COIR FIBRE.

By George H. Murray.

This article is based largely on my observations made on coir fibre preparations during several visits of study and travel in Ceylon and the East Indies during the past 25 years.

Many planters in Ceylon with whom I discussed the coir fibre industry informed me that the coco-nut husks on their estates were of more value to them as manure than the cash they would receive from coir mill owners, and from my own observations on the best managed estates I consider that such is the case. Still other planters, particularly small land-holders, consider it an advantage to receive ready cash for what may seem a waste product which is also the opinion of practically every native owner of coco-nuts grown in Ceylon and South India.

On the Malabar coast of southern India, which provides such a large part of the world's supply as a peasant industry, not a coco-nut husk is wasted; in every cottage almost, can be seen coir in some process of preparation, and no machinery at all is employed. The hand method may seem slow and cumbersome, but it has been the one used from time immemorial in these coco-nut-growing countries, where there is a considerable local demand for the product for rope, twine, boat caulking and other domestic purposes, and there is not likely to be any change in the existing practice.

The invention of improved machinery, about the middle of the nineteenth century, for processing the product brought it into more general use as a commercial commodity in other countries. The fibre has a special value for ropes subject to soakage in salt water, but, lacking strength, is of less value for general use than other rope fibres; it is, however, more elastic, and it does not therefore break so readily as ropes made of stronger fibre.

The industry is still of a minor character, but should be suitable for those natives of New Guinea who show sufficient enterprise and energy to apply themselves to such work.

When observing the amount of labour wasted by misdirected effort, mainly by women, and therefore not taken into account, in the production of native-cured copra, I could not but be struck by the fact that if the same time and energy were put into the preparation of coir fibre from the husks, there would be obtained good value from what is otherwise going to waste and probably as much money, if not more than for their labour put into copra, would accrue to them.

New Guinea natives are, however, so conservative that instruction, unless it can be backed by compulsion or authority, is of little advantage to them.

The fibre is of little value for textile purposes on account of its harshness and brittleness, and for its ordinary use in the manufacture of ropes, twine, and matting, the supply at present is more than equal to the demand. There are, however, possibilities for new uses for coir fibre products on an extensive scale, in which research is now being carried out. Underground pipes for gas, oil, or water and cables subjected to the corroding influence of bacteria and electrolytic influences of tramways, &c., could be protected from such corrosion by the pipes being packed with lagging of such material. The expense of repairs to pipes involving the tearing up of roads could apparently be greatly reduced or eliminated

by the use of such protective lagging. It is not an uncommon sight at present to see pipes protected in this way, and once the practice becomes general possibilities of the fibre for this purpose will be greatly increased.

Statements are frequently made by some planters that the millions of husks going to waste on plantations and native groves, in this Territory, should be turned into coir fibre as a subsidiary industry to copra-making, and one planter went so far as to purchase a small experimental machine with this object in view. Many coir-mill owners in Ceylon with machines of local manufacture produce fibre on a fairly large scale, but the small profits they receive would hardly be acceptable to most European planters in this Territory. Individual planters therefore would be well advised not to enter upon the industry in a small way. Preparation of coir fibre by small units in a territory like this might well be made a native industry, but, in an extensive way, it should be left to capitalistic enterprise, which, by careful management, and large-scale production by modern machinery, could expect reasonable profits provided their operations are carried on near large supplies of husks as in the Gazelle Peninsula, New Britain, or the east coast, New Ireland.

There is an assured market in Australia for approximately 1,800 tons of coir fibre. The *Papua and New Guinea Bounties Act* 1926-1936 of the Commonwealth of Australia provides for the payment of a bounty of £3 per ton on fibre produced in the Territory and imported direct into Australia for home consumption.

Native Cottage Industry.

I feel sure that a market could be built up for floor mats to take the place of, or compete with, the grass mats so commonly seen in bungalows to-day. I have in my possession a very fine large circular mat made from coir fibre by prisoners in a Javanese gaol. It is dyed in artistic designs with native dyes and has been in continuous use for the past six years, and is as good now as when first purchased, and far superior to any ordinary grass mat.

