product, than some of those which are now in cultivation.

Thus the species of *Bombax*, which are remarkable for their gigantic stature and their splendid inflorescence, are also so on account of their capsules, which, on bursting, display a flocculent substance, often mistaken by travellers for cotton, and the tree hence called *Cotton tree*. But as this substance is more silky than cotton, it has been distinguished by the name of *Silk Cotton*. It differs also in not spinning like cotton. Some difficulty, therefore, is experienced in making use of this very abundant cotton-like produce; but Mr. Williams, of Jubbulpore, has succeeded in spinning and weaving some of it so as to form a very good coverlet. It might be easily made use of for stuffing pillows, muffs, or coverlets, for wadding, or for conversion into half-stuff for paper-makers, perhaps for making gun-cotton.

In the 'Trans. of the Agri-Hortic. Soc.,' iii, p. 274, there is a report from the Society of Arts on two pieces of cloth made from the Simool or Silk Cotton tree; and it is observed that, from the shortness of the staple of the down, and its elasticity, it could not be spun by cotton-spinning machinery.

Several of this family abound in mucilage, thus a *Guazuma* is employed in South America in clarifying sugar ; as a *Kydia* is in India. A species of *Sterculia* yields a tragacanth-like gum on the west coast of Africa, as another does in India. Several species of this genus are remarkable for the tenacity of the fibre of their bark, which is employed for cordage, as *Myrodia longiflora* in Guiana, and *Chorisia crispifolia* in Brazil, *Dombeya umbellata* in the Isle of Bourbon, and *Sterculia Ieria* in the West Indies. *Helicteres Isora* may be similarly employed in India.

*Sterculia guttata* is a tree, a native of Malabar, which was first made known by Capt. Dickenson, in the year 1802. The bark of the younger parts of the tree abounds with very strong, white, flaxen fibres, of which the inhabitants of Wynaad manufacture a kind of coarse cloth. It is not usual to make use of the bark until the tenth year, when its size will be equal to that of most forest trees. The tree is felled, the branches lopped off, and the trunk cut into pieces of six feet long, a perpendicular incision made in each piece, the bark opened, and taken off whole, chopped, washed, and dried in the sun. By these means, and without any further process, it is fit for the purposes of clothing.

*Sterculia villosa*, called *Oadal* in Assam, is another tree of this genus, which is a native of the mountainous countries to the eastward of Bengal. Trunk straight. The bark is smooth, but fibrous. Bags are made of it. Its fibres are made into cords by the natives of the eastern frontier of Bengal, to bind wild elephants with.

Of a coil of *Oadal* rope, Major Jenkins gave the following notice in the year 1847 :

“The *Oadal* tree is very common, and the rope is made most readily ; the bark, or rather all the layers, can be stripped off from the bottom to the top of the tree with the greatest facility, and fine pliable ropes may be made from the inner layers of bark, whilst the outer yield coarse ropes. The rope is very strong and very lasting—wet doing it little injury.”

*Oadhul* is a creeper in Kemaon, with fine, strong fibres ; and *Microlana spectabilis* is a tree found at the foot of the Himalayas, which yields fibres fit for rope-making.

*Guazuma ulmifolia* is a South American tree, which was introduced into India, and largely cultivated at one time in the Madras Presidency under the name of Bastard Cedar, as fodder for cattle. The fibres of its straight, luxuriant, young branches were submitted to trial by Dr. Roxburgh. (*v.* p. 268.)

*Abroma augusta*, the *Woollet-comul* or *Ullat-kumul* of Bengal, and which Dr. Roxburgh at one time called Perennial Indian Hemp or Flax, is a native of various parts of India, growing luxuriantly in gardens even as far as 30° N. lat., and extending eastward to the Philippine Isles. It grows to a small tree, but may be cultivated as an annual, flowers profusely during the rainy season, and ripens its seed in the cold weather. It particularly attracted Dr. Roxburgh's attention; as the bark abounds with strong white fibres, which make a very good substitute for Hemp, affording good common cordage. The plant grows so quickly, as to yield two, three, or even four crops of cuttings annually fit for peeling; hence it may be advantageously cultivated, and is deserving of more than common attention on account of the beauty, fineness, and strength of its fibres. Dr. Roxburgh ventured to prognosticate as large a yearly produce as can be obtained from an acre of Danchee, Jute, Sunn, Hemp, or Flax; as it is a perennial, large, shrubby plant, in every respect easier to cultivate and to prepare the fibres than Sunn, and the produce much greater. Indeed, in an experimental culture, he obtained from three cuttings 271 lb. of clean fibre, which he states was three times greater than the average produce of Sunn.

