THE CULTIVATION AND PREPARATION OF COFFEE FOR THE MARKET

BY

JOSÉ P. UGARTE

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THE
CULTIVATION AND PREPARATION
OF COFFEE

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CULTIVATION AND PREPARATION

OF

COFFEE

FOR THE MARKET

(SECOND EDITION)

Giving in an intelligible manner, in plain language, the description of the various operations in connection with

COFFEE PLANTING

AND

Remarks concerning Pulping, Fermenting, Washing, Drying, Hulling, Polishing, and Grading

ALSO

General Remarks based on Practical Experience acquired in Mexico, Central America, etc.

BY

JOSÉ P. UGARTE

26 ILLUSTRATIONS

1916

DEDICATED

TO

DA. FLORA UGARTE DE PÉREZ

(MY BELOVED MOTHER).

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PREFACE

Though in the following pages I do not pretend to teach my planter reader how to plant his coffee or how to manage his estate, nor do I pursue the wish of a profitable literary composition or elegant rhetorics, I hope nevertheless to have brought to light some vital points in connection with the preparation of coffee for the market by giving in an intelligible manner first of all how to avert losses, and secondly how to handle the curing outfit to its full advantage.

If any slips are to be found, pray do not believe that it is due to negligence on my part, but simply to the fact that this is my first attempt in writing publicly in a language that differs from my own, both in origin and race. Please forgive my bold attempt.

By taking these remarks into account, the planter will, I hope, appreciate my desire of compiling the following pages in his interest.

THE
Cultivation and Preparation of Coffee.

CHAPTER I.

Comparative Notes.

From the days of "Thirty Years Ago" (reminiscences of the early days of coffee planting in Ceylon, by T. D. Millie, published in 1878) the luxuries now usual and common necessaries on every estate, such as bread, meat, ice, and electric lighting, were unknown. In those times, as the author of the above book mentions, at 5.30 a.m., having partaken of a cup of coffee and a cabin biscuit, which had to be sufficient to keep up the inward man until 11 o'clock, the daily routine of the coffee planting was thus started. Certainly coffee planting, besides being nowadays, without fear of contradiction, one of the best-paying investments for Europeans in the tropics, can

be considered as a hobby full of luxuries compared with the days of "Thirty Years Ago." My experience goes as far as Mexico and Central America are concerned, where I have had, and taken, the opportunity of visiting plantations administrated by Spaniards, Britishers, Germans, Frenchmen, and natives. In the majority of the plantations I visited, a phonograph constituted the chief entertainment after the day's work, and without exception the "indispensable" cocktail was served before each meal. The meals served in the plantations are certainly quite European. Meat is practically served at each meal, although they only kill once a week, but yet, by means of refrigerators, they can keep all kinds of provisions quite fresh.

If coffee-planting life is the same all over the world at the present time, if the profits are so remunerative in all the coffee-producing countries, why should not coffee planting be extended in those parts of the world where the natives or, in some cases, the religious missions have shown us that it can be carried out with success, such as in West Africa, British East Africa, Uganda, Nyasaland, Jamaica, etc.?

Referring to Jamaica as an instance of the suitability of its soil to all sorts of cultivation,

A specimen of a healthy Arabian Coffee Tree in full bloom.

it may be mentioned that it is no uncommon sight to find within the radius of a stone's throw on some small properties coffee, bananas, oranges, and other fruits which a planter can easily cultivate.

There are still thousands of acres in this desirable British Colony only waiting for agricultural hands and capital, and when a planter is given every encouragement—for instance, land on deferred payment, it is indeed a great inducement to an intending settler.

To-day about 24,700 acres are estimated to be under coffee alone, and the "Blue Mountain" coffee of Jamaica, which is cultivated at an altitude of between 3,000 feet and 4,000 feet, is the most noted of all, always fetching the highest price in the market, and the price is not affected by the market fluctuation. There are great possibilities, should any syndicate be formed to take over a large track of this land and cultivate it with "Blue Mountain" coffee, its cultivation being limited at the present time to about 400 tons annually.

Both Liberian and Arabian coffee are being cultivated in this island, the former not to such an extent as the latter; and I believe that even Robusta can be planted with success.

And now that I am referring to Jamaica some of the readers may be interested in the

following extract from the "Impressions of the West Indies." The writer says :—

"Anything in the way of cultivation more beautiful or more fragrant than a coffee plantation I had not conceived, and oft did I say to myself that if ever I became, from health or otherwise, a cultivator of the soil within the tropics, I would cultivate the coffee plant, even although I did so irrespective altogether of the profits that might be derived from so doing. Much has been written, and not without justice, of the rich fragrance of an orange grove, and at home we ofttimes hear of the sweet odours of a bean field. I have, too, often enjoyed in the Carse of Stirling, and elsewhere in Scotland, the balmy breezes as they swept over the latter, particularly when the sun had burst out with unusual strength after a shower of rain. I have likewise in Martinique, Santa Cruz, Jamaica, and Cuba inhaled the breezes wafted from the orangeries; but not for a moment would I compare either with the exquisite aromatic odours from a coffee plantation in full bloom, when the hill-side—covered over with regular rows of the shrubs, with millions of their jasmine-like flowers—showers down upon you, as you ride up between the plants, a perfume of the most delicately delicious description. 'Tis worth going to the West

Mavinkere Coffee Estate (India) – A mass of blossom, promising a good crop.

(Reproduced by the courtesy of Lieutenant-Colonel W. A. Lee.)

Indies to see the sight and inhale the perfume."

In Uganda, British East Africa, where coffee planting is now developing so much, two kinds are said to be cultivated by the European settler, viz., "Nyasaland" and "Bourbon." It is very interesting to note that the former variety, derived from "Blue Mountain" coffee of Jamaica, was introduced into Nyasaland, and thence into Uganda, some dozen years ago. The "Bourbon" is said to have been imported by the French missionaries from the island of Bourbon, but having originally come from Aden. Both these varieties are considered to be derived from Arabian coffee. It will be recalled that the outbreak of the coffee-leaf disease about three years ago in this Protectorate unfortunately obliged planters to go in for the cultivation of other kinds of coffee, such as Liberian. This kind, however, requires low, rich, and well-sheltered land to thrive well, since it suffers severely from breeze.

Up-to-date Estates.

During my last trip in Alta Verapaz (Republic of Guatemala) I visited the estate named Panzamalá, about fifteen miles from Senahú. Here I found something which certainly serves as an example to planters—

Mrs. Appenzauser (the wife of the owner) devoting some hours each day to teaching the native children how to read and how to write Spanish and in some cases, I believe, German. The management of a coffee plantation carried out to such a degree of perfection tends, no doubt, to the moral development of the future labourer. Mr. Appenzauser, to whom I am extremely obliged for the kindness he showed to me during my visit to his estate, certainly has set an example of what can be done in a coffee plantation besides the actual coffee planting. Further, the roads communicating his plantation and his neighbour's were most perfectly kept, and I do not doubt for a moment but that natives who see their masters taking a personal interest in their welfare do a great deal in return towards their masters' interest. Perhaps this may be the cause of the tidiness of Mr. Appenzauser's estate.

At Seamay, also in Alta Verapaz, the owner, Monsieur Paul Ossay, has gone as far as building a chapel, where the priest from Senahú goes once a week for service. I notice a similar thing in Mr. Hussmann's estate near La Tinta.

Combining business.

In nearly all the coffee plantations I visited planters have central stores where the natives

Mr. Appenzauser, referred to in this book.

(The residential house is seen at the back. He possesses a large and rare collection of orchids.)

employed in the estates can procure their main necessities of life, such as maize, rice, corn, beans, salt, or articles of clothing, and also light agricultural implements, to enable the natives to cultivate their land. In some estates I was surprised to see that on pay-day (Saturday) the majority of the natives used to spend the greater part of their earnings, if not all, at the stores, which amounts to practically keeping the same amount of cash in hand at the plantation, and some planters, I believe, make a fine business alone out of the stores. Of course this may not be practical in some plantations, especially those situated too near a town, but no one better than the planter is able to judge of this. However, one of the most important things to have in a coffee plantation is a medical book dealing with and describing methods for attending emergency cases and minor sufferings, such as cuts, snake bites, and cases of malaria, dysentery, etc. A medicine chest is also necessary. In all the coffee estates I have visited in Mexico and Central America they had this, particularly in plantations situated at long distances from any professional assistance. How often have I seen natives unable to walk or handle anything, due to some accident in their plantation, and how relieved they are when the planter is able to give the

native his "remedio" or cure. It is by showing kindness to the native that the planter is able to retain him; for I have known cases of plantations having practically been deserted by native labourers and being short of hands at the time of the crop, through, perhaps, ill-treatment or little diplomacy on the part of the "capataz" or foreman with whom the worker is generally in direct connection, and the owner perhaps knows little of what is actually happening.

Coffee Trees in Blossom, Mavinkere Estate (India.)

(Reproduced by the courtesy of Lieutenant-Colonel W. A. Lee.)

CHAPTER II.

Figures showing at a glance the worthiness of Coffee Planting.

The following is the result of observations as to the cost and returns of a plantation in Mexico.

Cost of one plant . . .	12 cents.
Annual gross yield . .	15 cents.
Annual nett yield . . .	9 cents.
Annual nett yield in weight .	1 lb.
Annual cost of cultivating one plant	5 cents.
Annual gross profit on capital invested	150 %
Annual nett profit on capital invested	90 %

The annual yield of one plant is given at 1 lb. of coffee to be perfectly safe in calculating, but 2 lbs. per tree after the fifth year would be the average, judging from the yield of well-established and properly managed plantations. Naturally the cost of a plantation varies somewhat, according to the locality, but unquestionably coffee planting is a safe and profitable investment, even when conducted on

a limited scale in connection with general farm operations.

To start a plantation of 500,000 plants 50,000 dollars capital is estimated sufficient, say 10 cents for each plant. At the end of the third year the first crop is obtained—a minimum of half a pound from each plant, or, say, 250,000 lbs. of coffee, which, at the low price of 10 cents per lb., gives 25,000 dollars, or 50 per cent. on the capital invested. At the end of the fourth year each plant produces one pound of clean coffee, equal to 500,000 lbs. of coffee, which at the same price of 10 cents gives 50,000 dollars. Allowing that gathering and general expenses absorb the 25,000 dollars produced by the first crop, the planter at the end of the fourth year has not only reimbursed the capital outlay of 50,000 dollars, but is also the possessor of a plantation that will continue to give large yearly profits.

This applies in the respective proportion to a plantation of 10,000 or 100,000 plants.

In 1896 the United States Consul General in the City of Mexico, in a report to his Government, said that estimates as to the profits obtained from coffee planting vary, but the lowest show something like 100 per cent. per annum on the capital employed.

Mavinkere Store, Mavinkere Estate (India).

Note Cherry Coffee drying in the foreground.

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CHAPTER III.

The History of Coffee.

Coffee has a romantic history. Its consumption was persecuted by the various religious sects, which appears incredible. It is more than 1,000 years ago since this plant was introduced into Arabia from Abyssinia. In the former territory the Mohammedans used it during their long religious services to prevent them from falling to sleep, but when the priests ascertained it they prohibited its use as an inebriating beverage. Notwithstanding the severe punishment that they inflicted on those who used it, the consumption of coffee kept on increasing. The same opposition was found amongst the religious body in Constantinople, and even with the heavy duties which the Turkish Government imposed, the use of coffee was becoming general in the 16th century, and soon afterwards coffee houses were opened in London. Charles the Second endeavoured to abolish these houses, maintaining that they were nests of traitors, nevertheless the business kept on.