The preparation of coir fibre and the manufacture of such mats, and other similar articles of domestic use, would be quite suitable for a native cottage industry, fostered by the Government in its gaols, and native schools, or in industrial missions.

In the Malabar coast the husks in many cases are purchased by merchants and the preparation of fibre performed as piece work by peasants, the beating, clearing and twisting after retting, being done by old women. Surely this would be easier and more profitable work for women than carrying heavy loads of native produce many miles to sell for a few sticks of tobacco at the Bung (native market) in Rabaul and other settlements.

Harvesting.

The general practice in Ceylon and the Malabar coast is to cut the stalk of the bunch by means of a full-length bamboo to the end of which a knife is fixed. On palms too tall for the nuts to be harvested by bamboo poles, such work is done by coolies climbing the trees and cutting the bunches or single nuts, their ripeness being gauged by the coolie tapping one of the nuts with his finger nail. The sound produced indicates the quantity of moisture in the husk and

the ripeness of the fruit, and the whole bunch is cut only when all the nuts have reached sufficient maturity. Payment in Ceylon for climbing is at the rate of two rupees (2s. 8d.) per 100 trees and the coolie usually climbs 50 to 60 trees per day.

By means of the bamboo about 150 trees can be picked per day per coolie, payment for which is made on the basis of 80 cents (1s.) per 100 trees, so that a man can pick by this means 900 to 1,000 nuts in a week. Contract labour is sometimes employed, when a contingent can pick an area of 10 to 12 acres in a day and will receive 15 rupees (£1 sterling) for the job. The work of collecting the nuts will be 1 rupee, and carting to the drying dump 3 rupees, or a further expenditure of 4 rupees a day.

Husking.

Nuts are allowed to lie stacked in a heap for a few weeks (a fortnight to a month) to partially dry out before husking, but one rarely sees heaps of "dries" as noticed in New Guinea.

The best coir fibre is prepared from nuts that have been harvested from the trees before the exterior of the fibrous covering is quite ripe, say, ten to eleven months old, as they are then most readily retted, besides producing better coir, colour being an important factor in assessing its value.

As coco-nuts are always harvested in New Guinea as "dries" there is little hope of our producing coir of extra good quality, but even the second quality (that which is coarse and hard), is still a good marketable commodity.

The method of husking is to have a straight wooden or iron spike driven fast into the ground—a piece of 1-in. round iron, sharpened at the outer end to a knife edge, is admirable for the purpose. The coco-nut is struck with a straight blow against the point or edge of the spike, which penetrates to the shell and with a twisting movement the husk and shell are readily separated one from the other. A skilled coolie can husk as many as 2,000 nuts per day, but 1,000 to 1,500 is nearer the mark for the average worker, for which he receives 50 cents (8d. sterling) per 1,000. It has been proved on a well-known estate in New Guinea that after about three months' practice, our natives can husk as a maximum 1,500 per day.

Retting.

The process of soaking and retting husks before preparation of the fibre has been the practice for such a long time that one is justified in thinking that there must be some sound reason for doing so, but which, of course, does not preclude the modification of the principle involved.

There is considerable variability in the process of retting, according to local conditions. Still water is not generally considered suitable for the purpose, but husks are frequently retted in pits with brackish water, in the backwaters of lagoons. The pits are formed by making enclosures with stout bamboos driven into the mud and joined together with plaited coco-nut leaves, subject to the movements of waters by the flowing and ebbing of tides, like the fish traps placed across many small streams, by New Guinea natives, to catch fish on a falling tide. An outlet is provided to permit the accumulated dirty water to escape with the outgoing tide, and to fill again on the returning tide, and by this method a complete change of water is effected.

In selecting sites for such retting pits, considerable care is exercised not only for the necessary water conditions, but with regard to the proportion of mud and sand at the bottom of the pit, as this has a bearing on the brightness and strength of the fibre.

The methods employed in Ceylon and South India are the result of many hundreds of years' experience, and therefore entitled to careful consideration. In some places the husks are soaked for a few weeks in water, or even sandy mud; in others the retting lasts for nine months, or even longer, and the fibre is then rinsed, partly dried and beaten. This is followed by further soaking, drying and beating to get rid of the dust before the material is rough carded.

