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THE CULTIVATION AND PREPARATION OF PARA RUBBER

BY

W. H. JOHNSON, F.L.S.,

EX-DIRECTOR OF AGRICULTURE, GOLD COAST COLONY, WEST AFRICA; DIRECTOR OF AGRICULTURE, MOZAMBIQUE COMPANY, EAST AFRICA.

Commissioned by Government in 1892 to visit Ceylon to study the methods employed there in the Cultivation and Preparation of Para Rubber and other Agricultural Staples for Market, with a view to introduce them into West Africa.


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THE RUBBER-PLANTER'S NOTEBOOK

A Handy Book of Reference on Para Rubber Planting

WITH HINTS ON THE MAINTENANCE OF HEALTH IN THE TROPICS AND OTHER GENERAL INFORMATIONS OF UTILITY TO THE RUBBER PLANTER

SPECIALIY DESIGNED FOR USE IN THE FIELD

COMPILED FROM THE MOST RELIABLE AND MODERN SOURCES

BY

FRANK BRAHAM, F.R.G.S.

WITH DIAGRAMS AND PHOTOGRAPHS

LONDON

CROSBY LOCKWOOD AND SON

7 STATIONERS HALL COURT, E.C., AND
101A VICTORIA STREET, S.W.
1911
PREFACE.

Of all tropical industries in recent years, few have received more attention than rubber. Its rapidly spreading use in the manufacture of motor and bicycle tyres, electric and other machinery, and for so many industrial purposes, has encouraged its cultivation all over the tropical world where conditions permit, and has caused an advance in its value of almost dramatic suddenness. While it is true that the return of capital invested in rubber plantations is not immediate, it is certain that the ultimate profits will fully justify the optimism of that numerous body of investors who have realised the importance and economic virtues of this commodity.

Although it is perhaps unreasonable to anticipate another "boom" such as that of 1910, yet it is certain that of all agricultural undertakings, rubber cultivation, if properly conducted, offers the most assured and profitable returns.

The art of cultivation, and the work of bringing a plantation into bearing, are subjects on which both
the ordinary man and thousands of young untrained assistants are in absolute ignorance, and it is for such as these that this little volume has been compiled. Technical language has purposely been avoided, the object of the little volume being to provide a notebook which the rubber plantation assistant can take with him into the field for purposes of reference and guidance. Of the many books by well-known experts, there are none quite suitable for this purpose. They are in the highest sense scientific, and deal with the subject in a manner too thorough and searching for the beginner. A debt of gratitude is due to them, which it is hoped that this book may in some sense repay, intended as it is not only to help the new hand in moments of doubt, but to inspire him to a further and more profound study of the widely spreading and remunerative profession, to which the information herein given is merely the key of the principal entrance.

I take this opportunity of expressing to Mr Herbert Wright my thanks for the valuable aid he has given me, and to the Proprietors of the *India-Rubber Journal* for their permission to reproduce most of the photographs in this little book.
LIST OF CONTENTS.

SECTION I.

NURSERIES, PLANTING, TAPPING, ETC.


SECTION II.

MACHINERY, LITERATURE OF RUBBER, USEFUL NOTES, ETC.

List of Contents.

Rubber Seeds and Seed-Oil—Other Sources of Commercial Rubber—Ceará Rubber—Castilla elastica—Funtumia elastica—Ficus elastica (Rambong)—Ficus Vogelii—Landolphia (Vine Rubbers)—Carpodinus and Clitandra—Guayule 55

SECTION III.

GENERAL INFORMATION.


INDEX 103
SECTION 1.

Nurseries, Planting, Tapping, &c.

Hevea Brasiliensis (Euphorbiaceae), the Para rubber tree, is a native of the forests of the valley of the Amazon, where it grows to a great size—often 60 ft. in height and 6 ft. in circumference. It was introduced into Ceylon and Singapore in 1876 from seedlings raised at Kew, the parent seeds having been collected by Mr. H. A. Wickham in Brazil. From that time on planting has gradually increased, and in recent
years so rapidly that it has become one of the most important agricultural industries of our Eastern Colonies, and bids fair to become equally important in all our Colonies where it can successfully be grown. Plantations have been established in East and West Africa with very successful results. In fact Hevea, being a very hardy plant, will grow well in all tropical countries where a minimum temperature of 80° to 90°, and rainfall averaging from 75 to 150 in. can be depended upon.

The botanical description of *Hevea Brasiliensis*:

Leaves - Trifid.
Leafllets - Elliptical lanceolate.
Flowers - Unisexual, small, green-yellow, sweetly scented, produced in panicles.

The female flowers are larger than the male flowers, and are frequently terminal.
Preparation of Lands.

The fruit bursts spontaneously with a sharp report, when ripe, and the seeds are scattered to a considerable distance from the trees. The seeds are about an inch long, flattened on one side, round on the other; in colour they are shiny brown mottled with blotches of darker hue. They contain kernels of rich oil somewhat akin to linseed oil, and in the future there is no doubt that a good demand for Para seed oil is likely to arise.

Hevea thrives best on damp, low-lying land of rich alluvial soil, but will grow satisfactorily in others. In Ceylon it grows up to 3,000 ft. above sea level; with good growth it becomes tappable in from four to six years, or when the girth has reached 18 to 20 in.

Preparation of Lands.

In preparing virgin lands preparatory to planting, all logs and timber should be felled as closely
to the ground as possible. Rotting logs and stumps of timber are almost certain to breed fungi, and constitute a very serious danger to cultivation. It is therefore necessary that all large logs should be removed or completely burned. Small stumps can be uprooted. Fungi present in rotting logs and stumps spread from the logs to the roots of the rubber plants and may destroy them. Fungal threads have been traced from an old stump in the nursery to young plants immediately around it.

Reference Plan.

For the proper ordering of the estate in the matters of planting, inspection, accounts, general observation and reference, it is essential that it should be divided into blocks or fields. Twenty acres to each block form a useful working area, though no hard and fast rule need be laid down. Each block should bear a distinctive number
corresponding to a number indicated upon the key plan of the estate, and upon the latter should be shown in the plainest manner, all the roads, nurseries, drains, hills, and streams. Such a plan should be found in the local and home offices of all plantation organizations. The adoption of this "reference" system will be found to be of the greatest assistance in controlling the work of the whole estate; it will enable the daily tasks to be allotted with precision, and the superintendence of "piece work" and contract work will be made proportionately easy.

Blue prints of the key plan on a reduced scale, with the reference marks added, will be found useful in the field. A copy should be in the possession of every European employed on the plantation.

Nurseries.

The selection of nursery beds requires special
care. The essentials are: loose, well-drained soil, good water facilities, light and shade. The best position is a sheltered valley with a stream running through it.
Nurseries.

They may be of any convenient size, but preferably about 6 or 8 ft. wide, and dug up to a depth of about 12 in. A furrow about 1 ft. wide should be left between each bed. The addition of a little lime and decaying leaves
will make an excellent manure for the beds, and lime is an essential addition if the soil is very friable.

New beds should be prepared each year.

All nursery beds should be well shaded during the day, and should be watered copiously morning and evening, care being taken not to dislodge the earth covering the seeds. Shades can easily be constructed by fixing upright posts about 8 ft. high, in lines about 10 ft. apart each way; on this support light cross bars are placed, and upon the whole a thin layer of palm leaves or thatch. Mathieu says: The best preservative against insect and fungoid pests is complete drainage of the land around the nurseries, keeping a strip all round the nursery and occasionally watering this strip with a solution of sulphate of copper and lime* (see Figs. 1 and 2).

Seeds.

Seeds.

Seeds should be carefully selected. The whole life of a rubber tree, its progress and ultimate rubber producing power, depend upon its first start, and it therefore follows that care and attention at the outset will prevent failure and disappointment later on. Seeds from trees ten years old or more are preferable to those from trees of younger growth.

The seeds should be planted in the nurseries, at a depth only just sufficient to cover them; then covered with a little earth sprinkled over them by hand.