To separate the bark from the shoots, maceration in stagnant water, from four to eight days, answers well during the warmer parts of the year, while three times as much is scarce sufficient during the cold season, indeed the process is scarcely practicable then; besides, the fibres are greatly weakened by prolonged maceration. The fibres being naturally very white and clean, they do not require to be cleaned. Dr. Roxburgh states that, in its native state, without being dressed in any way, it is about one tenth part stronger than Sunn, and in that state much more durable in water. A cord of its fibre bore 74 lb., when Sunn broke with 68 lb. (*v.* p. 269.)

In the following tables the results of some of Dr. Roxburgh's experiments are given:

*Comparative Strength of Fibres, both dry and wet, ascertained by weights suspended to four-feet lengths of the several lines.*

No.	NAMES OF THE PLANTS, And brief Remarks on the various Materials employed in these Experiments.	Average weight each line broke with when dry.	Average weight each line broke with when wet.	Average of weight found by wetting the lines.
1	Hemp, the growth of 1800, from the Com- pany's Hemp Farm near Calcutta . . .	158	190	20
2	Jeetee ( <i>Asclepias tenacissima</i> ) . . .	248	343	38
4	Sunn ( <i>Crotalaria juncea</i> ), cut before the plants were in blossom, and steeped immediately . . .	112	158	41
5	The same as No 4, but dried, or rather kept for some time before they were steeped . . .	60	78	30
6	Sunn cut when in full blossom, and steeped immediately . . .	130	185	42
7	No. 6, kept drying for some time . . .	100	166	66
8	Sunn cut when the seeds were perfectly ripe . . .	150	203	35
9	The same as No. 8, but dried . . .	110	163	48
10	Sunn, winter crop, cut when the seeds were ripe, and steeped immediately . . .	160	209	31
11	A var. of <i>Corchorus capularis</i> , Teetah Paat . . .	143	146	2
12	Reddish <i>Corchorus capsularis</i> , from China . . .	164	164	0
13	<i>Corchorus olitorius</i> , Bunghee Paat . . .	113	125	11
14	<i>Eschynomone cannabina</i> , Dancha, cut when the seed was nearly ripe . . .	138	145	5
15	<i>Abroma augusta</i> , young shoots cut before the blossoms appeared . . .	100	112	12
16	The same, from old ligneous plants, that had ripened their seed . . .	121	121	0
17	<i>Hibiscus strictus</i> , from the Moluccas . . .	104	115	10
18	No. 17, after it had ripened its seed . . .	128	135	5
19	<i>Hibiscus cannabinus</i> , cut when in blossom, and steeped immediately . . .	115	133	15
20	The same, cut when the seed was ripe . . .	110	118	7
21	<i>Hibiscus</i> (No. 18 of the next table), cut when in flower, and steeped immediately . . .	116	123	6
22	<i>Hibiscus Sabdariffa</i> , cut when in flower, and steeped immediately . . .	89	117	31
23	<i>Hibiscus Abelmoschus</i> , Calee Kustoree, cut when in full flower, and steeped immediately . . .	107	107	0
24	<i>Hibiscus esculentus</i> , D'heroos, cut when the seed was ripe, and steeped a few days there- after . . .	79	95	20
25	<i>Hibiscus furcatus</i> , cut when in flower, and steeped immediately . . .	89	92	3
26	<i>Hibiscus pilosus</i> , a large annual species, cut when in advanced flower, and steeped im- mediately . . .	97	130	34
27	<i>Guazuma ulmifolia</i> , stout young shoots of about six feet in height, from two years old roots, steeped immediately . . .	100	140	40
28	Fibres of the footstalks of the leaves of a large luxuriant wild <i>Musa</i> , or Plantain . . .	79		
29	A line made of fifteen threads of sail-twine, <i>Calloe</i> , <i>Urtica tenacissima</i> . . .	240	278	16



*Comparative Statement of the effect of Maceration 116 days in stagnant water, comparing the strength by weights suspended to four-feet lengths of the various cords therein mentioned, when fresh.*