It is said that more than three-quarter parts of the world's coffee originates from one plant

alone, which in 1690 was sent from the Dutch East Indies to the Botanic Garden at Amsterdam. Small plants were distributed from its seeds all over the West Indies and South America, and at the present time 600 millions of plants are estimated to be bearing in Brazil.

It is further said that in 1717 some plants were sent to Martinique from France, but on account of the long voyage and scant water supply these were all lost except one plant, which was saved through the sacrifice of an officer of the French Army, who divided his allowance of water with that one, thereby becoming the father of the coffee industry in the West Indies. From Martinique the coffee plant was distributed through the West Indies, reaching Jamaica in 1732; Porto Rico, Santo Domingo, and Cuba about 1750; and some of the Spanish possessions on the mainland about the same time.

Group of Coolies, etc., Mavinkere Estate (India.)

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CHAPTER IV.

Species of Coffee.

Arabian Coffee.

This species is the product of a small tree traced as having originated, as mentioned in the previous pages, in Tropical Africa. Its fruit is beautiful in appearance and sweet and luscious to the taste, differing a good deal from the Robusta and Liberian. Unquestionably it is the best marketable species, and being so well known, I do not think I need to waste my readers' time; but I am devoting special attention to some interesting and very productive varieties cultivated in Brazil and Costa Rica which are really derived from Arabian coffee.

Climate suitable for Arabian Coffee.

Experience has shown that the most favourable temperature is between 65 to 75 degrees Fahrenheit, with an annual rainfall of about 100 inches well distributed throughout the year. Coffee thrives well in locations with very heavy rainfall, provided the soil is well drained. The Alta Verapaz (Guatemala) coffee is grown under these conditions, and unquestionably it is the finest imported in this country from Central

America. Long droughts are harmful to the trees and diminish the crops. With regard to the best altitude for growing Arabian coffee there is a great diversity of opinion, but I agree with the author of "Coffee Culture in the West Indies" when he mentions that it is erroneous to say that good grades of coffee cannot be produced below a certain altitude. In many publications, both in English and in Spanish, 1,200 feet is given as the lowest limit at which coffee thrives well. When at La Tinta, in Alta Verapaz, at 240 feet above sea level, I was shown coffee grown in this village. It was simply splendid, and as a matter of curiosity I brought home a sample of the coffee. If the plantation is well protected from winds and shaded sufficiently to keep the air humid in the dry weather, and if the soil is well cultivated and fertilized, good coffee can be grown at almost sea level. I know that there are many that do not agree with me in this respect, but the object of my writing this booklet is to express my experience under various conditions.

Varieties of Arabian Coffee

In Brazil a variety has been known to give 46 lbs. of ripe cherry coffee per plant. The particular coffee referred to was "Conillon," and the tree from which the cherries were gathered was six years old and five to six yards

high. The grain of this species of coffee is small, and it contains a high percentage of pea-berries. This "Conillon" coffee (*coffea Canephora*) contains 10 per cent. more of caffeine than other varieties, and is a heavy cropper. I understand that the seeds can be obtained from Messrs. Eickholff Carneiro Leao & Co., Rua Moreira Cesar 77, Rio de Janeiro, Brazil.

Dr. Sixto Alberto Padilla, in the "Bulletin de Fomento" of Costa Rica, No. 10, has written a most interesting article on coffee, and he refers to a visit to a plantation called "Santa Alda," where he found the following varieties of coffee cultivated—"Café Amarillo," or yellow coffee; "Café Hibrido de Liberia"; and "Café Rojo," or red coffee. He describes them as follows:—There is a diversity of opinion as to whether this is a variety of Arabian coffee or if it is a new species. He thinks that yellow coffee is a new variety for the following reasons. The tree is, as a rule, of a pyramidical shape; the colour of the cherries when they are ripe is of a yellow tint—not red, as in the other kinds of coffee. The leaves are larger and the beans are more of a circular form or shape. The parchment is thinner and more transparent, and the appearance of the tree is stronger and finer than that of the other species. Chemically

Café Amarillo or Yellow Coffee.

it also has its differences, since, according to some analysis which were made in Paris, it was mentioned that it was more aromatic and more pleasing to the palate, containing 10 per cent. more of caffeine than any other coffee in Costa Rica. He maintains that the difference between the one and the other (yellow coffee and Arabian coffee) has been proved, the former being a native coffee of Brazil grown in São Paulo, and considers that a specific name should be given to it, such as that indicated by the celebrated naturalist, Dr. Joaquin Monteiro, "Caminhoa Coffaxanthocarpa" (coffee of yellow fruit).

Café Hibrido de Liberia.

This is a variety of beautiful appearance, its beans being a little larger than those of Maragogipe. It is a good cropper, of good vegetation, and very suitable for growing in the Republic of Salvador at an altitude of from 600 to 3,000 feet above sea level. When drunken it will be found very palatable and not so bitter as the others. The leaves are very beautiful. Seeds can be obtained from the firm "Hortuleana," 77 Rua Ouvidor, Rio de Janeiro, Brazil.

Café Rojo or Red Coffee.

This is also a variety of Arabian coffee—a strong plant. Its leaves are rounder and of a

dark-red tint; the beans are of a medium size. Seeds, I believe, could be obtained, but in small quantities, from the above firm.

Robusta Coffee.

This species of coffee appears to be much in favour in some coffee-producing countries—for instance, over 30,000 acres are at present under cultivation in the Dutch East Indies. It is considered to be very productive and of a good commercial class. When roasting this species it loses less in weight than any other. Plants can be seen flowering before they are one year old, and by planting the trees at 9 feet by 9 feet distance apart the following results have been obtained in Java :—

One plant 2 years old has given 2½ piculs* or 154 kilos** per hectare.†

One plant 3 years old has given 15 piculs or 922 kilos per hectare.

One plant 4 years old has given 34 piculs or 2,091 kilos per hectare.

One plant 5 years old has given 34 piculs or 2,091 kilos per hectare.

It is claimed, however, that the best distance for planting Robusta coffee is 12 feet by 12 feet.

* 1 picul = 133⅓ lbs. ** 1 kilo = 2⅕ lbs. † hectare = 2·471 acres.

I find in the bulletin of the Ministry of Public Works of the Republic of Venezuela that a new species of coffee known in the market as Robusta coffee, originating from Africa, was put into the market by a firm in Brussels. It is said that the representative of this firm found this species of coffee in the Congo, and in the catalogue for 1900 it was described and offered for sale for the first time. It is due to its vigorous vegetation that the name "Robusta" was given to this species of coffee. However, this is not its scientific name, because its description is not complete.

Some people are of the opinion that Robusta and Laurentii coffee are identical, this latter being a new species of coffee discovered in the Congo by the Belgian explorer, M. Emile Laurent. There is a great similarity between the two. Robusta coffee and Laurentii coffee are distinct new species from the others, Arabian or Liberian, the difference being as much as there is between Arabian and Liberian.

When Robusta coffee was sold for the first time several coffee planters in Java ordered young plants from Brussels, which were specially packed, and at the end of 1900 this new species was planted in various plantations in the east and centre of Java. During the first

two years the trees were simply considered as curiosities, but opinion changed when two years after these trees were loaded with fruit. In 1905 Robusta coffee was more extensively planted in several plantations, but at that time the seeds were very scarce and too costly to permit of establishing the cultivation of Robusta coffee on a large scale. From 1907 the cultivation of Robusta coffee has increased considerably. It can be estimated that during the period from 1907 to 1908 the cultivated area was more or less 5,000 acres, and in 1908-1909, 20,000 to 30,000 acres. In the Malang district from 50 to 60 acres were planted with Liberian and Arabian coffee, but this plantation has been abandoned. Although Robusta coffee is capable of standing long drought, it prefers, however, abundant and regular rain. On the hills south of Malang Robusta coffee has been known to stand a period of drought of nearly four months; the trees suffered a little, but recovered very rapidly soon after the first rain. I do not think that Robusta coffee trees have ever been known to die for want of rain. It must be noted, however, that in Java coffee is cultivated under shade, which preserves the soil and also the coffee trees from the hot rays of the sun.

According to the experimental results

Altitude suitable for Robusta Coffee.

carried out in Java, Robusta coffee can be planted from sea level up to an altitude of 3,000 feet. Of course nature exercises some influence on the development of the trees. The trees thrive well and more rapidly in low, damp lands than at a high altitude. The best Robusta coffee plantations are found in those districts in Java where the mean rainfall during the year reaches 10 feet. The altitude of those plantations varies from 1,000 to 1,500 feet above sea level, and the soil consists of a deep, rich vegetable mould.

Suitable Soil for Robusta Coffee

The roots of the Robusta coffee tree are strong and well developed; this can even be noticed when taking the young plants from the nursery. They are even stronger than the roots of Liberian coffee. The roots develop in a width larger than that represented by the spreading of the branches, especially on the top soil. If the soil between the rows were turned over one would easily notice the white roots. This large development of the roots denotes that the plants require a light soil. Robusta coffee grows rapidly in volcanic lands and in rich soils, such as in East Java. It has been noticed that in hard soils the development of the tree is slower and more delicate than it is found in the West of Java.

Liberian Coffee.

Coffea Liberica, or Liberian coffee, develops into high trees, being very rarely tapped, and the cherries are picked by climbing the tree.† Owing to the outspreading development of the roots, the young trees from the nursery must not be planted at a less distance than 25 feet square. The seeds of Liberian coffee appear to take longer to germinate than ordinary coffee. Of well-ripened seeds under favourable conditions, 96 to 98 per cent. will germinate and 94 per cent. will develop into fine trees.

The average length of Arabian ripe coffee cherries seldom exceed half an inch, whereas Liberian cherries are nearly one inch long.

The demand for this species of coffee is not by any means so great as for the other species.* Its cultivation is easier, but its treatment or preparation for the market differs somewhat, necessitating, if not actually special machinery, at least machines specially adapted, beginning with the pulper and finishing with the grader.

† The yield per tree (four year old) is reckoned to be 2 lbs. clean coffee. Older trees have given up to 4 lbs. or at the rate of 17 cwts. per acre, when the trees are planted at a distance of 10 ft. by 10 ft.

* From comparative analysis made by the late Professor McCarthy, Liberian coffee contains more potash than Arabian, but this latter is richer in caffeine and fatty matter.

	Caffeine.	Fat.	Ash.	Potash.	Phosphoric Acid.
Liberian .	·77	6·625	4·25	2·13	·436
Arabian .	1·65	10·375	4·28	1·95	·455

The loss in weight experienced in the preparation of this species for the market is very great. Of 50 pounds of ripe cherry coffee, only 4½ pounds of dried, shelled beans are obtained, which is an equivalent to 91 per cent. loss in weight. However, 85 per cent. may be reckoned as being the average loss.

In Java and Sumatra the trees are usually planted at the following distances :—7 ft. by 8 ft., 8 ft. by 8 ft., 9 ft. by 9 ft., and 10 ft. by 10 ft.

Planting at 7 ft. by 8 ft., 778 trees will go to the acre.

Planting at 8 ft. by 8 ft., 681 trees will go to the acre.

Planting at 9 ft. by 9 ft., 538 trees will go to the acre.

Planting at 10 ft. by 10 ft., 435 trees will go to the acre.*

In the Federated Malay States the usual practice is to plant at 12 ft. by 12 ft., when 302 trees will go to the acre.

* This is the distance more usually adopted.

CHAPTER V.

The Planter's Enemies.

Diseases, etc., of the Coffee Tree.