They should germinate in eight or ten days. As soon as they begin to grow they should be removed and replanted in a permanent nursery, at a distance of 9 in. apart. When the germinated seeds are planted in their permanent beds they must be covered with their own depth of soil; in other words, \( \frac{3}{4} \) or 1 in. of soil should be over them.
Fig. 3.—Hevea in Borneo—Twelve Months Old (Trees Protected by Poles).
Hevea seeds very soon lose their vitality and should never be kept unplanted.

As soon as the plants in the permanent nurseries have reached a height of about 12 in., the shade is no longer required, and should be gradually removed in order to harden them. If they are kept too long shaded, they grow long and thin, and the leaves become scanty and pale.

Plants should never be transplanted direct from shaded beds to the open field: they should always be hardened off for a few days before being transplanted.

Young plants in the nurseries must be protected from animals, which are very fond of them.

A plan often followed in the Malay Peninsula is to germinate the seeds in nurseries, and when the plants are 5 or 6 ft. high cut them down to within 6 in. or 1 ft. of the ground, these stumps being planted out in their permanent
position in the field. Sowing to stake is also resorted to on some plantations, *i.e.*, the seeds are planted straight away in their permanent positions; but it is always a more difficult thing to protect young plants when widely scattered in an open field than in nurseries, and it will be found in practice that nursery planting will prove the most satisfactory.

Another very satisfactory method is basket planting, the seeds being in the first instance grown in bamboo baskets, in the nurseries, and then transplanted, baskets and all, in their permanent sites. Herbert Wright recommends this method as being very effective, as it prevents damage to the roots.

**Drainage.**

All cultivated soils require drainage, which is essential if the best yield is to be obtained. The object of drainage is not merely to dry
Fig. 4.—Hevea Growing on Rocky Slopes—Ceylon (Note Drainage System).

By courtesy of "India Rubber Journal."
the soil, but also to permit free circulation of air and water, rendering the soil porous and causing bacterial energy, and thus promoting the formation of plant food. Drains are also necessary to check the washing away, by the heavy rains, of the valuable surface soil on steep hillsides.

The size of the drains and their distance apart from one another must depend upon the physical conditions of the land, and the local climatic conditions. On very steep land they should be no more than 20 to 30 ft. apart, while on gentle slopes they may be as many yards distant from one another. On hillsides they need only be shallow—1 to 1½ ft. in depth, and at right angles to the slope to prevent the formation of gorges.

Transplanting.

In transplanting young plants from the
Transplanting.

nurseries to their permanent sites in the field, most particular care should be taken that the roots are not damaged. The lateral roots should be disturbed as little as possible, and where seeds have not been planted in baskets, a simple method is to lift a ball of earth with the young plant. This ball of earth should immediately be wrapped in a leaf or leaves and tied round with fibre or tough grass, and the plant should be planted out without removing this wrapping. The more roots one can get covered with soil the better, but where the lateral roots spread out to a considerable distance beyond the earth surrounding the young plant, they should be pruned off. *Never prune the tap root unless it is very long.* Sometimes it is found that the tap root doubles up in planting, but this can easily be avoided by making the holes deep enough. The roots should be kept in their natural position, but should any be broken they should be cut off with a sharp knife.
Holing and Planting Distance.

Before arriving at a decision as to the distance apart at which Hevea trees should be planted, there are many views to be closely considered. The main objective is to encourage the most rapid development of diameter growth—not of height. Close planting produces tall trees while wide planting causes a sturdy growth. When no catch-crops are planted it may be more obviously economical to plant fairly closely, say 15 by 15 ft. apart, and afterwards thin out the trees by “tapping” them to death, as they become crowded. Trees closely planted will naturally produce a quicker return per acre, and weeding a plantation closely planted is less expensive than in the case of a widely planted estate. At the same time it must not be forgotten that the exclusion of the sun by close planting will retard the progress of diameter growth. It is safe to conclude, therefore, that where quick returns are
Fig. 5.—Results of Close Planting: Tall Spindly Trees.

Photo by Ivor Hetherington, by permission of "India Rubber Journal."
The Rubber-Planter's Notebook.

expected, planting at distances 15 by 15 ft. or 15 by 20 ft. is close enough, the trees being thinned out as they become too thickly crowded; but where ultimate profit is looked to, and time is of secondary importance, wide planting, as the cause of a heavier permanent yield, is strongly to be advocated.

The following table will show the number of trees per acre, planted at different distances:

<table>
<thead>
<tr>
<th>Feet.</th>
<th>Per acre.</th>
<th>Feet.</th>
<th>Per acre.</th>
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<tr>
<td>15 x 15</td>
<td>193</td>
<td>15 x 20</td>
<td>145</td>
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<tr>
<td>16 x 16</td>
<td>170</td>
<td>20 x 25</td>
<td>109</td>
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<tr>
<td>18 x 18</td>
<td>134</td>
<td>25 x 25</td>
<td>88</td>
</tr>
<tr>
<td>20 x 20</td>
<td>109</td>
<td>30 x 30</td>
<td>49</td>
</tr>
</tbody>
</table>

The average annual yield of rubber (dried) after the fourth year (in good soil), and provided the tree has obtained a girth, 3 ft. from the ground, of 17 to 20 in., may be calculated at \( \frac{1}{2} \) lb. per tree, increasing annually by about \( \frac{1}{4} \) lb., although much larger crops have been obtained.

Before planting commences, all trees, bush,
and scrub growing upon the land must be felled, cut down, and burned; particular care being taken to see that the land has been made free from stumps in the manner already indicated. The effect of this "burn" is not merely to prepare the land for planting, but the ashes resulting contain valuable fertilising constituents and should be spread wherever possible. The land must then be lined and the holes dug.

The size of the hole into which each seedling is to be placed should be, at least, 1\(\frac{1}{2}\) to 2 ft. wide; the depth the same. Larger holes are required in very dry districts. If the seedlings are more than six or nine months old the hole may not be deep enough for the tap root, and should therefore be deepened in accordance with the length of this root. Care must be taken to avoid bruising or damaging the roots (vide pp. 14 and 15).

After the holes have been dug they should be refilled with the richest soil obtainable, pre-
preferably soil to which a small quantity of manure has been emptied. The best soil is that obtained from the surface to a depth of 3 or 4 in. around each hole. Before planting, the holes should be refilled with soil scraped from the surface about two weeks prior to planting. After planting the tree the earth should be pressed fairly tightly around it. It is also necessary to see that the plants are not placed in pits, and the soil in which they are placed should be raised at least 3 or 4 in. above the surface of the surrounding ground surface. Do not ram the earth too tightly—use great care. Carelessly planted trees rarely do well.

The best time for planting is, naturally, during the period when the rainfall is most plentiful.

Weeding.

One of the most important considerations in connection with rubber planting is that of weed-
Weeding.

From the very outset the plantation should be clean weeded and kept in that condition. Weeds of all kinds retard the progress of the trees and must be suppressed. In the case of young seedlings weeds often choke them to death. They also harbour insects, rats, porcupines, &c., all dangerous to young plants. In course of time—in three or four years—the shade afforded by the trees themselves will have the effect of keeping back the weeds, and weeding will become less necessary, though they will always require to be kept under. From the very moment of planting the closest attention must be given to weeding.

The most rapid girth development can only be obtained by clean weeding, and once an estate is thoroughly weeded it becomes both easy and cheap to keep it so. It is a fallacy to suppose that "ring" weeding or "strip" weeding are more economical or answer the same purpose. Experience has fully proven
that satisfactory growth can only be obtained by maintaining the estate in a perfectly "clean" condition. Even where catch-crops are sown weeding must be religiously carried on.

The weeding must be done in a very systematic manner. This is not difficult if the following system, which is known as the "three-weekly system," is resorted to. It is largely employed in the East:

The area to be weeded should be divided into blocks, and after each block has been weeded, it must again be weeded once every three weeks before a fresh block is touched.