No.	NAMES OF THE PLANTS, And brief Remarks on the various Materials employed in these Experiments.	Average Weight at which each sort of Line broke.					
		When fresh.			After 116 days' maceration.		
		White.	Tanned.	Tarred.	White.	Tanned.	Tarred.
1	English Hemp, a piece of a new tiller-rope . . .	105			rotten, as was also an English log-line		
2	Hemp, Cannabis, the growth of this season, from the Company's Hemp Farm near Calcutta . . . . .	74	139	45	all rotten.		
3	Coir, the fibres of the husk of the Cocoa-nut . . .	87			54		
4	Ejoo, Saguerus Rumphii, Roxb. . . . .	96			94		
5	Æschynomene cannabina, Dansha of the Ben- galese. The fibres of plants that had nearly ripened their seed . . . . .	88	101	84	40	56	65
6	The fibres of the bark of No. 5, from plants coming into blossom . . . . .	46	61	48	rotten	68	45
7	Crotalaria juncea, Sunn of the Bengalese . . .	68	69	60	rotten	51	65
8	Corchorus olitorius, Bunghi-Paat. The fibres of its bark called Jute . . . . .	68	69	61	40	49	60
9	Corchorus capsularis, Ghee-Nalta-Paat. The fibres called Nalta-Jute . . . . .	67			50		
10	Flax, Linum usitatissimum, the growth of the Company's Hemp Farm near Calcutta . . . . .	39			rotten		
11	Agave americana . . . . .	110	79	78	rotten	rotten	15½
12	Sansevieria zeylanica; in Sanscrit Murva . . .	120	73	48	30	26	34
13	Abroma augusta. Woollet-comul of the Bengalese . . . . .	74	58	44	38	54	50
14	Guazuma ulmifolia, Bastard-Cedar. The fibres of the bark of some straight luxuriant young plants . . . . .	52	47	45	30	39	
15	Hibiscus tiliaceus, Bola of the Bengalese . . .	41	62	61	40	55	70
16	Hibiscus strictus, from the Moluccas, a tall, white-flowered variety of it . . . . .	61			26		
17	Hibiscus mutabilis . . . . .	45	53		rotten	45	
18	Hibiscus, from the Cape of Good Hope . . .	22			17		
19	Bauhinia racemosa, Roxb., a large scandent species . . . . .	69			rotten		
20	The same as No. 19, only maceration was used to help to take the bark off the twigs with more ease . . . . .	56			rotten		
21	Sterculia villosa . . . . .	53			30		

SUNN AND OTHER LEGUMINOUS PLANTS (*Leguminosæ*).

Sans., *Sana*; Hindee, *Sunn*; Bengalese, *Ghore Sun* and *Meesta pat*; Cing., *Kenna*; *Hemp* and *Sunn Hemp* in Calcutta; *Janapa*, *Shanapum*, also, *Madras Hemp*; *Taag* or *Conkanee Hemp*, *Salsette*, and *Bombay Hemp*. Some of the *Brown Hemp* of commerce.

The now well-known *Sunn* of India belongs to a family of plants, of which some, such as the Peas and Beans of Europe, are familiar to all; as are also the species of *Phaseolus* and *Dolichos*, yielding the pulses of India. The family has been named *Leguminosæ*, from the fruit of all consisting of a pod or Legume. Though very numerous in species, comparatively few are remarkable for their fibrous properties, though one of the oldest described cordage plants of Europe belongs to this family.

Under the head of *Esparto*, in the family of Grasses (p. 31), we have stated that *Stipa tenacissima* was no doubt one of the kinds of *Spartum* of the ancients, and that *Spartium junceum* was probably another. It was very common for the ancients to group substances together according to their properties rather than according to their external characters. Mr. Yates is of opinion, that this *Spartium junceum*, or Spanish Broom, was the original plant, and that the name *Spartum*, converted into *Esparto*, was afterwards applied to the grass. The *Spartium junceum*, or Spanish Broom, common in the sterile parts of the South of Europe, affords a fibrous thread which used to be made into cloth in Turkey, in Italy, and in the South of France. Near Lucca the twigs were formerly steeped in the thermal waters of Bagno a Acqua. After this process the bark is easily stript off, and it is then combed and otherwise treated like flax. In the vicinity of Pisa, also, the twigs were soaked in the thermal waters. In the South of France the Broom is grown in dry and unproductive parts, and also carefully prepared. The coarser thread is used to make bags for holding legumes, corn, &c.; the finer for making sheets, napkins, and shirts. (v. Yates's 'Textin. Antiq.,' pp. 323-4.) A white-flowered plant has also been long used for the same purposes. This, there is little doubt, is the *Spartium monospermum*, or the white single-seed Broom; and probably also *S. multiflorum*, which is the Portugal white Broom. As these plants are naturalized in our gardens, it is easy to ascertain the

toughness of their fibres by endeavouring to break one of their twigs.