It is an advantage to crush the husks before placing in the retting pits. Crushing or breaking machines are easily constructed consisting of two heavy rollers as used in old-fashioned cane crushers, and by repeating the process of soaking and crushing the period of retting is greatly reduced. The retting pits are sometimes dug in the soil adjoining a backwater of sufficient depth to hold 3 or 4 feet of water at all times with an inlet permitting fresh water moving in and out of the pit. Stagnant water spoils the colour of the fibre, and under such conditions a pronounced odour of sulphuretted hydrogen is noticeable.

A pit of 250 cubic feet with a depth of 4 feet of water can hold the husks of 1,000 nuts. In pits of this kind the husks are placed in layers, one above the other, and weighed down in the water by heavy logs. In some places where slowly moving water is not available concrete tanks and ponds are filled with fresh water for retting. This was the method employed at Pekalongan Gaol in Java, which I visited specially to study the coir fibre industry carried on by the Dutch Government, in that institution.

The pits should be shallow enough to be thoroughly warmed by the sun as the retting is thereby expedited, and too rapid a change of water should be avoided, otherwise the temperature will be unduly lowered, thus retarding the retting process: this also diminishes the action of the bacterial organisms which disintegrate the matter binding the fibres together.

The general opinion seems to be that retting in purely salt water is not advisable, yet, if retted in fresh water ponds for a very long time, the fibre is damaged, as the epicarp or outer skin becomes rotten, and is not easily removable.

Burkhill, in his *Dictionary of the Economic Plants of the Malay Peninsula*, says—

> "The ability to produce good coir rests on the nice adjustment between the various bacteria and organisms which operate in the tanks and their surroundings; too little air fosters the wrong ones; a slightly saline medium seems to inhibit their action; too low a temperature spoils the process."

The discovery of some method of retting the husks by a chemical process on a large enough scale, would no doubt enable husks to be processed on an economic basis, but, so far, research has not gone beyond the experimental stage.

Extraction of Fibre after Retting.

Hand Extraction.

After removal of the husks from the retting pits the outer skin is removed and the fibre beaten out by mallet on a block of wood.

In the Pekalongan Gaol, Java, there were 1,000 prisoners all employed in preparing coir fibre, and weaving into mats and various other articles. Larmuth and Bulmer machines for processing the fibre were partly employed, but large numbers of prisoners were hard at work beating out the fibre by the hand method, producing about 5 lb. of clean fibre each, in a 10 hours working day.

In Malabar, South India, one woman will clean the husks of about 100 nuts per day.

Machine Extraction.

As already noted, the coir mills in Ceylon are comparatively simple. The machines known as breakers and finishers consist of drums set with coarse and fine iron spikes respectively. The husk being still wet from the retting is fed by the labourer between rollers of the breaker with the back or hard side uppermost, when at high speed. The husks are fed rather more than half-way, then withdrawn, and the other end inserted in a similar manner. The back of the husk is in this way broken and then passed on to the finisher machine. The labourer feeds the husk into this finisher machine in the same way, which removes the spinning or mattress fibre. The breaker and finisher are in pairs, so that the half-treated fibre is passed to the labourer serving the finisher for the final operation. The finisher also removes the greater proportion of the fibre from the remainder, and the husk left in the coolie's hand, which is not passed through the machine, is known as bristle fibre. This is put back into another tank to be washed and afterwards dried in the sun.

The fibres which have passed through the breaker and finisher, and known as mattress, are then dried, preferably in the shade, and afterwards threshed with poles to remove the remaining dust, when the fibre should be ready for the final operations of willowing. This machine consists of a revolving drum carrying a number of teeth set on its axis which pass through similar teeth on the inner side of the machine. The fibre which has passed through this machine is soft and clean ready for manufacturing purposes. By this machine two persons can willow 300 lb. in eight hours. Improved and more costly machinery is manufactured for the purpose, resulting in a very much larger output of clean fibre.

The proportion of the two products is usually one bristle and two mattress dried. One thousand to 1,200 full husks are estimated to give 1 cwt. dried bristle fibre and 2¼ to 2½ cwt. mattress fibre. By a Ceylon locally-made machine 2,000 husks per day are treated.