As an example: assuming that a portion of the estate is divided up into say three blocks, A, B, C. At the end of the first three weeks block A will have been weeded. At the beginning of the second three weeks, instead of starting to weed block B, block A must again be weeded. This time—being the second weeding of block A—the work will be found to be much
Fig. 6.—A Young Clean-Weeded Estate.
24 The Rubber-Planter's Notebook.

easier, and instead of occupying the whole of three weeks, may only demand the labour of a fortnight, leaving a week to spare, which must be devoted to as much of block B as the time will allow.

Similarly, at the beginning of the third period of three weeks, the work must again start with block A, which, by this time, will perhaps be completed in one week, leaving two weeks for block B and part of block C, and so on. In this manner the whole of the estate will be brought under control, and there will be little difficulty in keeping it so, still working on this principle, always seeing that the first blocks are weeded before any new ones are touched.

For the practical purposes of rubber cultivation nothing can take the place of clean weeding. Turning up and forking the earth between the trees is very beneficial; it breaks up the surface crust and admits the passage of air. The earth should not, however, be stirred
Pruning.

deeply in the dry season as it may give rise to too great an evaporation of the inherent moisture. The object of weeding is not only to remove noxious weeds but to till and aerate the soil as well.

The weeds, however, should not be destroyed, but should be used as mulch, being worked into the earth in a shallow trench surrounding each tree.

Pruning.

Pruning is the cutting away or preventing the growth of unnecessary parts of a tree, thus causing concentration of vigour in the useful portions, and adding to their productivity. The main objective of the rubber planter being the production of the greatest yield in the shortest possible time, it is necessary to endeavour to so "shape" the tree as to give this result. The most accessible portion for tapping purposes is
that nearest the earth, while the flow of latex is greater at the base of the tree than higher up, and therefore, in order to produce a tree growth suitable in every respect to economic needs, the tree should not be permitted to grow tall and thin, and pruning should be resorted to. Trees which have grown to 10 ft. without branching should be pruned, which can readily be done by removing the terminal buds with the thumb nail or a sharp knife.

More than three or four branches should not be allowed to remain at each level, and any in excess of this number should be cut out. Branches that appear upon the tapping area—i.e., from the base to 10 or 12 ft.—should be removed. Whenever a tree branches too low down, this point should be attended to early, as otherwise there will not be a straight clear stump for tapping.

Trees of good diameter growth are naturally less liable to be broken by the wind than tall
thin ones, and wise pruning will greatly increase their girth and bring them to the bearing state far sooner than those not so treated; 1 in. per annum is known to have been added to the diameter growth of trees by judicious pruning in the foregoing manner.

One danger that must be guarded against in pruning is this: if only two lateral branches—one opposite the other—are left to develop, the bases of the branches form a cup in which water collects, and the ultimate result may be that the water will cause decay to set in and the tree to split down the middle. Wickham recommends as the "ideal" tree-form three main primary limbs, and to each of these three secondary branches, nine in all.*

Manuring.

Provided good soil has been chosen for the plantations, manuring may not be necessary, but it is always a good thing to bury all weeds in trenches round the trees. A small quantity of lime dusted over this organic matter is beneficial. This manure should be buried at a distance of about 1 ft. to 18 in. from the roots of the tree, calculating the lateral root growth as being 12 to 18 in. per annum. The trenches should be from 2 to 10 in. deep. No lime should be applied, however, until the plants are at least one year old.

Different soils require different treatment and fertilisers made up of different proportions of manurial properties, and this subject therefore can only be efficiently dealt with after analysis of soil has been made, and by direction of a competent agricultural chemist. Before planting, samples of soil from many different parts of the plantations should be analysed.
Potash, phosphoric acid, and nitrogen yield good results, but their proportions must vary to suit particular requirements.

Poor soil is always improved by applications of vegetable matter such as leaves, grass, and weeds, being forked in as mulch around the trees. Decayed leaves contain considerable quantities of potash and nitrogen—most useful fertilisers. Herbert Wright says on this subject:—

"Para rubber trees form a forest vegetation, and will grow well in relatively inferior soils, provided there is a fair balance of plant food, and the climatic conditions are favourable. The soil under forest vegetation improves in mechanical and chemical composition with age, owing to the protection which the trees afford to the soil, to the action of the roots, and the accumulation of leaf mould. The annual fall of leaf from Para rubber trees ultimately effects an improvement in the soil in which the trees are being grown."
Diseased Trees.

The estate should be divided up by belts of trees, so that, should an epidemic of disease break out, an effective screen would remain between different parts of the estate, and so prevent the disease from spreading over the whole area. These protective belts also act as wind belts and prevent the young plants from being blown down or damaged by the strong winds that sometimes prevail. Where forest land is being prepared for cultivation and land is plentiful, it is preferable to leave standing, belts of indigenous trees, but where land is not so easily procurable and there are no indigenous trees suitable, the trees for this purpose should be selected from those belonging to a different genus from that of the Hevea; the reason being that, generally speaking, specific diseases confine themselves to allied species of plants, and a disease that would attack Hevea would not attack any other species of rubber. It might
be wise to plant up the protective belt with *Funtumia, Ficus elastica* or *ceará* as yielding a profitable return.

Plants that at any time show root disease should at once be isolated by digging trenches around them, or the affected area. These trenches should be at least 18 in. deep. Dead trees should always be removed and burned, or they may become a source of infection. The trenches may, if necessary, be dug around individual trees, but it is better to dig around the whole of the affected area. Diseased trees, alive or dead, should be uprooted, and all parts collected and burned. The soil of the trenches should be exposed to the air for as long a time as possible, and all roots should be removed therefrom before being replaced. Professor Ridley recommends that the soil surrounding affected trees be treated with sulphate of copper sprinkled on the ground and in the isolation trenches.
It is often possible to check fungus diseases in their early growth. Sunlight is important in this connection, and therefore, in closely planted areas, infection is much more easily carried than in places where wide planting has been adopted.

Wounds often cause disease, and very careful attention should be given to covering up with tar any wounds that by accident or otherwise may have been caused.

It is not within the scope of this little book to enumerate the diseases to which the rubber tree is liable, and the planter would be well advised to make a special study of plant diseases whether caused by fungi, or otherwise, and their remedies. Fungicides, and Insecticides of approved value should always be kept handy. Bordeaux mixture is perhaps one of the most useful and effective where the tree disease is of fungoid origin. A recipe for making it is as follows:—
Tapping.

6 lbs. copper sulphate (98 per cent.).
4 lbs. freshly burnt lime.
Water to make 45 gallons.

Dissolve the sulphate of copper in water; slake the lime, mix it with the remaining water, and add it to the copper solution. The mixture should be stirred when being used. It has been successfully employed in the Malay States. Use only wooden vessels for this mixture.

Tapping.

To obtain the greatest amount of latex with the minimum amount of cortex (bark) removal, and without damaging the cambium, is the objective of scientific tapping. If the cambium is injured serious damage is caused to the yield of the tree; the surface of the tree may never regain its smoothness, and tapping, as a result, may become very difficult.
Fig. 7.—Hevea, 34 years old.

By courtesy of the "India-Rubber Journal".
The yield of the Para rubber tree increases after the first few tappings. This is called "wound response." The reason for this improved yield being best explained by the fact that tapping irritates the tissues, and in the neighbourhood of the incisions new latex vessels are formed. The Hevea tree has great vitality, and does not succumb to repeated tappings, though it must not follow that rough treatment should be used.

The flow of latex is greater near the base of the tree than higher up, whilst the rubber content is also greater at the base. The lower part of the tree also contains the best rubber. The greatest flow of latex is obtained early in the morning and late in the evening on sunny days, although tapping can also be carried on at other times when the temperature is low and there is an abundance of moisture. All night tapping could be carried on with great success, but in that case artificial light would be necessary.