Although the ripe cherries are a cause of temptation to the birds, squirrels, "micos," and other numerous vermin, due to the exquisite taste of the fruit, a coffee planter would consider himself happy if he only had to sacrifice a few bushels of coffee to satisfy the demand of the above uncontrollable "thieves." There are, however, a number of dangerous diseases to which a coffee plantation is exposed, amongst which I cite the principal, giving at the same time the explicit indications to detect such diseases.

The "Ojo de Gallo" or Cock's Eye.

By looking through the Bulletin of Agriculture of the Republic of Salvador, this disease is described as—

Sinonimia—Iron mark, pox, red mark.

The leaves are attacked and sometimes the fruit.

The marks or spots on the leaves are semi-transparent, and in time the leaves get perforated with holes 5 to 15 millimetres in diameter. Badly affected trees are completely deprived of the leaves, and therefore left in bad nutritious condition, both for the vegetation and for the production of the fruit.

A tree attacked by this disease will be noticed to lack usual freshness; the leaves often get discoloured with a dropping tendency.

Causes. The study of the disease made by Dr. Carlos Spegazzini mentions that it is due to a parasite fungus which does not develop, being in the nature of the plant, owing to meteorological and physiological causes.

The fungi found on the marks or spots are of various classes, those observed by Dr. Spegazzini being the following :—

Pistillaria Flavida (Cooke).
Laestadia (?) *Coffeicola* (Spegazzini), or
Spharella Coffeicola (Cooke).
Phyllostcita (?) *Coffeicola* (Spegazzini).

The predisposition is due to cultivation with excessive shade in rainy districts, with deposits of organic materials, and at an altitude of 3,000 feet above sea level, where mists are constantly prevailing.

If the plantation has too much shade, some must be removed, being careful in not over-doing it. **Remedies.**

When the disease is first noticed the trees should be sprayed with lime-water (2 per cent.) at frequent intervals during the dry season, also with the Bordeaux Mixture, which is composed of—

Sulphate of Copper .	2 lbs.
Lime	2 lbs.
Water	1 quart.

By making the above mixture in a receptacle, it can be employed with a brush, but preference should be given to the sprayers.

When the trees are far attacked by the disease, they should be cut down, and any grass or leaves round about the stem should be burned.

The fungus appears regularly during the wet season, nearly disappearing in the dry season, but re-appears again during the wet season, until the disease finishes up the whole plantation if the spraying is neglected.

The "Pulgón" or bug.

The Director of the Agricultural School in the Island of Reunion advises spraying the trees

with the following mixtures to fight this dangerous plague :—

Black Soap . . .	3 lbs.
Carbonate of Soda .	2 lbs.
Water . . .	22 gallons.

When, by means of the spraying with the above mixture, the trees are free from the plague, it is necessary to keep on protecting them every two years by spraying with the following solution :—

Sulphate of Copper . .	1½ lbs.
Black Soap . . .	1½ lbs.
Poli-sulphate of Potassium	1½ lbs.
Water	22 gallons.

The spraying must be effected by means of well-made machines which are capable of producing sufficient pressure and very fine ejection, thus all the parts of the tree will be covered, even under the leaves, without causing any harm to the plant.

The Bordeaux Mixture also produces excellent results in general coffee diseases, even in the most dangerous of all the diseases, the *Hemileia Vastatrix*.

From a note published in the New Hebrides Islands, the following interesting passages are extracted :—" In these islands there is a fact

which has been proved: in many shaded plantations, well looked after, but which have never been sprayed, while the trees are beautiful in appearance, they give very little fruit; whilst the same trees, once they have been sprayed, give very abundant crops. The contrast is very noticeable."

The Hemileia Vastatrix is perfectly cured with the Bordeaux Mixture. The best preparation appears to be the following:—

Sulphate of Copper .	1 lb.
Lime	1 lb.
Black Soap . . .	1 lb.
Water	22 gallons.

A coffee plantation which the author of the notes considered as lost revived to a state of complete health after it had been submitted to the spraying operation. The same thing happened in Bourbon. Since the spraying operation was started, they have kept doing it three times a year, when the vegetation starts.

The Secretary of the Agricultural Chamber for the French Colonies corroborates this data, pointing out considerable increase in export of coffee in the Island of Reunion, being 133,000 kilos in 1911 against 25,000 in 1908. This serves to call attention to all coffee planters as to the importance of spraying their coffee trees

to cure any present and prevent any future disease.

The "Taladrador" or Borer.

Although this unwelcome visitor to the plantation causes a good deal of annoyance to the planter, since its appearance is not detected till after it causes the harm, this enemy may not be perhaps considered so destructive as the bug.

The Borer breeds in decaying and rotten timber. A plantation which has been neglected is likely to be attacked by this vermin, and the favourite part of the tree to be attacked is the pith. It bores the bark until it reaches the centre and tender part of the tree; usually it proceeds upwards, and even downwards, until the tree dies. It is only by careful examination that the presence of the Borer is detected, and the tree should be cut off at the place where the perforation is seen. The grub will be found if the tree is split. Cases have been known, when the tree has been attacked for say two or three months, where the Borer has even gone on eating away the pith below the perforation. In this case the stem should be sawn vertically until the grub is found. A tree left in such condition will doubtless recover after some time, but by administrating some of the well-known

manures (please refer to the advertising section) in the proportions given by the makers, the tree will soon throw some suckers, some of which might develop to fine branches.

It frequently occurs that the Borer has practically destroyed some trees, and in some cases it would pay the planter better to root out those trees which have fallen victims to this pest, and plant fresh seedlings, than to follow the operation above indicated.

It will be well to mention that the Borer is a white or brownish grub, being the larva of a small flying beetle common in the tropics. It may be observed flying after rainy evenings in March and April and even May. An efficacious and inexpensive method of destroying this pest is by making bonfires in open spaces where there is no risk of setting fire to the trees or buildings. The beetles are attracted by the illumination and fall into the fire. I have known this pest in Salvador, Soconusco, and other dry localities.

"Pudrimiento" or Rot.

This is caused invariably by planting the trees too deep, and is therefore within the control of the planter. It is simply the result of excessive moisture and deficient evaporation, due to imperfect ventilation; and, therefore, knowing that this is the cause, the obvious

remedy will be to allow the free circulation of air by pruning and assisting the drainage of the soil. It has been noticed in new plantations, after a fortnight's dry weather succeeding the rainy season, the trees drop and turn yellow, finishing by dying off, apparently without any cause. If the trees are examined, it will be found that the bark has rotted and been rubbed off by the chafing of the tree.

CHAPTER VI.

Fertilization.

If the land selected for the cultivation of coffee is a virgin soil, rich in humus, this will not require manuring for a few years, depending naturally on the soil itself. Nevertheless, the soil becomes exhausted, in time, of the plant foods concentrated in the land, such as Potash, Phosphoric Acid, and Nitrogen.

When stable manure is available, this should be used, preferably in combination with some chemical fertilizer, the former being too slow in action when administrated by itself, because when cattle are fed on the only grass usually available in an estate, the nitrogenous elements which render animal excrement of every kind so valuable are absent, with the exception of a small quantity of ammonia and of phosphoric acid. Stable manure has the inconvenience of producing very irregular ripeness, and the crops last a considerable period, consequently the cost of gathering the cherries is greater. Sometimes the planter, through scarcity of labour or other causes, is obliged to gather green as well as ripe fruit, in order to do away

with the supplementary expenses, with the result that his coffee, when cured, will have an irregular appearance similar to that experienced with some Colombian coffee. Chemical fertilizers in conjunction with stable manure will produce more uniform ripeness. It would be difficult to state in what proportion the mixture of organic manure and chemical fertilizers should be administered; much depends on the nature of the organic manure.

From an analysis of the ash of the coffee bean, we find that ordinary wood ashes, with a small quantity of phosphate of lime, contain all the essential constituents necessary for the production of coffee. As this is an easily procured stimulant, it should therefore form a large portion of any manure which may be applied.

The divided opinion of some years ago as to the fertilizing action of chemical manures, which attracted considerable attention in coffee-producing countries, is, I might say, to-day in favour of these. From experiments carried out by Don Gustavo Helmrich in Finca (Estate), Samac, Alta Verapaz, Republic of Guatemala,* the following will illustrate the advisability of manuring by means of chemical

* Published in the Supplement to *Tropenpflanzer*, Nov. 4, 1908.

fertilizers, showing at the same time how the experiments should be conducted :—

Plot No.	Manuring per year, 1902–1906 inclusive.	Average Annual Yield per Tree, 1902–1908.
1	No Fertilizer	16·6 oz.
2	2·4 oz. Double Superphosphate 5·8 ,, Sulphate of Potash 9·3 ,, Sulphate of Ammonia	24·1 oz.
3	2·4 oz. Double Superphosphate 5·8 ,, Muriate of Potash 9·3 ,, Sulphate of Ammonia	32·3 oz.
5	1·2 oz. Double Superphosphate 2·9 ,, Sulphate of Potash 4·6 ,, Sulphate of Ammonia	23·1 oz.
6	1·2 oz. Double Superphosphate 2·9 ,, Sulphate of Potash 4·6 ,, Sulphate of Ammonia ½ Wheelbarrow Stable Manure	46·1 oz.
8	2·4 oz. Double Superphosphate 9·3 ,, Sulphate of Ammonia	38·3 oz.
9	5·8 oz. Sulphate of Potash 9·3 ,, Sulphate of Ammonia	30·9 oz.
10	2·4 oz. Double Superphosphate 5·8 ,, Sulphate of Potash	21·2 oz.

All the trees received an application of 4·5 oz. lime per tree in 1903.

Results at a Glance.

Plot No. 1—16.6 oz.	No fertilizer.
Plot No. 2—24.1 oz.	Increase in yield over Plot No. 1—7.5 oz.
Plot No. 3—32.3 oz.	Increase in yield over Plot No. 2—8.2 oz.*
Plot No. 5—23.1 oz.	Decrease in yield compared with Plot No. 2—1.0 oz.**
Plot No. 6—46.1 oz.	Increase in yield over Plot No. 5—23.0 oz.†

It will be noticed that plot No. 6 was fertilized like plot No. 5, with the addition of one-half wheelbarrow of stable manure, which plainly demonstrates that chemical fertilizers in conjunction with stable manure are the best manures.

There are, however, some coffee fertilizers concentrated in order to avoid the transportation of unnecessary materials, and such fertilizers may be bought ready mixed, containing not less than—

7 per cent. Nitrogen
10·5 per cent. Phosphoric Acid
14 per cent. Potash

if made from high-grade materials, and the following are some sample mixtures containing

* The increase was due to the use of Muriate of Potash instead of Sulphate.

** Received exactly half the amount of fertilizer of plot No. 2.

† Trebled the yield of plot No. 1.

one part of Nitrogen to one and a half parts of Phosphoric Acid to two parts of Potash :—

810 lbs. Sulphate of Ammonia (20% Grade).
550 lbs. Double Acid Phosphate (44% Grade).
640 lbs. Muriate of Potash (50% Grade).
2000 lbs.

500 lbs. Sulphate of Ammonia (20% Grade).
375 lbs. Dried Blood (14% Grade).
525 lbs. Double Acid Phosphate (44% Grade).
600 lbs. Muriate of Potash (50% Grade).
2000 lbs.

400 lbs. Nitrate of Soda (15% Grade).
600 lbs. Tankage‡ (a High Grade).
520 lbs. Acid Phosphate (33% Grade).
480 lbs. Muriate of Potash (50% Grade).
2000 lbs.

‡ Tankage—also contains some Phosphoric Acid.