Mr. Bunting, of the Department of Agriculture, Federated Malay States, in an article on coir fibre, written after a visit to Ceylon, states that twenty of the Ceylon machines, working on a 16-hour day, produce 300 tons of bristle fibre and 600 tons of mattress fibre, from 7,250,000 husks. It is also estimated that 24,000 husks will produce 1 ton of bristle fibre, and about 2 tons mattress fibre. In large mills of this character the fibre is packed by hydraulic press into bales of 2½ to 3 cwt., roughly measuring 11 cubic feet. The price paid for husks ranges from Rs. 1 to Rs. 3 per 100, according to fibre market quotations, delivered at the mill.

Bristle Fibre.

This is the most valuable portion of the coir product, being graded into three grades, each in a different manner as follows:—

The longest bristle fibre with three (3) ties.
The medium length fibre with two (2) ties.
The short length fibre with one (1) tie.

Prices vary naturally, according to supply and demand, but the latest available prices are as follows:—

Long bristle fibre three (3) ties—£27 10s. per ton.
Medium bristle fibre two (2) ties—£26 5s. per ton.
Short bristle fibre one (1) tie—£24 per ton.

Mattress Fibre.

Fair ordinary brown fibre—£12 per ton.
Super quality brown fibre—£14 per ton.
White bleached fibre—£26 per ton.

Working Costs.

It is a very difficult matter to give an estimate of the working costs for the extraction of coir fibre by the modern machinery, as labour and other conditions vary even in any one country. However, to give some indication of the requirements to operate a plant such as manufactured by Messrs. Larmuth and Bulmer Limited, of Manchester, England, the following particulars are supplied:—

General supervisor	1	European or Asiatic.
Engineer or maintenance man	1	„ „ „
Boiler or maintenance man	1	„ „ „
Husk-crushing machines	2	„ „ „
Extracting machines	16	boys.
Willowing machines	2	„
Brush, combs (for bristle fibre) (Also to attend to fibre-cutting machines.)	4	„
Baling press	2	„
Milling machine	1	„
Eight 6-headed small spinning machines	48	„
Four 2-headed small cabling machines	8	„
Over and above these workers it would be necessary to have about six boys about the factory to aid in moving the material from place to place	6	„
Total	92	

Installation of Plant.

To ensure that the above machinery was installed in satisfactory working order, it would be advisable for a thoroughly competent erector and demonstrator to be sent out with the machinery from the makers, and remain for about a year to demonstrate to the operating staff of each machine, and produce goods such as

the material affords. Such a demonstrator would instruct the various operators as to the operations they are required to fulfil, and he should stay on until the general supervisor and engineer have thoroughly mastered every branch of the plant, so that they would know how to get a full return from every worker on the staff.

Messrs. Larmuth and Bulmer Limited have supplied particulars of the machinery for the treatment of 10,000 coco-nut husks per day of ten hours, to convert the fibre extracted into yarns, complete with millwright work, boiler, engine, &c. Such a plant is only suitable for a company operating in a large coco-nut-growing district in Gazelle Peninsula and East Coast-road, New Ireland, where millions of coco-nuts are going to waste yearly.

Methods of extracting and processing coir fibre without previous retting have been invented or described, but the only one with which the writer has personal knowledge is the Van der Jagt, which claims to extract the fibre in the marketable form from the husk of dry nuts, in less than two hours.

This process was described in the *Engineer*, June, 1912. A full description with photos of the machinery supplied by Mr. Van der Jagt himself, was submitted to the head of this department in 1930. The fibre produced by this method is apparently softer and more easily worked than that of the older system, but renders it unsuitable for many of its ordinary purposes. While in Europe in 1931 I made certain investigations on this method, and saw samples of the produce (including gunny bags), made from the fibre, and they appeared quite suitable for copra and fertilizer sacks and similar purposes. The fabric for the copra and similar sacks is stiffer and harsher than that made from jute, and would hardly be acceptable for such purposes, unless obtainable at a considerably lower price.