The flow of latex from the tree is regulated
by the transpiration of the water from the leaves of the tree. All the water absorbed by the tree enters through its roots, and transpires through its leaves, and as such transpiration is least in the very early and latest hours of the day, the flow of latex therefore is at its best during those hours. Professor Ridley says the girth of the tree increases towards evening.*

There are several methods of tapping the rubber tree now employed, and new methods are constantly being suggested and experimented with, which renders it very difficult, therefore, to express any firm opinion as to which is the best system. The one which was first adopted by Ceylon planters (borrowed from Brazil) is known as the V method. The object of this form of incision is to permit the latex from the two cuts on each side to run together

Tapping.

at the apex from which the latex runs into the receiving vessel. A serious drawback to this method is that the V is sometimes difficult to heal and results in a protuberance which causes interference with future tappings.

The **Herring-Bone** method appears to be the most useful method at present in use, and consists of the formation of a central channel varying in length from 1 to 6 ft., and radiating from it a number of oblique incisions, alternating with each other on either side, and cut at an angle of about 45° — the distance apart of such oblique incision varying from 9 in. to 1 ft. This system is in reality an adaptation of the V method, and in some degree the same objections apply, though the saving in the cost of labour and collecting vessels renders it far preferable — the V method requiring numerous small receptacles, while the herring-bone requires but one at the base of the vertical channel.
FIG. 8.—TAPPING MATURE TREE. FULL HERRING-BONE SYSTEM.

By courtesy of H. Wright, Esq.
The Half Herring-Bone method is similar to the before-mentioned herring-bone system, except that the oblique incisions are cut on one side only of the central channel.

Spiral and half-spiral incisions are also recognised methods of tapping, but are now considered to be too drastic. Generally speaking, the full herring-bone, or half herring-bone, will be found to be the most practical, the latter being mostly adopted on up-to-date estates in the East. Where great care is taken not to injure the cambium, the development of the tree will not be retarded; if the cambium is injured the cortical tissues are a long time repairing. No more than about \( \frac{1}{20} \) in. of cortex should be removed at each operation. The half herring-bone method is sometimes applied in the following manner: only one quarter of the circumference of the tree is tapped in the first year, the tapping being carried on every other day. In the second year the quarter immediately opposite is tapped,
and in the third and fourth years the remaining two sides are dealt with. It is a good method, and is likely to come into general use for trees of sufficient girth, as the first section becomes ready for re-tapping by the time the last section has been completed; four years being the time necessary for cortex removal to take place (see Fig. 11).

The average amount of rubber obtainable per tapping operation is likely to increase when an interval of one or more days is allowed between each operation, and in some places several months of rest is advocated. It may, however, be stated as a general principle that with short resting periods the tapping can continue every other day throughout the year. Very careful observations as to the yield of latex should be kept, and upon any indication of the tree becoming "tired" it should at once be rested.
Fig. 10.—Mature Trees in Ceylon. Half Herring-Bone, × Section.

By kind permission of Herbert Wright, Esq.
FIG. 11.—HALF HERRING-BONE, ½ SECTION.

By courtesy of "India-Rubber Journal."
Fig. 12.—Full-Spiral System (The First Incision).

By permission of "India-Rubber Journal."
Fig. 13.—Full-Spiral System (after the tree has given 2 lbs. Dry Rubber).

By permission of "India-Rubber Journal."
Collecting Vessels.

These should be of enamelled iron, glass, aluminium, or vulcanite. Tin and iron corrode, and are liable to cause the latex to be injured.

Preparing Rubber from Latex.

Such rules for the preparation of the latex as will permit of no variation, cannot yet be laid down. Experiments are constantly being made and it is therefore possible that the best system has not yet been arrived at. This branch of the rubber cultivator's art is extremely important, as upon it will depend the economic value of the product in the market.

There are several methods in use, but the underlying principles, in every case, are the same.

Immediately the latex has filled the collecting vessels it is transported to the curing house,
Preparing Rubber from Latex. 47

in an enamelled basin or milk pail—either will do. No iron or tin to be used.

Next, the latex is strained in order to free it from all impurities such as bark, leaves, &c. A fine hair sieve, muslin gauze, or very fine wire will do for this purpose. Then the clarified latex is poured into shallow, enamelled iron, glass, or vulcanite dishes—about 1 ft. in diameter and $\frac{1}{2}$ in. deep.

A little acetic acid or lime juice is added to each dish of latex and the mixture allowed to stand. In a short time the latex will have coagulated and separated from other fluids and will be presented as a spongy mass. (The addition of the acetic acid or lime juice is merely to hasten coagulation, as left to itself the latex should coagulate in about twenty-four hours.)

This coagulated mass is then pressed with a metal roller; placed upon clean porous shelves to drain, and afterwards placed for some time
in the smoke of a wood fire. Finally the rubber, which is now in the shape of "biscuits," is placed upon shelves constructed of some light material which admits of the free circulation of air.

The following methods, all of which are more or less a variation of the foregoing, are largely employed:—

Crepe and Sheet.

Instead of coagulating the rubber in small vessels as in the case of "biscuits," the rubber is coagulated in bulk, then cut into pieces and passed through a washing machine. If the rollers of this machine are grooved, the rubber emerges in the shape of "crêpes"; if smooth, as "sheet." Manufacturers greatly favour either of these forms, but "crêpe" is now in good demand, as it generally arrives in Europe in better condition than "sheet." Smoked rubber is in particular demand,
Washing and Créping.

**Fig. 14**

Bridge's Machine for Washing, Créping, &c.
50 The Rubber-Planter's Notebook.

Fig. 15.
Shaw's Machine for Rolling and Washing.
(Hand Power.)
Packing.

Block Rubber.

This form of rubber also is obtained by coagulation in mass, being afterwards subjected to hydraulic or screw pressure. If the "block" rubber is thoroughly dried, and made uniform in colour, it is strongly to be recommended, as it is more easily packed for transportation than either crêpe or sheet, and the manufacturers are always inclined to give it preference (vide Sec. 2, Machinery).

Packing for Export.

Be careful to grade all rubber before exporting it. The manufacturer buys from sample, and if it should happen that a piece of rubber, no matter how small, of an inferior quality has crept in, the whole consignment may be disadvantageously considered, and a low price realised. The different colours should be sorted. Use no ordinary paper for packing purposes; if paper must be
used employ waxed paper, but better still avoid paper altogether. If the rubber is thoroughly dry, and packing cases carefully constructed with the insides smoothly planed, none should be necessary. The packages should be of uniform size and weight, thus rendering it easy to calculate the size and weight of any given number. The marking of cases for export should be done with the greatest care, the gross and nett weights being plainly stencilled on the outside. Always keep to one mark, as buyers identify the quality of the rubber by the marks, and if once a good reputation has been earned by any one mark it will again be sought for. If the rubber is smoked, mark it "smoked." Smoked rubber is coming into great favour with buyers owing to its preservative qualities.

These matters are much more important than they appear to be; they should not be neglected. The curing house of a rubber estate should be spotless in its cleanliness. Anything in the
shape of dirt, dust, leaves, or twigs should be excluded, as it is only by the most scrupulous attention that rubber can be brought into the market in such form and condition as to encourage the highest price.

The more care the planter gives to the cultivation and preparation of rubber—from the seed to Mincing Lane—the greater will be his reward. No detail must be regarded as unnecessary or “too much trouble.” Each tree on the estate must be as closely studied and watched, tended and tapped, as if it were the only and favourite tree. Wounds and diseases must be sought for, and a permanent gang of coolies, carefully instructed, should be constantly patrolling the estate hunting for and treating them. The tar pot should be ever handy, and the insecticide and fungicide preparations should be readily accessible.
SECTION II.

Machinery, Literature of Rubber, Useful Notes, &c.

Machinery.

