

clothed with a downy substance and have a silvery appearance. The minute greenish flowers are closely arranged along a slender axis. This variety has been cultivated by the Chinese for many years, and the fibre, which is obtained from it by a tedious hand-process, has been used more or less as a substitute for silk.

The variety *tenacissima* differs in its more robust habit and larger leaves, which are pale green on the face and a very much paler green on the bark. They are not downy, however, and this affords a ready means of distinction from true China-grass. *Boehmeria nivea* is sometimes found wild in India, Malaya, China and Japan, and is probably a native of further India and Malaya. China-grass and ramie are widely cultivated not only in China, Formosa, Japan, India and Malaya, but also in Queensland, Mauritius, the Cameroons, the West Indies, Brazil, Mexico and the southern states of North America, and also in south Europe.

The plant, which attains a height of from 3 to 8 ft., is grown from seed, cuttings or layers, or by division of the roots. It is easy to cultivate, and thrives in almost any soil, but especially in a naturally rich, moist, light, loamy soil. For the best growth a good and equally distributed rainfall is necessary. Sudden changes of weather result in irregularities in growth, and these have a tendency to produce plants the fibres of which vary in strength. Liberal manuring is necessary, as the plant withdraws a large quantity of valuable constituents from the soil. The plants should be cut when the flower is beginning to fall and the seed to form.

It is stated that two to four crops per season may be obtained on suitable ground, each crop yielding about 4 tons of stems per acre. With only two crops per year, and a 4% yield of fibre, the resulting product would nearly reach one-third of a ton per acre. When proper attention is given to the choice of ground, and to planting, there is not much difficulty in the way of raising a good crop; the trouble arises in the extraction of the fibre.

The stems when ripe are cut down, and after the leaves and small branches have been removed, the outer cover and the layers of fibre are stripped off in the form of ribbons. These ribbons contain the bark, the fibre and a quantity of very adhesive gum. The Chinese remove this bark and as much of the gum as possible before the plant has dried. This hand-process is naturally a slow and tedious one, and many decorticators have been invented to supplant it. The action of all these decorticators is very similar. The ramie stalks are fed into the machine, and during their passage are beaten by 12 to 20 rapidly revolving blades. These break the stalks into small pieces, and leave the bark and fibre in long ribbons. At the same time, part of the gum is squeezed out between the beaters and the anvil. Up to the present, however, these machines have not been very successful. They usually bruise or otherwise injure the fibre, and they do not squeeze out the gum thoroughly. If the gum be allowed to dry on the ribbons it is difficult to remove it, and the chemicals employed in the degumming, if not thoroughly removed by washing, often injure the fibre to such an extent that the ultimate fabric or article is soon decomposed. If, however, the ribbons be degummed immediately, or soon after the plants are cut down, the gum will be much more easily extracted—indeed it might be possible to remove it then by boiling water or steam. The fibre cannot be expected to make much headway until the operations of decorticating and degumming are successfully carried out on or near the growing grounds; and, until a proficient decorticator is made, the fibre should be stripped by hand and the degumming operation begun immediately. By this method the least possible damage would result to the fibre, no waste material would be shipped, and a clean fibre would be placed on the market.

The fibre possesses some very valuable properties; it is not only much stronger than any other known fibre, but almost equals silk in its brilliance. This latter property, however, is now challenged by mercerized cotton. It successfully resists atmospheric changes, is easily dyed and is affected but little by moisture. On the other hand, articles manufactured from it are

**RAMIE** (RHEA, CHINA-GRASS), the product of one or more species of the genus *Boehmeria*, a member of the order Urticaceae and nearly allied to the stinging nettle genus (*Urtica*), from which, however, it differs in absence of stinging hairs. Some confusion has arisen in the use of the various terms China-grass, Ramie and Rhea. Two plants are concerned. One, *Boehmeria nivea*, China-grass, has been cultivated by the Chinese from very early times under the name *Tschou-ma*. The other, probably a variety of the same species (*Boehmeria nivea*, var. *tenacissima*), though sometimes regarded as a distinct species (*B. tenacissima*), is the Ramie (Malay *zāmi*) of the Malay Islands and the Rhea of Assam.

*Boehmeria nivea* is a shrubby plant with the growth of the common nettle but without stinging hairs, sending up each season a number of straight shoots from a perennial underground rootstock. The long-stalked leaves recall those of the nettle in their shape and serrated margin, but their backs are

<sup>1</sup> From the position of the words it is even not unlikely that "Pithom and Raamses" may be the addition of a redactor, and that the first author of Exod. i. 11 only spoke generally of store-cities.

said to crack and break easily when sharply bent, and on account of their hairy character have not the same smart appearance as those made from flax. Although the fibre is in some cases 12 in. long, it varies considerably in length. This is one of the drawbacks in the preparing and spinning. It is impossible to make perfect yarns from fibres of various lengths; hence it is necessary either to separate the fibres into reasonable groups, or to cut them into satisfactory lengths. The latter method appears, on the whole, to be the better, and it is the method adopted by Messrs Greenwood & Batley Limited, Leeds, who make special machinery for the dressing, preparing and spinning of ramie and China-grass. If no special machinery be employed, the length of the fibre will decide the class of machinery to be used. The fibre has been prepared and spun on flax, wool and silk-waste machinery, but it must be understood that none of these systems are really suitable for the process. A fibre with special characteristics requires special machinery for its manufacture.

When so many different opinions obtain as to which existing machinery is best adapted for the preparing and spinning of ramie, it is not surprising to find that different methods are employed in the process of manufacture. In general, however, we may say that, after decortication, the first process is that of degumming. This is usually done by immersing the fibre in a caustic soda solution, which is then heated in a closed vessel. The fibre is laid on galvanized trays, of which as many as forty-four can be fitted in a cage, which is then placed inside the boiling keir, the lid of which is screwed down and the necessary pressure of steam admitted. After having been boiled a sufficient time to remove the gum, the material is lifted out, the alkali neutralized, and the fibre thoroughly washed to remove all traces of chemicals. The bulk of the water is removed by a hydro-extractor, and the fibre is then hung up or laid on perforated plates to dry.

To facilitate the subsequent processes, the fibre is softened by passing it through a machine fitted with fluted rollers. Then follow the operations of dressing, roving, wet spinning and doubling, and finally the twisted thread is passed rapidly through a gas flame in order to remove all superfluous hairs.

In spite of the many disappointments which have been experienced in connexion with the treatment of this fibre, we are of the opinion that it will ultimately hold a good place amongst commercial fibres. It is at present spun in several European countries, but its use is still very limited. This is due, not to any imperfection of the fibre, but to its price and to the limited supply of raw material. It is at present chiefly used for gas mantles, for which it is particularly well adapted. It has also been used for paper-making, ropes, lines, nets, underwear, and for canvas and several other fabrics. If only a good supply of clean fibre could be obtained, there is not the least doubt that manufacturers and machine-makers would quickly provide means for dealing with it.

(T. Wo.)