CHAPTER VII.

Shade.

In the cultivation of coffee, the same as in that of cacao, shade is said to be necessary, but the why and wherefore is not universally understood. However, the question of shade is very important. Shade in the culture of tropical products is for the purpose of protection from winds and against the quick evaporation of moisture from the soil. At high altitudes less shade is usually required, but this does not actually mean being indispensable in those localities where high winds prevail. In selecting the shade for a new plantation, if none is available the following points should be considered :—

1. The trees must be suitable for the soil and climate.
2. They should not be subject to diseases and insects attacking coffee.
3. They should be fast growing and long lived.
4. The wood should be durable and the trees well anchored in the soil, so as to withstand strong winds.

A well-laden tree with Coffee Cherries.
(Photo taken at Finca "Chajar," Alta Verapaz.)

A young unshaded Plantation in Alta Verapaz (very unusual).

5. High-branching trees with not too dense foliage are preferable, and those belonging to the leguminous family should be planted in preference to others.

The Banana is often used in Latin America and in the West Indies because of its quick growth. It is not desirable, as it is a gross feeder and soil exhauster, but can always be depended upon when nothing else is at hand.

Inga vera, in Spanish *Guayava*, is not suitable to all kind of soils; it is, however, free from the Borer, and therefore satisfactory in a general way.

Pithecolobium dulce and *P. saman*, are seldom used, but they are well worthy of trial, as they grow rapidly and are good nitrogen gatherers.

Andira inermis. It is a legume, but not very fast growing.

Erythrina poeppigiana or *micropteryx* (*Bucare* or *Madre de Cacao*) is very good for shade, largely used in Guatemala. It is a splendid nitrogen gatherer, a fast grower, and it allows the coffee to grow close up to the trunk. It has, however, a great disadvantage

in those localities where strong winds prevail; its wood being soft, sometimes breaks, damaging the coffee trees.

Castilloa elastica (Rubber) has frequently been recommended; the coffee trees, however, should not be planted too near to them.

Citrus and the "*Gallito*" (*Agati grandiflora*) are also often used; the former may be considered of double value if transportation of its fruit is good. The latter is a legume, and seems to have no undesirable features, except that the wood is soft, and the trees should be cut down before they blow down and cause damage to the coffee trees. It may be considered as an excellent temporary shade.

Trees of the leguminous family are able to supply themselves with nitrogen from the air, and again supply that to the coffee trees through the leaves, which they periodically shed.

Windbreaks. The *Mango* is undoubtedly one of the best all-round trees for a permanent windbreak, especially at low altitudes.

Bixa orellana (*Anatto*). It is also an excellent windbreak, grows fast, makes a good hedge, and may be planted on the wind side, but it only reaches about ten feet high.

Casuariana equisetifolia, called Australian pine, would make valuable windbreaks in many places. It is also a fast grower, and reaches a considerable height in a short time.

The Adulteration of Coffee.

Things have really changed since 1820, when the famous book entitled "There's Death in the Pot" was published, but not without giving a shock to the public. To-day you can safely go to any restaurant in this country and ask, and even get, a cup of coffee more or less well made, but you can rely as to its purity. At the time when the above book was published, and even later, when the disclosures by the "Analytic Sanitary Commission" instituted by the "Lancet," coffee was adulterated to such an extent that it became a dangerous drink. The part roasted, that is the bean itself, is a hard, horny albumen, and many other plants similar in texture were, and are even now, used in some parts of the continent to adulterate it. Machinery has even been invented to manufacture coffee beans, which seems incredible. Coffee used to be mixed with mahogany sawdust, and even when sold as "genuine" was mixed with chicory. Coffee mixed with

chicory in certain proportions had been permitted by a Treasury minute of 1840, and the quantity of chicory had increased till the late Mr. Gladstone brought in a resolution that the words "mixture of chicory and coffee" should be placed on any package containing both ingredients. But the worst of it was that chicory itself was adulterated with roasted acorns and other vegetable substances, dog's biscuits, burned sugar, red earth, and even horses' and bullocks' baked livers. In fact, it was discovered that the articles used to adulterate were themselves adulterated. The mixture of coffee with chicory may always be detected by sprinkling it on the surface of water. Genuine coffee floats a long time, and sinks slowly, colouring the water but slightly; chicory, however, sinks quickly, and colours the water with a deep-brown tint at once.

CHAPTER VIII.

Planting.

No attempt should be made to go in for coffee cultivation unless one has sufficient capital to keep it up for three or four years, referring to Arabian coffee. The soil in which coffee is to be cultivated must be rich in phosphoric acid and potash. The estimated coldest temperature that coffee is capable of standing is 42 deg. Fahr. It is believed that an altitude where the mean temperature is from 65 deg. to 75 deg. Fahr., with an annual rainfall of 100 inches, is the best for growing coffee.

If it is intended to top the trees when they have reached 4½ ft. high, then a sufficient distance for planting is 6 ft. by 6 ft. If, however, they are left to grow to a height of from 6 ft. to 8 ft., then they must be planted wider apart.

As a rule, Arabian coffee trees commence to bear fruit the third year they have been planted—that is, the fourth year from seed. Each tree should give from three-quarters of a pound to half a pound of merchantable coffee, although the average of a developed tree is from 1½ lbs. to 2 lbs.—that is to say, in the seventh

year—and would continue to give this yield up to the twenty-fifth year. From this up to the thirtieth year the crop will diminish to nil.

Selecting the ground for planting.

Nothing is more discouraging to a planter than the effect of a high north wind blowing when a plantation is in full blossom. I have seen a crop practically ruined in a night by high north winds depriving the trees of their blossom, so in order to avoid this calamity the planter should select a ground where there is no prevalence of winds. He will be able to determine this by noticing the direction in which forest trees bend. The ground should be a virgin forest soil of dark nature, and on a mountain slope.

Favourable altitude.

The most selected altitude for planting coffee is 2,000 to 3,000 feet above sea level. Coffee can be effectually planted at a higher altitude, say 5,000 feet, but great care must then be taken not to select a zone where frosts are experienced.

In preparing the ground for the seed beds, all the stumps, weeds, etc., should be removed, not burned. The beds should be laid out two feet apart, each being four feet wide. The top soil should be thrown from the four-foot bed on to the two-foot walk, and the bed should

The "Administrador" (on the left) and assistant of Finca, "Chajcar," Alta Verapaz, Guatemala.

Seed Beds at "Chajcar," Alta Verapaz (Guatemala).

be forked as deeply as practicable, and loose top soil previously removed should be thrown back again, including the top soil of the walk. The bed would then be sufficiently high to ensure drainage. To prevent washing, half-logs may be placed at the sides, fixed by stakes in the ground. Virgin soil should be selected for the seed beds, containing a good supply of leaf mould; but if this is not conveniently available, a good commercial fertilizer may be used, this generally giving excellent results. A fertilizer containing about 4 per cent. nitrogen and 6·8 per cent. each of potash and phosphoric acid can be used, applying in this case one to three pounds per square yard, according to the richness of the soil. A dressing of lime or wood ashes and charcoal on top of the beds often prevents "damping off," a fungus disease attacking seedlings.

Keep the bed moist, and pay special attention to the shading.

Selecting Seeds

The seeds must be carefully selected beans from evenly dried berries, if possible freshly gathered and pulped the same day they are picked. The seeds should be planted four to six inches apart and about three inches deep. It has been found that seeds planted in a nursery where the mould has been mixed with

dry wood ashes spring quicker. The nursery must be properly arranged and well shaded, and when the young plants reach the size and strength required, usually when they have developed into four to six leaves, they are transplanted to their permanent destination.

A tree taken from a nursery with all its roots and planted thus will exclusively form a system of superficial roots; on the contrary, instead of transplanting the young trees completely, these are cut almost to the roots. On leaving three-quarters of an inch to one inch of the principal roots the tree will develop very vigorous new roots with an extraordinary penetrating power, and will grow perpendicularly to a great depth in the soil. These roots will be far more vigorous than if the same tree had not been pruned so much, and will have the advantage of not being exposed to summer droughts, or even to the work of a plough, if this is used in connection with the cleaning of the "cafetal" or coffee plantation. Mr. J. A. van der Laat, an authority on coffee, in his article in No. 4 of the "Buletin de Fomento," of Costa Rica, gives in a very explicit manner the advantages of pruning the roots, and I would recommend readers of this booklet to read the particular article to which I refer.

As mentioned above, a virgin forest soil is

General view of one of the many up-to-date Coffee Estates in Soconusco (Mexico).

best for growing coffee. This, however, must be cleared and got ready for receiving the young plants. There is no established rule giving the number of trees to be planted on any given area. The quality of the soil with the topographical situation of the plantation and the individual notions of the planter all have their influence in determining this question. It may be said that the usual number will vary between 500 to 1,500 plants to the acre.* The distance apart should be sufficient for the lateral development of the plant and no more, say six to seven feet all round, according to the nature of the ground. The planting should be effected in even rows to facilitate the picking of the cherries during the crop. The distance above mentioned between the rows of the plants, besides being the correct thing, enables the "Peon" or native labourer to handle freely his "machete" when cleaning the plantation from weeds. Holes of 15 in. to 18 in. diameter by 18 in. deep should be dug to receive the plants from the nursery, and the

* Usually planted at the following distances apart, referring to Arabian coffee:—

Distance apart.	Number of trees per acre.
5 by 6 feet,	1,452
5½ by 5½ ,,	1,440
5½ by 6 ,,	1,320
6 by 6 ,,	1,210

roots of these plants must be well outspread to enable the thriving of the young trees. If the subsoil is of a cold clay nature the tap roots should be cut. Opinions vary also as to the shade required for the coffee trees. The elevation above the sea level of the plantation will have considerable influence on the question. The higher the altitude the less shade required. What young plants require is a protection from the hot rays of the sun.

Pruning.

After the first full crop is produced annual pruning becomes necessary. The old wood bears very little fruit after one crop. The primary branches, which grow horizontally, should be kept whole as long as possible, and only the secondary and lateral ones cut, the fresh shoots thrown out by the primary and secondary branches being those which bear fruit. Severe pruning is never required. To explain, the proper part of the tree to cut off is three to four inches above the brown bark, which would leave a pair of branches still on the green bark, and these two branches should be cut off to within two to three inches of the stem, thus leaving three to four inches of the stem above the two top branches, which will prevent the tree from splitting at the top. The trees, after having been topped or pruned, are liable to

Specimen of the Indian labour employed on the Coffee Estates in Soconusco (Mexico).

throw out suckers from under the sides of the top branches. These should be plucked off by hand, for if a knife were used the number of suckers would increase.

In Central America coffee begins to yield in the third year (referring to Arabian coffee), giving a minimum crop of three-quarters of a pound per plant. At the end of the fourth year the yield gives an average of one pound per plant. In the fifth year the trees in full bearing sometimes yield two to four pounds, as the case may be. One or two pounds from each plant is a very safe yield to calculate upon. Plants have been known to yield as much as six pounds each, but this is very exceptional. The duration of a coffee plantation varies from fifteen to twenty years. It will grow to a height of fifteen to twenty feet if allowed, but it is easily kept down by pruning to five or six feet. This increases the production and convenience of gathering the berries.

As mentioned in the preceding pages, coffee planting may be considered as one of the best paying investments for Europeans in tropical countries, more especially if the management of the coffee estates is under the personal supervision of the owners. The supervision, however, must not end with the planting. A planter, or "hacendado," as he

is called in Spanish America, must also supervise the working of the "beneficio," or curing plant, and from the remarks given in the following pages I hope to convince the reader that this statement is correct. A coffee planter is liable to lose a considerable amount of money on one crop alone, and a thorough perusal of this booklet will go far towards helping him to avoid such a loss.