In these days economic conditions compel the use of machinery in the preparation of rubber. The old-fashioned methods of hand preparation, though good, do not permit of the finished commodity being placed on the market in time to meet the demand as it arises, to say nothing of the expense that hand labour, throughout, involves. Coagulation, rolling, pressing, drying, and smoking are all to be effected by the aid of machinery, and the results obtained are equal
56 The Rubber-Planter's Notebook.

if not better, than in the case of manual preparation. The planter wishing to become expert should make careful study of all mechanical inventions having reference to his vocation, and should allow no machine to slip his attention. Daily, new machines are being placed on the market, and of these there are many of great utility. It is, therefore, not only wise, but the duty of the conscientious planter to keep au courant with all inventions in connection with rubber cultivation and preparation.

This little book would be incomplete, however, without some idea being given of the machines now in use on the most progressive plantations in the East, and I am indebted to their makers for permission to describe them, and for the illustrations herein given.

*Da Costa Process of Coagulating and Smok- ing.*—The latex is brought from the field to the central factory in its fluid condition. If it is found to contain impurities of any kind it is
carefully strained and then poured into coagulating tanks, steam in the meantime being raised to about 30 to 35 lbs. in the boiler, forest wood alone being employed for fuel. On to the burning wood in the furnace are then thrown green palm leaves, nuts, or any green twigs of tropical trees, the distillation of which produces acetic acid, while the fumes of the green foliage will be found to contain creosote to some extent. These fumes are accumulated in a special wash-tank after being cleared of cinders, &c., and they are then forced into the coagulating tanks by a steam injector. The force of the steam violently agitates the latex, and during this operation every particle of it is reached by the smoke. In about ten minutes, or rather more if the quantities to be dealt with are very large, the caoutchouc globules coagulate and separate from the lyes and rise to the surface.

The coagulated substance, after being allowed to cool off in the tanks, is then cut up into
suitable sizes and put through the crêping or sheeting machinery. Crêping or sheeting with this process is only necessary for quick drying. After being dried in an open and well-ventilated room or steam-heated drying chamber, or by a vacuum process (*vide* Vacuum Machinery), the rubber is ready for exportation.

It is claimed for this coagulating plant that:—

1. It dispenses with the assistance of all liquid chemical agents.

2. The rubber produced fully satisfies all the requirements of manufacturers throughout the world.

Messrs David Bridge & Co. Ltd. are the makers.
Michie-Golledge Coagulating Process consists of a revolving cylinder, ribbed on the inside, with curved blades. The rubber latex is poured into the cylinder, which is then set in motion. The revolving cylinder and its ribs force the latex forward onto the blades which carry it to the centre, where the rubber forms into a spongy mass.

Before it is put into the machine the latex is well strained and diluted with water in the proportion of 4:1. It is then placed in the cylinder, and acetic acid in the proportion of 1 dram of acid to 1 gallon of the diluted latex is then added. The machine is then turned by means of a handle at about thirty revolutions per minute, gradually reduced to eighteen or twenty revolutions. At the end of five minutes coagulation will have been effected, and the rubber should immediately be taken out and despatched to the washing machines.

If the liquid is not quite clear, the machine
**Fig. 18.—“Michie-Golleedge” Rubber Coagulating Machine.**
The Rubber-Planter's Notebook.

should be operated again for a short time at a slow speed.

I am indebted to Mr. Michie, of Walker Sons & Co., of London and Ceylon, for the following description of the new Michie-Golledge curing process:—

Rubber cured by this process possesses unequalled keeping qualities, and it is ready for despatch in one or two days after the latex is taken from the trees. Latex is coagulated in three to four minutes by means of the Michie-Golledge hand-driven coagulating machine, these machines being placed in sheds at places where latex from the various fields can be conveniently collected. Immediately after coagulation the rubber, while still in a plastic state, is passed through a small hand roller and rolled into sheets. These sheets are taken to the factory or curing store, and are at once cut into strips by a special machine. The strips, spread on wire trays, are placed inside drying chambers
Vacuum Drying.

through which slightly heated air is drawn or forced by a fan. When smoke-cure is required, smoke is passed with the air through the strip rubber during the drying process. One or two hours suffice to thoroughly dry-cure the "strip," which is then, if the rubber is to be finished in crêpe or sheet form, passed through the crêpe or sheet mills.

Vacuum Drying is coming rapidly to the fore as a means of drying rubber, as all kinds and shades of rubber can be dealt with. In the past slow drying was considered the only effectual method, but the results obtained from vacuum drying are quite equal to the "slow" process, while the rapidity with which it can be carried on is of the utmost advantage.

Passburg Vacuum Dryer.—The dryer consists of a cast or wrought iron chamber or cylinder which is closed hermetically at one or both ends by doors.
The chamber contains a number of closed steam or heating shelves or pipes (also for hot-water heating) arranged one above the other, in which small pipes for the admission and exit of the heating steam or hot water are fitted.

On these are placed iron, copper, galvanised
perforated iron or earthenware trays, or trolleys, which contain the material that is to be dried. After the door of the dryer, which is fitted with an india-rubber joint, has been closed, a high vacuum of at least 28 in. of mercury or more is created by means of an air pump, whilst exhaust or live steam or hot water passes through the heating shelves or pipes. At a very moderate temperature of the material that is to be dried—about 95° Fahr. (35° Cent.)—the water, owing to the vacuum, begins to evaporate briskly out of the substances, and the latter dry after a few hours, without the substances being in the least impaired through being overheated.

Shaw's Vacuum Drying Process.—The heating shelves are constructed of iron plates riveted together at the edges, and tested to 90 lbs. hydraulic pressure before delivery.

Exhaust steam is passed through the shelves, valves being provided to regulate the supply
and maintain the temperature in the stoves at the requisite level.

The rubber is placed on trays, inserted in the stove, the door is then closed, and a vacuum

of at least 28 in. of mercury is created in the chamber by means of a special air exhaust pump, and maintained throughout the opera-
Vacuum Drying.

Owing to the vacuum and the comparatively high temperature (not exceeding 100° Fahr.) the material rapidly gives up its moisture, which is drawn through a tubular condenser, and falls, drop by drop, into a receiving tank at the base. The latter is provided with inspec-
tion windows, through which the drip of water can be kept under observation, and a cessation of the drip indicates that the material in the stove is dry.

The air exhaust pump can be driven by belt, steam, or electrically.

Messrs Shaw also manufacture a smoker-coagulator.

Fig. 21 illustrates a complete up-to-date rubber factory as fitted out by Messrs David Bridge & Co., Ltd.

Literature of Rubber.

No planter can afford to neglect the literature of rubber. Such books as "Hevea Brasiliensis," by Herbert Wright, "The Cultivation and Preparation of Rubber," by W. H. Johnson (Crosby Lockwood), should be easily accessible on every bookshelf of the plantation library (and there ought to be one on every estate). The India-
Bibliography.

Rubber Journal and Tropical Life, published in London, deal with every problem affecting the planters' interests, and being conducted by experts, contain such knowledge as would be dangerous to ignore.

The Agricultural Bulletin of the Straits is another publication of the utmost value, as in it are recorded the results of the most recent experiments in the line of botanical, agricultural, and plant-pathological research. A fairly complete list of authors and publications is given at the end of this section.

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"Lectures on India-Rubber." An official account of the proceedings of the Conference held at the
Mature rubber trees, after the fifth year, should yield about five hundred seeds contained in fruits each producing three seeds. There is every probability of a considerable commercial demand arising for the seed as it is known to contain a clear light yellow oil akin in its properties to linseed and cotton-seed oils, as well as useful elements for cattle food in the residue. Indeed a demand has already arisen which hitherto it has not been able to supply by reason of all the available seed being required for planting purposes. The time is, however, rapidly approaching when the supply of seed for planting will overtake the demand, and the possibility of a new and lucrative market for the seed should be remembered, and when erecting machinery it would be wise to make
Sources of Rubber.

plans with a view to the inclusion, later on, of crushing machinery.