In the subdivision of Leguminous plants with these Brooms we find the *Sunn* plant of India (*Crotalaria juncea*), which has so close a general resemblance to the Spanish Broom, that Mr. Yates has figured them together in the same plate, with the very object of showing their affinity.

The *Sunn* is probably the earliest of the distinctly named fibres, inasmuch as we find in the Hindoo 'Institutes of Menu,' that the sacrificial thread of the Cshatriya or Rajpoot is directed to be made of *Sana*; cotton being reserved for the Brahmins. Its name, *Shanapam* or *Janapa*, on the Madras side, is not very unlike *Canapa*, *Hampa*, *Hennip*, and *Hanf*. From these we derive our own name of *Hemp*. Under the name *Sana* it is mentioned in many Sanscrit works; and by that of *Sunn* it is known in most parts of India. The first notices in European works is, by Rheede ('Hort. Mal.,' v. ix, t. 26); by Ironside, in the 'Phil. Trans. of London,' lxiv, p. 99; and it is mentioned by Roxburgh in the early volumes of the Society of Arts' 'Transactions.' Towards the close of the last, and the beginning of this century, it attracted much attention both in India and in England; and much information respecting it is contained in Dr. Roxburgh's several works, as well as in Wisset's 'Treatise on Hemp and on the Sunn Plant,' 1804 and 1808. Dr. Buchanan in his 'Journey through Mysore,' mentions that Goni cloth for sacks is made of the fibre of *Crotalaria juncea*.

The annual stem is straight, smooth, striated, from four to eight (varieties even ten and twelve) feet high, branching towards the top, but more so when the plant stands single. Leaves scattered, short petioled, lanceolate, obtuse, with a small bristle-like point, from two to six inches long, both sides covered with soft, silver-coloured hairs. Stipules subulate, small. Flowers in terminal racemes, papilionaceous, of a beautiful bright yellow colour, each supported by an oval bract. Calyx two-lipped; the upper lip two-cleft; the under one two-parted in the middle. Of the yellow petals, the banner is obtuse, erect; the two wings oblong obtuse; the keel much pointed, slightly twisted at the apex, and closely shut. Filaments ten, their lower half united into one body, with a fissure down the upper side, which has a circular gape at the base; extremities free, and the alternate ones shorter than the others. Anthers on these linear; on the larger filaments ovate and two-lobed. Legumes sessile, club-shaped, turgid, from one to two inches long. Seeds numerous, kidney-shaped. (Roxb., 'Flora Indica,' iii, p. 261; 'Corom. Pl.,' t. 192.)

The seeds when ripe and loosened rattle within the pods, as in the other species, whence the genus has been named from the Greek word *krotalos*.

It is an annual plant, very generally cultivated in the southern parts of Asia, and everywhere in India, on account of the fibres of its bark, so well known as *Sunn* and *Sunn Hemp*, often erroneously called Hemp, though the true plant is also most common in India, but valued in the plains only for its intoxicating properties. The Sunn is exported from different parts of India, as from Calcutta, by the name of Sunn; that from Madras is known here as Madras Hemp; that from Bombay as Brown Hemp, being known there as *Taag* or Conkancee Hemp. It being a common practice to name it from the province where it has been grown. The late Dr. Stocks informed the Author that it was cultivated in Sindh, and that the species named *Crotalaria Burhia*, which grows wild in the most arid places, is also employed in Sindh as a cordage plant. The Author may mention that he has seen it thickly sown and carefully cultivated in the most northern provinces of India. The time of flowering and ripening its seed, as stated by Dr. Roxburgh, depend on the season it is sown; though in most parts it is raised during the rainy season, in others it is not sown until their cessation.