In dealing with the preparation of the coffee I would naturally mention all its states from the very beginning.

Bringing in Coffee in Guatemala.

CHAPTER IX.

The Receiving of the Fruit prior to Pulping.

A planter should endeavour to run his plant of machinery as automatically as he can, thus doing away with as much hand labour as possible.

Receiving of the Coffee before pulping.

This is usually effected in a large tank made of concrete. The size of this tank would be proportionate with the daily quantity of the fruit.

In Central America "Peones," or native labourers, employed on the plantations are usually paid weekly. Each labourer holds an account book or card showing from a quarter up to the full amount of ripe coffee cherries he is capable of collecting during the day. The amount of work he brings to the receiving tank is checked here by the "capataz," or foreman, who marks on the labourer's card the actual amount of coffee that he has brought. The marking is effected by perforations on the card or account book or card, denoting whether it is one "caja," half "caja," or quarter "caja" of

cherries.* The perforation should not be a plain, round one, because I have come across natives perforating their own cards.

The receiving tank being as a rule of large dimensions, it is usually covered at the top to prevent accidents, and when covering same the cross beams, or material with which it is covered, should be strong enough to allow persons to walk on it. It is usually on the top of the tank that the coffee is received. Several measures, usually made of wood, representing quarter, half, and one "caja"† are permanently erected on the tank, and the labourers, when the fixed time has come for the receiving of the ripe cherries, each fills in rotation as many "cajas" as he is able to, and presents his card or book to get credited with the amount of his day's labour. The bottom of each "caja" is opened automatically by means of a lever, and the foreman is the only person authorised to work them. This is the quickest method I have seen of dealing with the receiving of the coffee.

* Metal counters are in some cases used, but as Central American natives have a mania for burying their money, and as they consider the metal counters as cash, the counters disappear in time to the benefit of the planter, but he often finds himself inconvenienced by the shortness of counters; that is why the cards referred to are preferable.

† The "caja" is a wooden measure 28 inches long by 12 inches wide by 13 inches deep.

NAME OF
THE ESTATE.

Plot No: .....

Name of Labourer, ...

1/8 BOX	1/4 BOX	1/2 BOX		1/1 BOX
			MONDAY	
			TUESDAY	
			WEDNESDAY	
			THURSDAY	
			FRIDAY	
			SATURDAY	

Specimen of Account Card used on certain Estates in Central America.

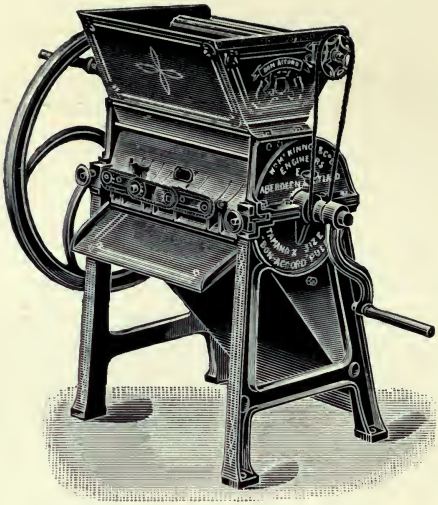
CHAPTER X.

Pulping.

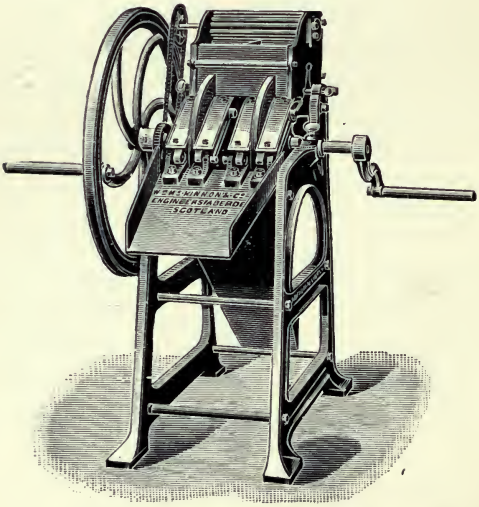
The receiving tank is in direct communication with the pulper or pulpers by means of a main channel, and as many branches as there may be pulpers. The tank has to be filled with water up to the sluice gate of the channel to the pulpers. This sluice gate is generally open when half of the total quantity of the coffee has been deposited in the tank, the pulpers being then set in motion.

Pulping is one of the most important operations in the curing of the coffee. The cherries should be pulped the same day they are gathered, and it will be found that by doing so the coffee will be better pulped, and when husking the parchment the silver skin will not have the tendency to adhere to the beans. It is in trying to remove the silver skin from some coffees when husking that unnecessary pressure is used, whereby the coffee gets overheated, and the appearance of the beans is damaged. A point which I would like to emphasise with

regard to the pulping is the adjustment of the breast, referring to the cylindrical pulpers, and to the cheeks, with reference to disc pulpers. In the old style of coffee pulpers (still offered by some manufacturers), referring to cylindrical type, the adjustment of the breast was not an easy matter, the surface of the breast having to be as near as possible to the rotating drum without actually touching it. There was no means to prevent the breast getting too close to the barrel or drum, and perhaps touching the drum at some point and allowing too much clearance at others. If there is too much clearance between the upper part of the breast and the rotating drum it will be found that a considerable amount of pulp would come out together with the pulped coffee, and if the lower part of the breast is too wide apart with relation to the drum, a considerable amount of good coffee would come out together with the pulp by the back shoot, and all this coffee, unless it can be noticed in proper time, would be lost. Further, if one end of the breast is nearer to the drum than the other, one will observe that some of the coffee would come out only partially pulped. Unfortunately manufacturers of coffee machinery very seldom send along with the machines they supply working instructions, and the planter abroad, with



The latest Cylindrical Coffee Pulper—
"The Bon-Accord."



Double Disc Coffee Pulper.

(Used in the Dutch East Indies and in Mexico.)

unskilled labour, has to "experiment" with his machinery, waste considerable time, and even coffee, before he is able to get to the proper adjustment of his machines.

A new Improved Patent Coffee Pulper has recently been introduced, the "Bon-Accord," which simplifies a good deal the adjustment mentioned above. The breast is self-adjusting to the barrel. The adjusting screws on the ears of the breast, and those on the side frames, are done away with. The breast is simply put in position and maintained there by means of two hand wheels. The depth of the channels on the breast is now all adjusted simultaneously by means of an ingenious gear arrangement and chains. The advantage of this simultaneous adjustment of the depth of the channels is obvious, because as soon as one of the channels is properly adjusted the others are bound to be also. In the old system (still adopted by some) of adjusting each channel separately, it is practically impossible to adjust two of the channels alike. I may also mention that the above machine's new style of bearings, or the cylinder's supports, may also be considered as a great improvement from the planter's point of view, since they last three times as long as the previous style in use.

The adjustment of the breast.

When a planter receives a new pulper, but of the old style, the first thing he should do, referring to the pulper, cylindrical type, which is most generally used, would be to ascertain if the full surface of the breast is quite as near to the barrel as possible without actually touching same. He would then have to tighten the adjusting screws and proceed with the adjustment of the depth of the channels. To start with, he should allow the clearance between the face of the channel and the copper cover to be a quarter of an inch, and if he finds that the cherries are delivered partially pulped this would denote that the clearance is too great, and he should then turn each adjusting hand wheel to the left, giving same a quarter- to half-turn to each wheel, in order that the depth of each channel would be as nearly equal as possible, and *vice versa* if the pulped coffee is delivered with any signs of scratching. The adjustment of the breast and its channels should be very carefully effected, as by exercising care one often prevents defective pulping and beans that are known in the market as "pulper nipped." I need not give instructions as to the adjustment of the "Bon-Accord" latest breast, because it is so simple that even the most unskilled "Peon" or labourer is able

View of the well-known Finca "Serītquiché."

to do it without any risk whatever as to its being wrongly adjusted.

I consider this machine to be a combination of well-thought-out ideas, and to be the most improved on the market.

I have visited a considerable number of coffee estates, and I believe that the best equipped I have seen are those in the State of Chiapas, Mexico. Here, in the large "haciendas," or plantations, the pulping operation is effected in the tandem machine—a combination of two pulpers, one being adjusted to pulp the large cherries and the other to pulp those cherries delivered unpulped or partially pulped from the first machine. Between the two machines there is an oscillating sieve made of copper, which serves to separate the pulped coffee from the unpulped before this latter goes into the re-passing machine—that is, the pulper adjusted to treat the unpulped cherries delivered by the first pulper. The majority of these machines were supplied by a British firm, although some I found to be of American and even German manufacture, which were easily detected by their light, rough finish, and in some cases unnecessarily heavy.

With reference to the disc pulpers, these machines are very much in use in the State of Veracruz, Mexico; also in the Dutch East

Indies. Regarding the working of these pulpers, referring to the results, these are much about the same as those obtained in cylindrical type of pulpers. These pulpers are made in various sizes, and they are provided with 1, 2, 3, or 4 discs, according to the capacity desired. Each disc is covered, both sides, with a copper plate of the same shape, punched with blind punches, and are secured to the iron discs by means of copper rivets.

In this type of pulper the pulping takes place between the rubbing action of the bulbs on the copper plates and the lateral pulping bars fitted to the side cheeks. The same as in the cylindrical type of pulper, the clearance between the surface of the bar and that of the copper disc can be adjusted to allow any clearance which may be required, according to the kind of coffee to be treated. The advantage of these machines is that they require the minimum amount of water for pulping, therefore they should be used in those countries where a scarcity of water is felt. The hopper of the machine is usually fitted with an automatic feed regulator to ensure that each cheek does the same amount of work. Having seen these machines at work, I can fully recommend them.

CHAPTER XI.

The Fermentation and Washing of Coffee.

As the pulped coffee is discharged from the pulping machine it proceeds to the fermenting tanks, accompanied by some of the water which is used for pulping, the water being allowed to drain off from it when it reaches the tanks; and for this purpose the fermenting tanks are generally provided with two draining plates and two sluice gates, one for the discharge of the water, and the other for the discharge of the coffee. The coffee is left in the tanks until the saccharine matter, which adheres to the parchment coffee, gets loose, due to the fermentation, and the parchment gets rough. The time occupied by the fermentation process depends principally upon the atmospheric temperature. For instance, I noted in the State of Veracruz, at a temperature of 30 deg. Centigrade the fermentation took twenty-four hours, and at 20 deg. thirty-two hours. There is a diversity of opinion with regard to the fermentation of coffee. I am of the opinion that fermentation is necessary, even if it is only from a commercial point of

view, and in this respect I would ask people to compare the prices of unwashed coffee (coffee treated in the dry cherry without pulping, fermenting, or washing) and coffee such as Costa Rica.

In some plantations in Mexico and Guatemala the fermenting tanks are lined inside with cedar wood, and there is a very good reason for this, because I have found for myself that the coffee gets fermented sooner. Further, I have seen in some plantations in Central America the coffee in the tanks during the course of fermentation covered with some empty jute bags. It is claimed that by doing so the fermentation is accelerated. To ascertain if the coffee is properly fermented, a handful should be taken from the tank, and if it is found that there is no saccharine matter on the surface of the parchment, and this feels rough, this may be taken as an indication that the coffee is ready for washing. As mentioned above, the duration of fermentation depends principally on the atmospheric temperature, and, therefore, a planter should not take for granted that his coffee will always ferment during the same period of time. He should try two or three times during the course of fermentation to see if it has reached the desired stage, because if the coffee is too much fermented it will be

found that when peeling the bluish colour natural in the coffee will not be so much marked as when the coffee has been fermented just the necessary time. The same tank can be utilised for washing the coffee if there are no mechanical washers.