The seeds on the estate could be gathered by the women and children, who in this way would be kept usefully employed, receiving payment by results, "the seed being sent to the oil mills where it would be crushed and the oil extracted, the residue being made into oil-cake." *

The oil is clear, light yellow in colour, and on saponification with caustic soda furnishes a soft soap of yellowish colour. If the seed has been ground to a meal, the oil extracted is solid owing to decomposition; but that expressed from freshly ground seed is liquid. The husks contain a solid fat in small quantities. †

Other Sources of Commercial Rubber.

_Ceará Rubber (Manihot glasioii)._—Native

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† A Report of the Director of the Imperial Institute.
of the province of Ceará, Brazil. Is a quick-growing tree, 30 to 40 ft. high, and yields a rubber, if carefully prepared, only inferior to Hevea; is now being largely planted in East and West Africa. It can be planted at closer distances than Hevea, and is tappable at an earlier age.

Castilla elastica.—Native of Honduras, Costa Rica, Nicaragua, Guatemala, and Mexico. A tall tree, quick growing, large oval leaves, next in quality to Ceará.

Funtumia elastica.—Native of West Africa—Liberia to Congo inclusive—and also East Africa, Uganda, &c. A tall tree, quick growing, and yielding good rubber. Seeds are small and granular, with a silky tuft at the end. This tree is now being largely cultivated in East and West Africa; with good growth, tappable in four years.

Ficus elastica (Rambong).—Native of Assam, Burma, Sumatra, Java. A large spreading
Sources of Rubber.

tree; aerial roots developing downwards from the branches, or with buttressed roots. Slow growing.

*Ficus Vogelii.*—Native of West Africa—Sierra Leone to Congo inclusive; a medium sized tree, yielding a rubber vastly inferior to Hevea.

*Landolphias (Vine Rubbers).*—Native of East and West Africa and Madagascar. There are a great number of different Landolphias, most of which yield a good rubber. Their cultivation is not practicable as tapping is extremely difficult, and the yield relatively small. A large proportion of “wild” rubber sold in the market is of this description. Experiments for the systematic planting of Landolphia vines have been made in the Congo and elsewhere in Africa, but results have not justified their continuance.

*Carpodinus and Clitandra.*—East, West, and Central Africa. Also yield fairly good rubbers, but of small value as compared to Hevea.
Guayule.—A native of Mexico. A low shrub, rising on a single trunk usually branching near the base, and producing a widely spreading mass of lesser branches and twigs. A considerable quantity of rubber from this source finds its way to the United States.
FIG. 22.—HEVEA IN JOHORE, 18 YEARS OLD.
Girth 84 inches at 3 feet from ground.
*By courtesy of Mr Herbert Wright.*
SECTION III.

General Information.

Hints on the Preservation of Health in Tropical Climates.

Provided he will observe a few simple rules of life and take ordinary precautions, there is no reason why the normal man should not be able to maintain a good physical condition whilst resident in the tropics. The greatest of all difficulties to new arrivals is the abandonment of habits formed in other surroundings, and in different conditions, which will call for the exercise of considerable self-control and determination, as the tendency of the tropics, by reason of the greater atmospheric heat and
Hints on Health.

humidity, is to cause a feeling of "slackness," itself often difficult to shake off. Persistent effort will, however, accomplish much, and by degrees a new order of living, suited to the climatic conditions, will be established, and a consequent physical condition, which will permit of long residence without ill effects, will be reached.

The essential rules are:—

1. Moderation in all things—in eating, drinking, and exercise.

2. Eat much less meat than in Europe.

3. Eat plenty of vegetables and fruit; eat fish and chicken always in preference to butcher's meat.

4. Drink as little as possible; fluids inflate the bowels. It is better to avoid alcohol except under doctor's orders. Avoid strong coffee and tea.
5. Eschew tinned or preserved provisions, unless compelled otherwise by circumstances.

6. Eat no heavy meal during the daytime; let your heaviest meal be dinner at 7 P.M.

7. Allow at least three or four hours between each meal.

8. Don't sleep after the midday meal. The "siesta" is a useless habit and conduces to lethargy; better rest quietly and read something light for half an hour after the meal.

9. Rise early; retire early.

10. Always wear a helmet (of pith for preference) between 8 A.M. and 5 P.M., and if much in the sun use a white umbrella as well.

11. Never over-exercise. Gymnastics, golf, tennis are all good, but over-fatigue is bad and induces fever.

12. Avoid constipation, see that the bowels act at least once a day. If they require to be "moved" light purgatives only should be taken.

13. Never drink beer,
Hints on Health.


15. Never bathe in cold water; a shower bath in the morning and evening is excellent (see that the water has the "chill" off).

16. Clothing should be of medium weight and loose texture. Underclothing must be light in weight, and of some absorbent material; wool is best, but must not be rough or heavy, or prickly heat will be induced. In the field wear putties or leggings.

17. Most important.—Never sleep without a mosquito net of close mesh. If the mosquitoes are very bad, protect the hands, wrists, and ankles in every possible way in the evening. Fever is contracted in the evening, never in the day.

18. Houses and bungalows should be immaculate in their cleanliness. Mosquitoes love dark corners, where they hide during the day, and residences, therefore, should be so constructed as to have as few dark corners as possible.

19. Beware of catching cold; a chill is always
The Rubber-Planter's Notebook.

the forerunner of fever. Avoid draughts. In the tropics the skin is more active and sensitive than in colder climates; the perspiration from the body is greater, and colds are easily contracted.

20. Be careful to see that all drinking water has been boiled and filtered.

The principal diseases to be guarded against in the tropics are:—Malarial Fever, Dysentery, Cholera, and Inflammation of the Liver.

Malaria.—It has now been ascertained beyond all doubt that this disease is caused by the presence in the blood of minute parasites, introduced by means of a particular kind of mosquito—the Anopheles. In this knowledge is explained the reason why so much importance is attached to the use of the mosquito curtains. According to Ross and Boyce, malarial fever can be avoided, as small-pox in Europe is avoided.

Symptoms.—The patient begins to feel cold; has a feeling of general malaise; shivers more or
Hints on Health.

less violently; has pains in the limbs, is thirsty and inclined to vomit.

Treatment.—It is always wise to go to bed immediately on feeling a sensation of fever. A strong aperient should be taken, and every effort should be made to induce free perspiration by taking hot tea or other hot liquids, such as lemon or lime-juice (no alcohol), and covering up with heavy blankets or rugs. After the sweating has taken place, take a sufficient dose of quinine, five to ten grains, and remain abed till the temperature becomes normal. Quinine must be continued in diminishing doses for several days afterwards.

In cases of obstinate fever and continuous vomiting, half a teaspoonful of spirits of chloroform in a wine-glassful of sugar water should be given.

As soon as the fever is over build up the system with liquid nourishment, such as soups, beef tea, &c., but no alcohol except in cases
84 The Rubber-Planter’s Notebook.

where extreme debility has resulted, when champagne is often a splendid tonic.

**Dysentery** is the inflammation of the inner lining of the large bowel. It is not clear how this disease arises though it is supposed that the drinking of impure water is the main cause.

*Symptoms.*—Griping stomach pains; blood and slime in the stools, and constant desire to stool.

*Treatment.*—Rest in bed; stop at once all solid food and give instead such foods as milk and arrowroot or corn flour (no alcohol); apply warm flannel belt and fomentations to the body. Give castor oil, or small repeated doses of ipécaçuanha. In convalescence be careful not to resume ordinary diet too quickly as the bowels generally remain irritated for some time after the attack has subsided.

**Cholera** is caused by microbes—the comma-
Hints on Health.

shaped bacilli—introduced into the system by infected drinking water, although it appears also in the soil of certain tropical regions, and is conveyed by infected persons. In the majority of cases, however, it is transmitted through the water supply.

*Symptoms.*—An attack of cholera is usually preceded by numerous liquid evacuations, leading to severe spasms of the muscles of the calves of the legs. Patient collapses in very short time.

*Treatment.*—Doctor must be sent for at once, but pending his arrival apply hot-water bottle, plenty of blankets, warm tea: an anti-cholera pill may be given. “Apply a mustard plaster to the abdomen and give, if possible, small pieces of ice to relieve thirst” (Simpson).