*Culture.*—The general time of cultivation is during the rains; and in Bengal a rather elevated rich soil is required, which ought to be well ploughed, or otherwise dressed to free it of weeds, and bring it into good tilth. In Wisset's treatise, pp. 38 and 39, it is stated that clayey soils are injurious, and that in a rich soil the fibre produced is of a coarser quality than that from high, dry situations. The quantity of seed, Dr. Roxburgh states, should be from eighty to a hundred pounds weight to the acre. In some districts less, in others a larger quantity is sown. (*v. Wisset.*) The natives say, the thicker the Sunn grows the better, and so thick as to prevent the air from passing through it. (*l. c.*, p. 73.) At Commercally it is stated that there are two kinds of Sunn; one being sown in June, the other in October, though they are nearly similar in quality. That sown in June is generally cut about August or September, and the other about April; but it is also sown in October in parts of the Dacca district. (*v. Wisset*, pp. 59 and 82.) The cause of the difference in the time of cultivation, is supposed by some to be that during the periodical rains the face of the country is under water.

In most places the seed is sown when the first showers fall, in May or June, and covered in by the harrow, or by any other mode. Little more is required, as the plant grows so rapidly as to keep down the weeds itself; otherwise it requires to be freed from weeds, when about nine inches high. By August the plant will be in flower, and from five to eight or more feet high. When the fibre is required of a fine and soft quality, it is pulled in this stage of its growth; if greater strength is the object, it must stand till in seed, or even till the seed is ripe. A portion of the crop always requires to be left for the sake of ripening some seed. The natives make use also of the fibres of such plants, and consider them strong. When ready for the purposes intended, the plant is cut or pulled up by the roots. At Hurriaul it is cut down as close to the ground as possible, and laid in ridges, care being taken to place the plants so that the leafy parts be one upon another. In this state they continue five, six, or ten to twelve days, or until the leaves begin to rot and fall from the stalks on being shaken about. (l. c., p. 113.) For culture in Madras and Bombay, see pp. 279, 282.

*Produce, &c., per acre.*—The produce of the cultivation of this plant per acre is most fully detailed in the abstracts of reports given by Mr. Wisset, and varies from 3 cwt. to 10 cwt. per acre; or on a medium probably about 700 lb. an acre. But there is difficulty in determining the point with exactness, from the difference in the begah as well as in the maund. The cultivation was said to yield tolerable profit, inasmuch as the plant requires scarce any attention, and consequently little labour or expense; and it may be off the ground in time to allow this to be prepared for any cold-season crop. But the expenses and the profit are as variously stated as the produce. The price is also given as varying from R. 1 8, and R. 1 12, to Rs. 3 per maund, at the same time; which it is difficult to account for, except from the habitual carelessness of the natives of India in all such statements. (v. 'Wisset,' pp. 146—155.)

*Steeping.*—Having grown and cut the plant, as well as removed its leaves, it is ready for the next process, that of committing to water, or other operation for separating its fibre. The length of time required for steeping depends on the season of the year, the heat of the weather, and consequently of the

water. In August and September, from two to three days is generally sufficient. When the required effect has been attained, which will generally be known by the bark separating freely from the stalk, the people employed in the work stand in the water in which the plant has been steeped; each takes a handful thereof, which he breaks in one or more places, after having washed off any mud or filth; then grasps it by one end between both hands, and beats it against the surface of the water, which quickly removes the reed from the fibres; when the parcel is turned, and the other end treated in the same manner. Care must be taken not to over-steep, as this much weakens the fibre. (Wisset and Roxburgh.)

With respect to the proper time for steeping, and the period during which the stems should be steeped, great differences of opinion prevailed during the experiments at the beginning of the century. Mr. Fleming, disapproving of the native method of steeping the plants immediately after they were cut, and for three or four days, recommended that the plants, after pulling, be *first dried in the sun for two days*; after which, they should not be let remain in the water more than *forty* hours. Mr. Frushard objected, first, to the drying the article before watering; secondly, to the insufficiency of the time for watering; and lastly, to the manner of separating the fibre from the reed after watering. The general practice, he observes, is to set the plant upright in the water, immersed about one third only from the bottom, for one day before the complete immersion, in order that the thicker may be immersed longer than the thinner parts. Of the natives one said, "to dry before steeping was doing to undo." Another observed that it seemed to be "wanted to make difficult what was easy." Others exclaimed: "You may imprison our persons; you may strike our necks; but never will we make Sunn according to the advertisement." (*v.* Wisset, pp. 162, 195, and 202.) The whole forms an interesting commentary on attempts to improve native processes, before principles are thoroughly understood, or the superiority of European practices carefully established. (*v.* Table, p. 268.)