Washing Coffee.

This is only done for the purpose of separating from the parchment the saccharine matter which has become loosened by the fermenting action.

The washing tank is filled with water up to double the depth represented by the coffee alone (this should be the minimum), and the coffee is then stirred by an implement consisting of a piece of 1-inch board 1 ft. 6 ins. long by 9 in. wide, riddled with 1½ in. round holes, having a handle fixed in the centre. Clean water should be added after say ten minutes, and while this is being added the dirty water should be allowed to drain off.

Owing to the position in which some tanks are built, it is not very easy to empty the tanks through the bottom, and in such cases the use of a hydraulic injector or pump is found to be very convenient. The injectors work with a head of water, and the coffee is raised to a height of 25 per cent. of the fall of the water to a receptacle provided with a large galvanised

draining plate somewhere near the "patio," or drying ground.

Before going any further I may mention that in places where there is a scarcity of water the use of the Okrassa Patent Coffee Washer will be very convenient, because this is the washer considered to utilise the minimum of water to wash the coffee, also the well-known Vertical Washer is largely employed. This machine, however, works by charges, being capable of washing twenty-five cubic feet of fermented coffee in about ten minutes. The Vertical Washer has an advantage over the others, since it separates the "natas" or light coffee, from the sound beans. "Natas" is the term given in Central America to coffee, which in appearance when in parchment is just about the same size as the sound coffee, the beans, however, not having reached their full development.

"Patio" or Coffee Drying Ground.

CHAPTER XII.

Drying Coffee.

In countries like, for instance, the Republic of Salvador in Central America, where they can depend on the weather for drying, the wet parchment coffee is spread in "patios," or drying grounds.

The construction of these drying grounds necessitates, however, a considerable area of ground. They have to be well made, and finished with cement not liable to crack or chip off.

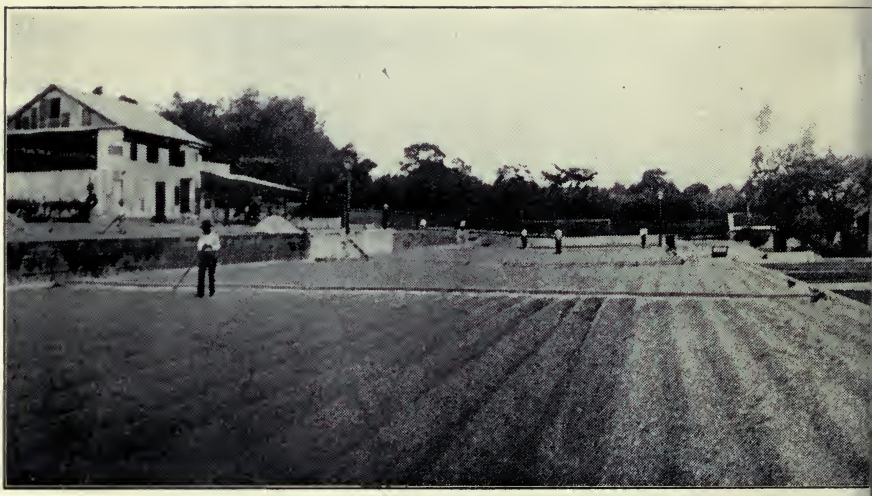
Now that there are some mechanical dryers, however, which dry the coffee with such perfection that one is unable to distinguish the natural from the artificial drying, coffee planters are abandoning the drying grounds, and, instead, installing drying machines; therefore new planters do not have to allow for the considerable initial expense in constructing drying grounds. The Guardiola and Okrassa Patent Coffee Dryers are, I may say, the only two I know to give good results, particularly the Okrassa latest design. This latter machine is undoubtedly taking the leading place in the market. The drying is most uniform, and the machine is so simple that it is not liable to get

out of order. I understand that in the plantation "Westfalia," in Guatemala, and others,* this machine has given particularly good results. These coffee-drying machines are supplied with either exhaust steam heaters or direct fire heaters for heating the air, which enters the machine by means of a powerful fan.

In drying coffee artificially there is something new worthy of the attention of both planters with existing drying machines and intending buyers.

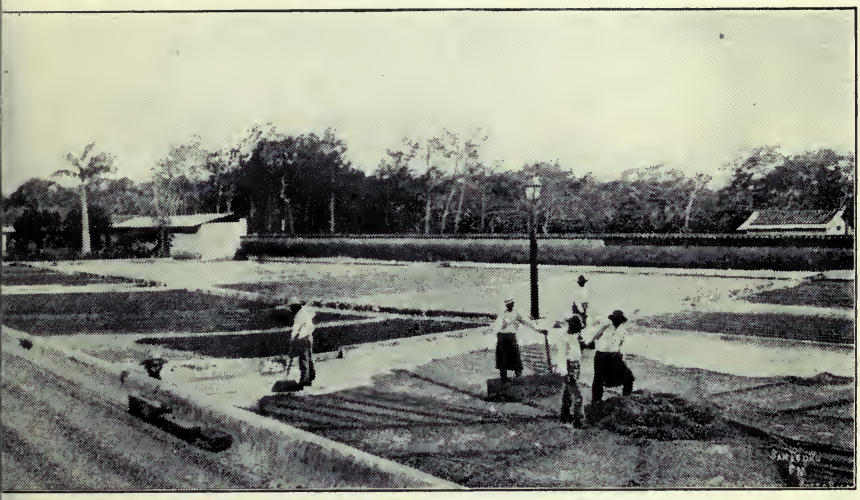
From the time when Don José Guardiola invented the machine of the same name up to the time when the new Okrassa Patent Coffee Dryer was put into the market it was thought that 65 deg. Centigrade was the maximum temperature for drying coffee, but it has since been found that a much higher temperature can be used, without any fear of being detrimental in any way to the appearance or quality of the coffee. An authority like Don Roberto Okrassa says that, when starting to dry 85 deg. to 90 deg. Centigrade can safely be used for the first few hours, and from 75 deg. to 80 deg. as an even temperature for the rest of the drying operation, with the result that, instead of taking 36 hours to dry a charge of wet coffee

* In Uganda, where this machine is largely used, the results are said to be highly satisfactory.



Drying Coffe

(By kind permission



Costa Rica.

m. Brockman, Esq.)

direct from the fermenting tanks, only 24 hours, or even less, are necessary. The Okrassa Patent Drying Machine has many advantages over the Guardiola; but both have many advantages over the drying grounds, amongst which I may particularly mention the time that is saved in drying, whereby a planter is in a position to export his coffee more quickly; great saving in hand labour, as a drying machine only requires say one or two men, according to the size of the machine; whereas a drying ground requires quite a number of men for keeping it in order and for moving and spreading the coffee. Another, and not less important, advantage of the artificial dryers is that the coffee can be dried in any weather, the planter not having to depend on this; and further, if for some reason the coffee plantation has to be abandoned, a coffee dryer can easily be dismounted and taken to wherever it may be required.

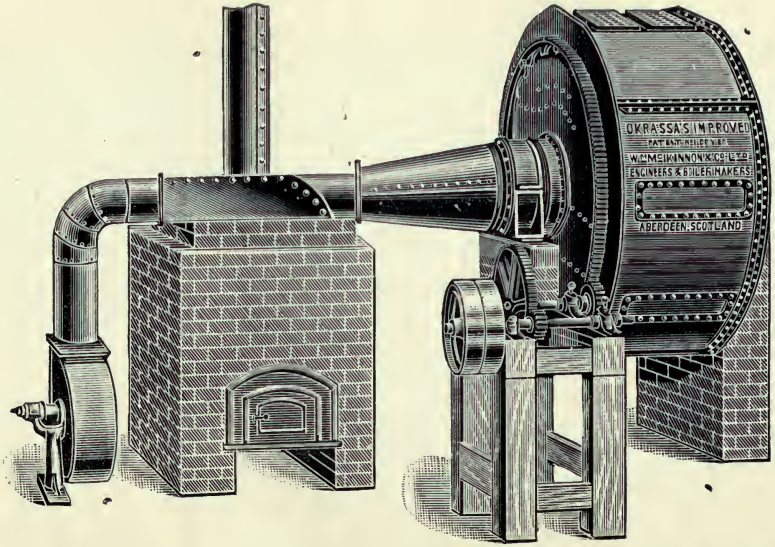
The pointer in drying Coffee.

In drying coffee, the same as in the crystallisation of sugar, a pointer is usually employed, one employee having sufficient experience to discharge this duty, for a man without any experience in coffee drying may consider coffee sufficiently dried when in reality it is not. To ascertain when coffee is sufficiently dried to pass

to the husker, a few grains from the middle of the rotating drum should be taken and husked between the palms of the hands, or by means of a sample husker; and by looking at both extremities, if one finds two dark points, which denote dampness, this indicates that the coffee is not ready to come out. These dark points will gradually disappear, but before one of them actually does, and when there is still a faint appearance of that point, the coffee is ready to come out of the drying machine. Coffee should not be over-dried; this would mean wastage, and consequently loss. The usual loss in weight in drying is 40 per cent., estimating from coffee which has been allowed to drain off before putting into the dryer.

It is a mistake to peel and polish coffee directly it comes out of the dryer. I have found that by allowing the coffee to remain unshelled for at least four hours in a dry place a better appearance is observed when peeling and polishing.

It is also a good policy to reduce the temperature of the air in the heater when the drying operation is about two or three hours from the finish. In some plantations the heat is reduced to nil; in fact, the fan is run for about 1½ hours simply circulating cold air, and as I am referring to the action of heat and the



Okrassa's Patent Coffee Dryer combined with Okrassa's Patent Direct Fire Heater.

circulation of cold air, I think it wise to mention that I have come across some planters who put as much faith in the amount of dry air in the drying cylinder as in its temperature. I might also remark that the majority of planters increase the speed of the fans given by the manufacturers with excellent results.

Saving fuel.

When generating heat by means of a direct fire heater a certain amount of fuel can be saved in the following way. If the chimney of the heater runs vertically through the building it may be jacketted, and the jacketted space connected by means of piping to the inlet of the fan; the result would be that the surrounding hot air between the chimney plates and the outer casing would be drawn into the heater by the fan, thus the minimum amount of fuel would be necessary to heat this over to the required temperature, therefore an economy in fuel would be experienced. In order to maintain the highest efficiency of the heated air, particularly referring to the Guardiola dryers, in which, due to their design, the air has to travel through a considerable quantity of piping before it enters the drying drum, the hot-air piping could be covered with asbestos rope. This is not necessary with the Okrassa dryer, because the air is forced into the drying drum

as soon as it is generated, so no loss of heat efficiency can be experienced in this dryer.

Now that the heat required for drying machines can be generated by the consumption of wood, coffee husks, oil, and even electricity, no planter of any importance should be without a dryer. I understand that there are coffee-drying machines of from 500 lbs. capacity up to 28,000 lbs. of wet parchment coffee per charge, so this range of sizes will no doubt meet the requirements of from the smallest to the largest planter.

In some up-to-date and well-fitted plantations, as the coffee comes out of the washing machine or washing tank it is passed through a centrifugal machine in order to thoroughly drain and extract from the parchment as much water as possible. It is claimed that by doing so 15 per cent. to 20 per cent. of the damp in the drying operation is saved. Of course this does not apply to the Okrassa Dryer, since the inventor claims that coffee can be put into the drying drum after the coffee has been ordinarily drained, and it is dried in 24 hours, as already mentioned.