The capital outlay for this plant to deal with 5,000,000 coco-nuts per annum is quoted at £40,000, including buildings.

The Australian Trade in Coco-nut Fibre.

The following article on the Australian aspect of the trade, reprinted from the *Malayan Agricultural Journal*, April, 1936, may be of interest to readers:—

> "An inquiry was recently received for information concerning the Australian trade in cono-nut fibre (coir). The following notes are drawn from a communication by H. M. Senior, Trade Commissioner in Australia, and from a letter from one of the principal importers.
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> *Imports.*—In the year 1934-35, 24,189 cwts. of coco-nut fibre were imported into Australia, of which 22,301 cwts. were from Ceylon, and 1,630 cwts. from India. The total value of these imports was £5,522. Queensland was the largest importer (14,107 cwt.), while other States imported as follows:—Victoria, 4,593 cwt.; New South Wales, 2,494 cwt.; South Australia, 1,542 cwt.; Western Australia, 1,452 cwt.; and Tasmania, 1 cwt. The demand is regular, but, as will be seen from the above figures, not a large one.
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> *Packing.*—There are two types of packing suitable for the Australian market. The first type is in hydraulically-pressed bales containing 2 cwt., 2½ cwt., or 3 cwt. The measurement would be about 12 cubic feet for a

2-cwt. bale. The bale type of packing is not popular with many manufacturers as they find that the fibre is exceedingly hard to tease; they, therefore, prefer to pay a little extra for a looser packing. As a result, in many cases, fibre in ballots is more popular. A ballot is a small bundle of fibre varying in weight from 12 to 15 lb., tied loosely with yarn made from coco-nut fibre. From 200 to 250 ballots weigh 1 ton.

Freight.—The freight rate on ballot fibre exported from Colombo to Australian ports is 30 rupees per ton of 6 cwt., equal to £7 2s. 6d. sterling per ton of 2,240 lb., while on bale fibre the freight is 40 rupees per ton of 50 cubic feet, equal to £5 sterling per long ton.

The freight on fibre is by far the largest item in the landed cost. Until recently, the f.o.b. price, Colombo, of ballot fibre was exceedingly low, and the price of £9 5s. c.i.f., Sydney, would represent an f.o.b. cost, Colombo, of £2 2s. 6d. Bale fibre at that time was quoted at £7 12s. 6d. per ton c.i.f., Sydney, representing £2 12s. 6d. f.o.b., Colombo. At the end of January, 1936, c.i.f., Sydney, price for bale fibre was £10 and ballot fibre £11 2s. 6d.

It is stated that the high freight charges on coco-nut fibre are made on the grounds that the fibre is hazardous cargo. They bear little or no relation to freight charges for other kinds of goods."

Summary.

1. On well-conducted coco-nut estates coco-nut husks can be put to best use as manure, but for those desirous of receiving an immediate return they can be sold to advantage to mill owners.

2. Coir fibre preparation is largely a cottage industry in southern India and Ceylon where these is a considerable local market for processing into rope, twine and boat caulking.

3. The invention of machinery in the middle of the nineteenth century for processing the fibre brought it into more general use as a commercial commodity.

4. The supply is fully equal to the present demand, but research has shown that it can be put to new uses particularly as lagging for oil, water or gas pipes to prevent corrosion and when this practice becomes general there should be a much greater demand for the product.

5. Coir fibre preparation cannot be recommended as an industry for individual planters, but should be suitable for capitalistic enterprise with the use of modern machinery in districts where there are large nearby supplies of coco-nut husks as in Gazelle Peninsula, New Britain and east coast, New Ireland.

It should also be suitable as a native industry in industrial missions or as work in government institutions like gaols and schools. The preparation of fibre by natives could open the way for a valuable secondary industry in the making of mats and other articles for which there would be a ready sale.

6. The best coir fibre is obtained from coco-nuts that have been harvested before being thoroughly ripe and as nuts in New Guinea are always harvested as "dries" it could not be expected that the finest fibre could be produced in this territory. Second grade is a thoroughly marketable commodity.

7. Preparation of fibre by retting is the general practice, but researches are being carried out with a view of expediting the process by technical means.