At Commercally, when the plants of *Phool Sun* have been pulled and tied in bundles, they are for a day or two kept standing on their roots in an inch or two of water, which

allows the fibre to obtain a proper degree of firmness, without suffering it to be parched by the heat of the sun.

Dr. Roxburgh observes, "all that seems necessary is to caution the cultivators against oversteeping the plant, which they are apt to do, because it renders the separation of the bark from the stalks easier, but weakens its fibres. Small pools of clear water, well exposed to the sun's beams, seem best suited for steeping in, because heat hastens maceration, consequently preserves the strength of the fibres, while the clean water preserves their colour. Deep water, being cooler, requires more time for the operation." He further states, that the result of many experiments leads him to think that steeping immediately after the plant is pulled is the best, at least in Bengal during the rains, for then it is very difficult to dry it, and the fibre becomes weakened and the colour injured. He found no advantage, but the reverse, by drying the plant, after maceration, and before the bark was removed, as often practised with Hemp and Flax in Europe.<sup>1</sup> But in his 'Fl. Ind.,' iii, p. 262, he says: "Others, and I believe with good reason, recommend its being dried for some time previous to its being steeped." When the seed is ripe the fibre is stronger, but requires a much longer time for steeping.

If the Sunn be dressed before it is shipped for England, the commodity will be rendered more valuable; but considerable loss of weight (probably about one third) having ensued from the combing or heckling removing much short fibre or tow, it is of course increased in price. The Sunn of Bengal is always whiter than that of Bombay, owing to the mode in which it is prepared.

*Drying.*—When the Sunn has been thoroughly washed, it is usually hung up on lines or bamboos to dry. When dry, it is combed, if intended for fishing nets or small lines; but if for common use, they merely separate the fibres a little with their fingers, and make it up into bundles for market. The use of the Hemp-brake is unknown in India, but the Sunn might in many cases, after watering, be bruised with a brake and then scutched.

It is in cleaning the fibres Mr. Frushard considers that the

<sup>1</sup> See also 'Observations on Fibrous Veg. Substitutes for Flax and Hemp,' p. 45.

natives are most liable to fail. He thinks it ought to be strongly insisted that they beat the plant (by handfuls at a time) on the surface of river water, in order to get rid more readily of the filth and mucus with which it abounds after steeping. But when the fibre is separated it must be thoroughly washed, by repeatedly squeezing the water out of it, and ultimately well wrung, to accelerate the essential process of careful drying. The cylinders for pressing Flax when moist (*v. p.* 206) would be useful, as also scutching mills properly suited to the fibres to be separated and prepared.

After the fibrous parts are well separated and well washed, they are in some places in Bengal laid in the sun to dry, before stripping them. At Jungypore, after washing and beating in the water, the *Sunn* is laid in the sun an hour or two, and the stalks are separated when half dried. Mr. Fleming recommended that after watering the plants forty hours, they should be taken out and dried gently in the sun for three or four hours, before the fibres are separated. The natives say, that to dry the plant on taking it out of the water before separating the fibre from the seed, will occasion a much greater loss in tow; so that they never practise this method but when distressed for time, and under the dread of leaving it too long in the water, when any parcel proves too much for the labourers employed in one day. Mr. Frushard also objected, that such drying must be insufficient, and that in Europe, generally, the plant is most thoroughly dried before it is put under the brakes, and that in Livonia the Hemp is heaped up, and covered up with straw, &c., in order to make it *sweat*, and that the Livonians say, it is in this operation of *sweating* that the good or bad quality of their Hemp depends.

Mr. Frushard observes, that "the natives get through the whole business with so much celerity that their mode of practice is highly in favour of the fibre retaining its strength; and should *sweating* be found to answer, it will be found much more congenial to its execution than the doing it while the fibre is still on the reed."

The measures adopted were successful to a great extent. Though the natives did not adopt all the innovations which had been proposed to them, yet from the supervision practised, they prepared the *Sunn* carefully according to their own