CHAPTER XIII.

Husking Parchment Coffee.

Now I am going to deal with one of the most important stages in the preparation of coffee. Many styles of husking machines exist in the market, the system being practically the same in the majority of cases; but the machines universally used are the Smout, the invention of Monsieur Jules Smout, a Swiss, and the Okrassa, the invention of Don Roberto Okrassa, of Central America. Both these machines are polishers as well—that is, the husking and the polishing are effected in one operation. Roughly speaking, the Okrassa latest patent machine has many advantages over the Smout, without in any way condemning this latter machine, since I know by experience that its working is highly satisfactory. However, the advantages of the Okrassa latest patent Combined Peeler and Polisher over all the existing machines for the same purpose on the market are the following :— **Husking and Polishing.**

1st. It requires very little power for the output.

2nd. Its capacity is larger compared with other machines of similar size.

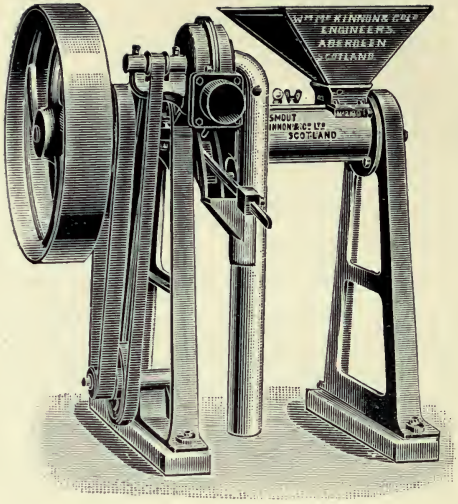
3rd. The husks and dust are completely withdrawn from the coffee after husking and polishing.

4th. The coffee is not heated, thus retaining its natural colour much longer than coffee treated in any other machine.*

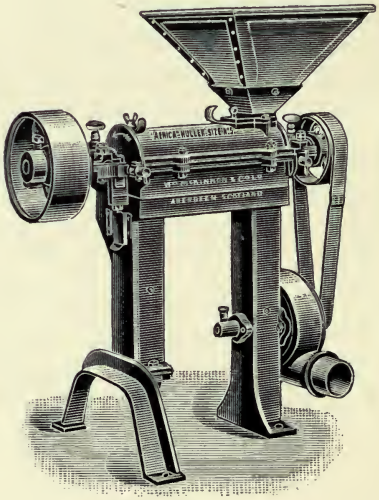
5th. And what is most important, the wearing parts of the machine are only lining castings of small dimensions, which can easily be replaced, instead of having to replace complete cylinders and cones, this being the case in nearly all the other machines.

The advantages mentioned are improvements introduced by Mr. Okrassa on his previous machine, which, practically speaking, was not by any means a perfect machine; and I believe this is why we have not heard much about it. I have seen both the old and the new

* According to Dr. Ure, coffee contains vegetable fibrine, fatty matter, coffeine and legumine, and by exercising excessive pressure on the coffee, the valuable oil or fatty contents are brought to the surface of the beans and naturally evaporate in a short time; that is the reason why the polishing imparted by all the polishers but the Okrassa is not lasting.



A small size Smout Coffee Peeler and Polisher.



The "Africa" Coffee Huller.

patent machine working, and, therefore, I am in a position to criticise them.

Adjustment of the Smout Peeler and Polisher.

Now, with regard to the working of the Smout and the Okrassa machines, I will commence with the former. Usually the machine is fed by means of a shoot from a large hopper on the floor above that where the machine is installed, or by means of an elevator. At the base of the feed hopper on the machine will be found a sliding door. This should not be opened to its fullest extent at the beginning of the operation. Open it only half-way to start with, but before doing this care should be taken that the sliding weight on the lever of the discharge door is placed from the machine half-way out from the lever. Set the machine in motion, slide the feed door half-way out, fixing this position of the door by means of the set screw provided for the purpose. Notice how the coffee is delivered, but pay little attention to the first ten or fifteen pounds, since these have only been passed through the machine for the benefit of the coffee following. When the first fifteen pounds have been delivered from the machine the coffee should be examined to see if it is properly shelled. If it is found that some beans are not properly shelled, or if the silver skin or pellicle is still

adhering to some of the beans, the sliding weight on the lever should be pulled out towards the operator, and this position fixed by means of the set screw. The sliding feed door should also be drawn out a little. Follow now the results, and if the coffee is still discharged with some of the pellicle on, the weight should be pulled still further out the lever, and the feed door opened to its full extent, these rules being followed until the desired results are obtained. With regard to the weight on the lever, it has sometimes been found that the weight supplied by the manufacturers is not heavy enough, so if it is found that the pressure exercised by the weight received with the machine is not sufficient, other weights should be added. The position of the weight will not be the same for every kind of coffee—for instance, Maragogipe coffee is quite easily shelled, requiring very little pressure or friction, while Liberian coffee is very hard to shell. It also depends on the condition of the coffee, for if this is slightly damp, the parchment therefore not being quite crisp, much friction and additional power are required for removing both shells—*i.e.*, the parchment and the silver skin —and, further, it is when exercising pressure for producing the necessary friction that the coffee will also lose a good deal of its shape.

It would be noticed that some coffee will be twisted, and, of course, this will tell afterwards in the grading. The further the weight is out on the lever and the more the feed door is open, the more power will be required for driving the machine, and, therefore, I would advise planters that, if the power at their disposal is limited, instead of exercising too much pressure on the coffee allow the coffee to come out unpolished, and to again pass it through the machine to obtain the polish required.

In some plantations I have visited I have seen them use two Smouts—or one Okrassa and one Smout—one on top of the other—the upper one for shelling and the lower for polishing—with the screws or cones reversed, one running to the right and the other to the left, in order that the discharge spout of the upper machine coincides with the hopper of the lower one. When these Smouts are combined with exhaust fans for the purpose of separating the dust and husks from the clean coffee, a sliding door will be found on the vertical pipe just at the point where the coffee enters this pipe. This sliding door serves to regulate the amount of suction draught made by the fan. The cylinder on the new style of Smout Peelers and Polishers is hinged. This is very convenient, since it facilitates the cleaning of the internal parts of

the machine when it is necessary to do so. In the old style the machine had to be dismounted.

Adjustment of the Okrassa Peeler and Polisher.

Now, with regard to the Okrassa Combined Peeler and Polisher, in this machine there are two weights to regulate—one corresponding to the peeling compartment and the other to the polishing compartment, the weights being screwed up and down, instead of sliding along as in the Smout machine. This is, of course, much handier. The regulation of the weights is similarly effected as in the Smout machine, but the following should be observed. When regulating the weight appertaining to the peeling compartment it should be done so that the coffee is simply delivered husked, allowing as much of the pellicle as possible to remain on the coffee. The coffee should not be allowed to proceed to the polishing compartment until this adjustment has been made. In this machine there is a neat and ingenious automatic arrangement for the regulation of the suction from the fan. The suction must be regulated so that when the coffee is delivered from the peeling compartment into the polishing compartment all the dust and husks generated in the peeling operation should be drawn away by the action of the fan. The polishing operation is a repetition of the peeling—in reality it amounts

to having two machines in one. Some glass panels are fitted on the suction piping of the machine to ascertain if the suction from the fan is too strong, whereby the coffee may be lifted with the shells; in this case the draught regulator should be opened to diminish the suction power.

CHAPTER XIV.

The New Method of Polishing Coffee by means of Phosphor Bronze Polishers.

A few years ago some experiments were carried out in the Republic of Salvador in Central America by a well-known planter of Santa Ana to polish coffee with a Smout Polisher made of phosphor bronze instead of the ordinary cast iron. The results were so highly satisfactory that ever since this planter has polished his coffee by this method. This gentleman mentions that his coffee, having obtained such a good reputation in the coffee markets for its beautiful polish, due, according to him, to the fact of it being polished in phosphor bronze machines, he would not care to depart from his present method of polishing.

It is also interesting to note that nearly all the London coffee mills have adopted this method of polishing, and also the majority of the mills in Hamburg. The principal feature of this process is that the phosphor bronze imparts a bluish colour to the coffee, due to the phosphoric action of the metal and the friction generated in the course of polishing. I must

say the appearance of the coffee after being polished in the Phosphor Bronze Machines is bright and most natural, but whether coffee thus treated has any advantage over the same coffee polished by the ordinary process—that is, in an iron machine—that, of course, I am not in a position to say; but it would be very interesting if someone took the matter up and analysed a sample of coffee treated in the Phosphor Bronze Polisher and another sample treated in an Iron Polisher. As mentioned before, the Smout Peelers certainly heat the coffee whilst peeling and polishing, and I claim that by exercising excessive pressure on the coffee the oil, or fatty contents,* are brought to the surface of the beans, and I have been wondering if the phosphoric action of the metal would have any detrimental effect on the coffee. Of course it is a well-known fact that coffee polished in the Smout Peelers does not retain the polish so long as coffee treated in the Okrassa Improved Patent Peeler and Polisher, because by the simple though effective method introduced in this latter machine cool air is circulated between the internal parts, whereby they are kept quite cool. I am of the opinion that if the polishing compartment of the

* According to Dr. Ure, coffee contains vegetable fibrine, fatty matter, coffeine and legumine.

Okrassa Patent Peeler and Polisher was made of phosphor bronze the polish would be lasting and brilliant, and not less natural than that imparted by the Smout Machine. Of course this phosphor method of polishing the coffee may be good enough for inferior coffee of light appearance and colour, such as that usually imported from Colombia in South America. It is, however, evident that many planters and many coffee mills have taken advantage of this original idea of the planter above referred to, and I am of the opinion that he ought to have had it protected by patent. The planter, I understand, knows the reason why his idea was not protected, but the actual manufacturers, who have made and sold a considerable number of them, were not aware that this particular planter was the originator of the idea, since at that time the makers were supplying their coffee machinery through well-known engineer merchants in London.

CHAPTER XV.

Hulling Dry Cherry Coffee.

Both Monsieur Smout and Señor Okrassa have designed a huller. The former's principle is based on the disc system, and the latter's on the cylindrical system. Both the machines require very little power, and their respective capacities are very large. These machines can also be used for effectually preparing the parchment coffee before the polishing operation. There are no weights or complicated pieces in these machines; both are simple in the extreme. It is worthy of note that the wearing parts of the Okrassa Huller can be sent to a planter by parcel post.

In the Smout Huller the hulling takes place between a rotating disc and the casing of the machine. Both the fixed and the rotating surfaces are furrowed, and the rotating disc is adjustable to suit the various varieties of coffee, *i.e.*, Arabian, Robusta, and Liberian.

In the Okrassa machine the hulling takes place between the rotary drum, which is covered with a steel plate punched with vertical bulbs, and the hulling chilled iron plate, with pyramidal teeth cast on the plate. This plate

is adjustable to suit various grades and varieties of coffee.

There is another system of coffee huller for treating dry cherry coffee, this being the "Africa" Huller. The only advantage I consider worth mentioning in this machine, referring particularly to the size I have seen most in use—that is, the No. 5—is its compactness, the machine being combined with an exhaust fan for the purpose of separating the dust and shells from the cleaned coffee. This machine treats the "bolita" very well, which is the term given in Central America for those dry cherries which only contain a peaberry each.