Inflammation of the Liver.

*Symptoms.* — Complete loss of appetite,
nausea, pain in region of the liver, often in the right shoulder; stools either difficult or very loose; yellow tinge to complexion.

_Treatment._—No solid food; milk and arrow-root or corn flour should be taken instead. Purging medicine to be taken two or three times a day. Place ice bag over the region of the liver; if ice not available paint with tincture of iodine.

**Prickly Heat** also deserves mention as being a most irritating tropical complaint. It is not serious, though most uncomfortable. It is caused by too profuse sweating, and the irritation of warm woollen clothing next the skin.

_Remedy._—Light diet, no alcohol. Keep the skin clean and dry, and dust with powder of starch, arrowroot, or oxide of zinc. Rubbing fresh lime juice over the body often relieves itching.
Notes on the Geography and Climate of Para Rubber-Growing Countries.

Ceylon lies to the south of India between 6° and 10° N., and between 79½° to 82° E., the greatest length of the island being 267 miles, and its greatest breadth 140 miles.

Ceylon is perhaps the healthiest district in which Para rubber is now grown with success. Though the climate is naturally tropical the heat is much tempered by the surrounding sea. The hottest season is during the interval between the monsoons, February to May. The highest temperature is about 95° Fahr., the average being about 80°, and the rainfall, well distributed throughout the year, is about 88 in. Rubber is grown with greatest success only in the south-west corner of the island.

Straits Settlements.—Climate hot and humid, but being exposed to the sea, the heat is not so
intense as in most countries situated so near the equator. The average temperature is perhaps slightly higher than that of Ceylon, and the rainfall is abundant throughout the year. The climate cannot be regarded as being particularly unhealthy, although in the low-lying districts malaria is rife. In the Straits Settlements the temperature at night drops to 75°, causing heavy dews and the humidity so essential to successful rubber growing.

The Straits Settlements occupy that portion of the Malay Peninsula south of Siam, between 1° and 6° N.

Federated Malay States.—The climatic conditions of the Federated Malay States approximate closely to those of the Straits Settlements. In both malarial fever is more prevalent than in Ceylon, and for that reason Europeans are forced to take more frequent recruiting trips. Rubber grows somewhat more quickly than in Ceylon,
and a tree four years old in the latter island is generally only equal in size to one of three years' growth in the Straits and Federated Malay States.

The annual rainfall, except near the mountain ranges, is about 90 in. per annum; mean temperature about 90°.

**Borneo** lies across the equator between 7° N. and 4° S. The rainfall varies according to locality. In British North Borneo, in the rubber-growing districts, it exceeds 100 in. per annum. The temperature rarely exceeds 90°, falling to 75° at night.

**Java** lies between 6° and 8° S. of the equator; its greatest length is about 600 miles.

**Sumatra** lies about 6° on each side of the equator; it is over 1,000 miles long, and at its
greatest width about 300 miles. It is separated from Java by the Straits of Sunda.

Hevea is being extensively planted in the Philippines, New Guinea, and Samoa, in all of which countries the climate varies according to locality, though the best rubber-growing districts have characteristics closely in common.

In East and West Africa also, the Hevea plant has been introduced with great success, and bids fair to become an important industry. In West Africa greater strides are being made than in East Africa, where the Ceará tree seems to be in greater favour. There are plantations of Hevea at Sierra Leone, in Liberia, the Gold Coast, the German Cameroons, and the Congo, in all of which countries the climatic conditions are greatly in favour of its satisfactory growth, though enervating to Europeans, who are compelled to make frequent trips to Europe to recruit their health.
Plantation Life.

The young man who aspires to become a rubber planter must be blessed with that greatest of blessings, robust health, as the climate of all rubber-growing countries is extremely trying, and the work itself entails hard physical strain, and certain privations and discomforts. He should have a good general education, some knowledge of accounts, be able to do rough surveying, and draw plans. Botanical knowledge, of course, is of the greatest value, though the planter should not be altogether scientific; a combination of science with organising and business ability is mostly required, and will carry farthest. Tact and good temper are by no means negligible virtues where large bodies of coolies have to be controlled, yet withal a full measure of firmness is necessary. The ideal plantation manager is he who represents in his own person business man, engineer, botanist, and judge, and who exercises a paternal
care and influence over all those human beings placed under his charge. It is not easy to handle large groups of natives, for in every tropical country under the sun the native is naturally indolent and suspicious; indolent because nature is generous and gives him nearly all he wants with the smallest amount of work,—suspicious because he can no more fathom the "white man's mind" than the white man can fathom his. If there is one virtue in the European that the native admires and respects more than another it is a sense of justice and impartiality, and much can be done with the native if absolute fairness and firmness are exercised in dealing with him. The writer, after nearly twenty years of experience in tropical countries, has rarely known an occasion where just, but positive, treatment has failed. Rough treatment is never successful.

On his arrival at the estate the new hand may be allotted one of very many tasks, though
as the distribution of work depends entirely upon the manager, it is impossible to say what the first duty will be. He may be sent to a point of the estate far removed from headquarters, or he may even be sent to perform the preliminary work of opening up new areas in a district where for weeks together he may be away from the society of any other European. It is then that he will find conditions hardest, and he will want all his fortitude to fight against the sense of depression that may seize him. That feeling will probably be absent during the day, because, being fully occupied and loving his work, the time will slip round quickly enough; but the long tropical evenings, alone and far removed from companionship (except that of his coolies), are sorely trying to sensitive nerves. Solitude is perhaps one of the hardest trials a man can suffer, and it is when thrown thus upon himself that all his inner qualities are to be called up. Those long evenings, "black as the
pit," but for the scintillant stars, the musty, moist atmosphere, the reeking stench of decaying vegetation, and then the awful silence, broken only by the perpetual chirping of the cicada (which goes after a time unnoticed), or the faint echoes of the tom-tom or drum being beaten in the distant village—all these cause such depression of spirits, often verging on terror, which to resist and overcome, all one's resources must be called up. The best of these is study, and enthusiasm for one's profession. Buoyed by these one should become impervious to impressions and influences other than those that make for advancement in the chosen career.

The young planter may be sent to superintend any of the various operations mentioned in this book, and there is not one in which he will not find an endless source of satisfaction and pleasure, for to take part in and watch the evolution of an organised rubber estate from primeval jungle, gives enjoyment such as few other professions
will afford. As the estate becomes opened up the work will become less exacting and more satisfying, and the first tapping is an exhilarating performance, for the toil of years has at last borne fruit.

On a well-ordered estate early hours are the rule. At dawn the gangs of coolies ready for the day's work "tumble up" to a given centre or centres for roll-call. It is an interesting sight to see these coolies in charge of the headmen rolling up to the sound of a bell or horn or tom-tom, to be counted and have their day's work assigned. Their names or numbers having been registered they go off to their respective "jobs"; some to weeding, some to holing, lining or tapping; some to hunt out diseased trees, or the thousand and one other forms of labour which the plantation exacts. The coolies despatched, the staff proceed to eat an early breakfast and then they too proceed to inspect and control the work, which by this time is well under way;
returning to their bungalows for breakfast or lunch at 11.30 or 12 P.M. o'clock, and then after a short spell of rest back again to the field till 4.30 or 5, when the day's work ceases, to be succeeded by tennis or other form of exercise and amusement, a bath, a change, and dinner at 7 or 7.30.

Contemplating plantation life as a whole, its charms outweigh the rough and tumble and strenuous physical effort that it entails, and for the young man fond of outdoor life it offers great inducements. The terms of engagement for men without tropical experience are usually for four years beginning with a salary of £150 per annum, increasing annually until £250 per annum is reached in the fourth year. Passages out are accorded, and upon satisfactory completion of the agreement, the return passage to Europe is also paid, together with usually six months' leave on full pay.

After the first term of engagement the salaries
Fig. 23—General View of Tapping Operations.

By courtesy of "India-Rubber Journal."
are gauged by the experience and capacity of the planter, and engagements at £500 per annum, and over, are easily obtainable. In Malaya, for instance, salaries quite unheard of a few years ago are now being paid, and there is competition among the plantation owners to secure the service of the best men, for after all the soul and success of the plantation is the Manager.

### USEFUL INFORMATION AND MEMORANDA.

#### Land Measure.

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,840 square yards</td>
<td>1 acre</td>
</tr>
<tr>
<td>640 acres</td>
<td>1 square mile</td>
</tr>
<tr>
<td>10 square chains</td>
<td>1 acre</td>
</tr>
</tbody>
</table>

Chain, or Gunter’s chain, is 66 ft. long divided
Useful Information.

into 100 links joined by rings. One mile is equal to 8,000 links, or 80 chains.

An inch of rainfall equals 100 tons of water spread over one acre.

One ton of water contains 35.9 cub. ft.

Bouw.—Dutch land measure = 1 3/4 acres.

Table Showing Total Quantity and Average Price of Plantation Rubber Offered at Auction in London during the Last Five Years.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1906</td>
<td>98 1/4</td>
<td>250 1/4</td>
<td>348 1/2</td>
<td>5/6 1/4</td>
</tr>
<tr>
<td>1907</td>
<td>192 1/2</td>
<td>621 1/2</td>
<td>814</td>
<td>4/9 1/2</td>
</tr>
<tr>
<td>1908</td>
<td>290</td>
<td>1,005 1/2</td>
<td>1,295 1/2</td>
<td>4/1 3/4</td>
</tr>
<tr>
<td>1909</td>
<td>432</td>
<td>2,252</td>
<td>2,684</td>
<td>6/7 3/8</td>
</tr>
<tr>
<td>1910</td>
<td>761 1/4</td>
<td>4,432 1/4</td>
<td>5,193 1/2</td>
<td>7/7 1/4</td>
</tr>
</tbody>
</table>

* Agricultural Bulletin of Straits, February 1911.
The Rubber-Planter's Notebook.

Analysis of a Fair Sample of Dried Fine Para Rubber.

*Caoutchouc - 94.0 per cent.
Resinous matter - 2.5 "
Aluminous matter - 3.0 "
Mineral - 0.5 "

Imports of Rubber into the United Kingdom, from Custom House Reports.

<table>
<thead>
<tr>
<th>Years</th>
<th>Cwt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1906</td>
<td>607,077</td>
</tr>
<tr>
<td>1907</td>
<td>667,294</td>
</tr>
<tr>
<td>1908</td>
<td>575,066</td>
</tr>
<tr>
<td>1909</td>
<td>700,062</td>
</tr>
</tbody>
</table>

To Measure the Girth of Trees.

The girth of rubber trees is always measured at 3 ft. from the ground. For measuring purposes a tape may be used or string and tape. The tape should consist of a band about $\frac{1}{2}$ in.
Useful Information.

in width and so constructed as to alter its length as little as possible when moist. It should be divided into inches and decimals of inches. A small hook at one end is useful in measuring large trees as it can be lightly pressed into the bark whilst the circle of the tree is being made. Flexible steel tapes can of course be used. The string can be used in the same way but it takes more time.

To Prevent Coagulation of Latex on the tree, use a small drip tin at the top of each cut, filling the tin with water, ammonia, or formalin. Latex can be kept liquid for a long time by the addition of formalin, though it is better, if possible, to use no chemicals.

Tackiness in Rubber is said to be caused by bacteria and fungi; the rubber turns sticky on the surface, and may soften right through until it takes the form of a thick gummy mass. It
can best be kept in check by thorough drying without exposure to high temperature. Absolutely positive information with regard to the causes of tackiness has not yet been ascertained.

Rubber should never be exposed to the sun.

**Growth of Hevea Trees.**—Normally, in good soil, and widely planted, this tree should grow about 6 to 10 ft. in height every year for the first three or four years. In girth the tree should show 3 to 4 in. in the first year, and thereafter increase at the rate of about 4 to 6 in. per annum, but as the tree thickens the increase is, of course, less.
INDEX.

AFRICA, East and West, 2, 90
   *Agricultural Bulletin of the Straits*, 69, 71, 73
Analysis of dried rubber, 100
Arden, S., 69

BAMBER, Kelway, 69
   Biscuit, rubber, 48
Block rubber, 51
Blue prints, 5
Bordeaux mixture, 32, 33
Borneo, 89
Bouw, Dutch land measure, 99
Brazil, 1
Bridge's machinery, 58

CAMEROONS, rubber in, 90
Carpodinus, 75
Carruthers, J. B., 69
*Castilla elastica*, 74
Ceará (*Manihot glaziovii*), 73
Ceylon, 1, 3, 87
Cholera, symptoms and treatment of, 85
Clitandra, 75
Clothing for tropical use, 81
Coagulation of latex, 47, 56, 60, 101
Collecting vessels, 46
Collet, O. J. A., 70
Congo, Hevea in the, 90
Cramer, P., 70
C r è p e rubber, 48
Curing house, 52, 53

D A COSTA process, 56, 57
Diseased trees, treatment of, 30, 31
Distance apart of trees, 16
Drainage, 12
Drying process, 63
Dysentery, symptoms and treatment of, 84

E X P O R T, packing for, 51

F E D E R A T E D Malay States, geography and climate, 88, 89
Ficus elastica, 74
Ficus Vogelii, 75
Fungicides, 32
Funtumia elastica, 74
Girth of trees, how to measure, 100
Gold Coast, 90
Guayule rubber, 76
Gunter’s chain, 98

Half herring-bone tapping, 40
Health, hints on preservation, 78 et seq.
Herring-bone tapping, 37, 40
Hevea, growth of, 102
yield of, 18
Holing, 19

India-Rubber Journal, 69, 71
India-Rubber World, 71

Java, geography and climate of, 89
Johnson, W. H., 68, 70
Journal d’Agriculture Tropicale, 71

Land measure, 98
Latex, preparing rubber from, 46 et seq.
“Lectures on India-Rubber,” 71
Liberia, Hevea in, 90
Literature of rubber, 68
Liver, inflammation of, symptoms and treatment, 85
8
Index.

MACHINERY, 55 et seq.
   Macmillan, H. F., 70
Magazines dealing with rubber, 71
Maladies, symptoms and treatment, 82
Manuring, 28
Mathieu, C., 8, 70
Michie-Golledge processes, 60, 62

NEW GUINEA, Hevea in, 90
   Nurseries, selection and preparation of, 5 et seq.

PARA rubber seed, 3, 9
   Pearson, H. C., 70
Petch, T., 70
Philippines, Hevea in, 90
Plan, reference, 4, 5
Plantation life, 91 et seq.
Planter's Chronicle, 71
Planting, distance apart of trees, 16
Prickly heat, remedy for, 86
Protective belts, 30
Pruning, 25, 26, 27

RIDLEY, H. N., 31, 70
Index.

SALARIES of assistants, 96
   Samoa, Hevea in, 90
Schidrowitz, P., 70
Seeds, germination of, 9
Seed-oil, 3, 72, 73
Seeligmann, Torilhon and Falconnet, 70
Shade for young plants, 8, 9, 10
Shaw’s process, 65
Sheet rubber, 48
Sierra Leone, Hevea in, 90
Spiral tapping, 40
Sumatra, geography and climate of, 89

TACKINESS, 101
   Tapping, 33 et seq.
Transplanting, 14, 15
Tropenhflanzer, Der, 71
Tropical Agriculturist, 71
Tropical climates, preservation of health in, 78 et seq.
   Tropical Life, 71

VACUUM drying machines, 63 et seq.
   Vessels, collecting, 46
V Tapping, 36, 37
Index.

WEEDING, 20 et seq.
  Wicherley, W., 70
Wickham, H. A., 70
William, F. C., 70
Wind belts, 30
Wright, H., 71
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