In the "Africa" Huller the hulling takes place between the steel ribs on the internal cylinder and the adjustable knife or hulling blade in front of the machine. The bottom of the outer casing is sometimes perforated or at times made of woven wire. The one is used for treating dry cherry coffee and the other for preparing parchment coffee before the polishing operation. The bottom of the outer casing is connected to the suction action of the fan, and all the dust and shells passing through the perforation or the open spaces of the woven wire are drawn by the fan.

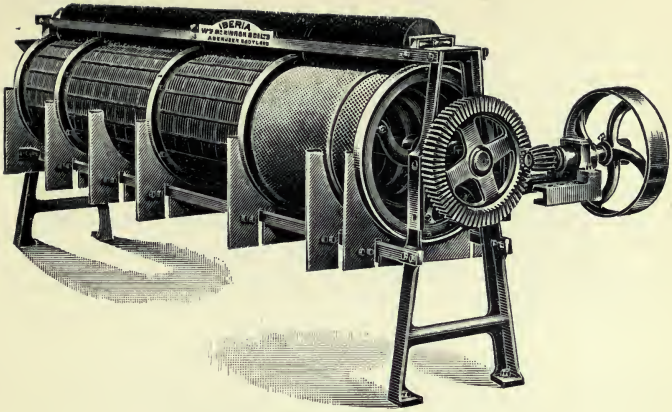
In a plantation which I visited during my last trip in Alta Verapaz I found a planter

struggling away and trying to hull his "bolita" in a Smout Peeler, and, without exaggerating, he had to pass his coffee through the Smout about six times before he could see that he was heating and super-heating his coffee by trying to hull it, with the result that the coffee was so much disfigured that had he put it on the market by itself it would have realised miserable prices. A planter should therefore bear in mind that a coffee peeler and polisher is only for treating parchment coffee, and should he require to hull some of his coffee, it would be far more advantageous for him to get a coffee huller, even if it is a small one. The term "huller" indicates in the trade that the machine is for treating dry cherry coffee.

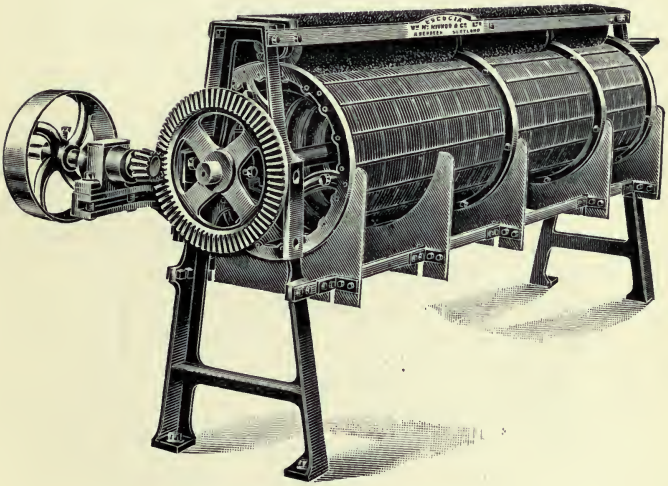
CHAPTER XVI.

Grading or Classifying.

Grading coffee is quite a simple operation. It is, however, an important one, since on it depends to a certain extent the prices to be obtained in the market. At the commencement of this booklet I mentioned the fact that planters are bound to lose some money if they do not personally superintend their plantations and machinery, or at least have a person who, by taking an interest in his work and his principal's interests, is able to detect defective work of any of the employees, or possible defect in the machinery. A defective grader may cause considerable losses to a planter. The reason is obvious. Coffee is classified in various grades, each grade realising a different price in the market, according to the state of this. The following classifications are usually demanded—"Triage," thirds flats, seconds flats, firsts flats, and first and second peaberries. When the planter contemplates ordering a separator the best thing he could do would be to send an unclassified sample of his coffee to the maker of the machine, such as is discharged



The "Iberia" Coffee Grader.



The "Escocia" Coffee Grader.

from his polishing machine. The manufacturer will be able, by examining the sample, to ascertain the various proportions of the different classes and make the separator specially suitable for treating the coffee—that is, a separator capable of separating the highest percentage of firsts.

Old method of Grading.

Coffee used simply to be classified by its thickness, making three grades of these—thirds, seconds, and firsts. The percentage of firsts seldom exceeded 25 to 30 per cent. This is the old and wrong way of classifying coffee, because the beans, though they may be of the same thickness, yet they may differ a good deal in their width and length. The sample of firsts by the old method of grading was very irregular.

The European coffee markets demand nowadays that coffees should be very uniform in appearance, and in order to comply with this demand coffee must be graded first of all by its thickness, being the smallest dimension, then by the width and afterwards by its length, these two latter dimensions being more apparent to the sight.

Up to the present no single machine is able to make the above three classifications, but two machines can be combined to produce the results demanded.

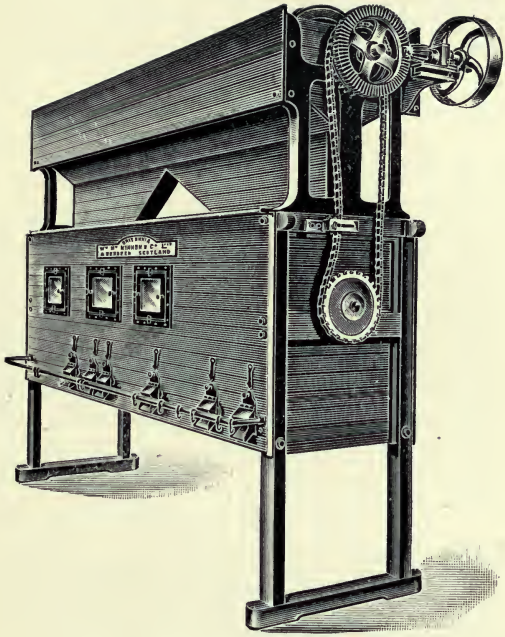
Up-to-date method of Grading.

The "Britannia" Grader is a special machine that classifies the coffee into the following grades:—Dust and shells, "Triage," thirds (flats), seconds (flats), firsts (by their thickness and by their width), and two grades of peaberries.

By classifying the coffee in this manner from 50 to 60 per cent. of firsts can be obtained, against 25 to 30 per cent. by the old method. Therefore, taking as an average that the difference in price between the firsts and seconds is four shillings per hundredweight, a plantation of 300 acres yielding 105 tons* of marketable coffee would produce an additional 25 per cent. of firsts—that is, 525 cwts.—which at the price of four shillings per hundredweight means an increase in value of £105, which would more than pay for the grader to which I refer.

The above example simply refers to the classification of the coffee by its width and thickness, since I have already mentioned that up to the present there is not a machine that, by itself, will grade the coffee by the three dimensions indicated. However, there is a subsidiary machine for the purpose of separat-

* As it will be noticed this is only taking at the rate of 7 cwts. per acre, which can be considered as a very safe average for estimating.



The "Britannia" Coffee Grader.

ing the long and short beans from the seconds. The long beans extracted from these can be considered as firsts, and therefore an additional percentage of firsts is obtained. This subsidiary separation is quite reasonable in price, and I would advise planters to adopt it if their crops allow it.

Hand-Picking.

It is practically impossible to separate from the bulk of the coffee those beans such as black, or those in any way defective in colour, by any mechanical process. In the large mills in Central America and in this country hand-picking machines are used to separate such defective beans. The machine consists of a travelling band running in the direction of the operator. The coffee is spread on the travelling band by means of a brush fitted at the bottom of the hopper of the machine. The operator works the machine by means of a treadle, similar to that used in sewing machines, and as the band travels towards the operator he picks out the defective beans and deposits them into side shoots, while the good coffee proceeds along and is delivered into a bag. This is also a machine that soon pays for itself.

The above is the last treatment in the preparation of coffee. I have thus given in a few pages the whole process of curing coffee, and I

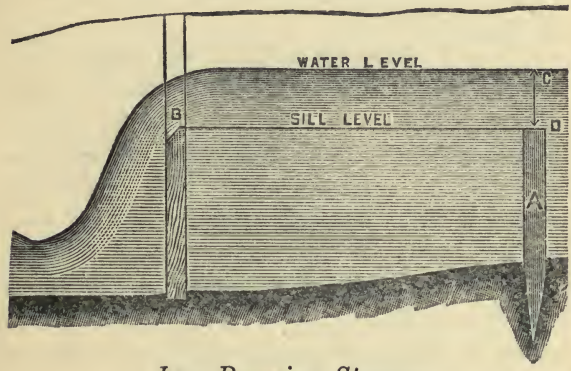
hope that my remarks will be useful to my planter reader.

In the following pages I give some useful technical information, which I hope will also be of service to those planters not having any knowledge of engineering.

CHAPTER XVII.

Method of Measuring Water for Generating Power.

The accurate measurement of the water flowing down a stream is sometimes a matter of considerable difficulty, but a moderately close approximation may generally be obtained by one of the following methods.



In a Running Stream.

Choosing a part of the stream where the section is fairly regular, mark off a convenient distance, say 20 yards, along the bank. Then throw a float (a bottle sunk down to the cork makes a very good float) into the stream, and see how long it takes to travel the distance set out. The experiment should be made two or three times, and the average speed recorded. The speed thus measured is that of the surface

near the centre of the stream. The water runs faster there than elsewhere. Near the bottom and at the sides it flows more slowly. The difference depends upon the nature of the channel. If it is a wooden trough with smooth sides and bottom, take off 15 per cent.; if a channel made of bricks, 17 per cent.; if the bottom and sides are earth, 29 per cent. In rough mountain streams 36 per cent. must be taken off the speed.

Take the average speed of the stream to be 100 feet per minute, and the channel to have earthen bottom and sides, and the area of the stream 18 square feet. First correct the speed, by reducing it 29 per cent., and 71 feet per minute is left. Multiply this by 18 feet area, and the answer is 1,278 cubic feet per minute.

It will be seen that, owing to the great variation in the size and character of various channels, this method of measuring water can never be more than approximate.

Another method of ascertaining the quantity of water is from the overflow on a weir, or where no weir or bye-wash exists, planks may be put across the stream and a rectangular notch made (see illustration) sufficiently wide and deep for the whole of the water to pass through. The water should be dammed back until it is as nearly as possible in the condition of a still reservoir, having little or no

sensible velocity of motion until it approaches the overflow. Ascertain the depth C to D.

It is to be especially noted, however, that the depth of the overflow must be taken, not on the edge (B), but at some distance back from the weir (A), before the water begins to curve downwards, which it does before reaching the weir. After ascertaining this depth, the following table should be made use of :—

*Table of Discharge for each foot of width of Sill in Cubic Feet per minute.**

Depth of C to D in illustration in inches.	Fractions of an Inch.			
	0	¼	½	¾
0	0	·596	1·69	3·1
1	4·78	7·46	9·83	11·1
2	13·5	16·1	18·9	21·7
3	24·8	28·0	31·2	34·6
4	38·2	41·7	44·5	48·9
5	53·4	57·4	61·4	65·4
6	69·4	74·1	78·8	83·6
7	88·4	93·3	98·2	103
8	108	113	118	123
9	129	134	139	145
10	151	156	162	168
11	174	180	186	192
12	198	204	210	217
13	224	230	236	243
14	250	256	263	270
15	277	284	291	298
16	305	312	319	326
17	334	341	348	356
18	364	371	379	387
19	395	403	411	419

* One cubic foot of water = 6·24 gallons = 28·3 litres = ·0283 cubic metres = 62·5 lbs.

Method of Calculating the Speed and Diameter of Pulleys.

I shall call "Driver" the pulley on a main shaft and "Driven" the pulley on a machine.

1st Problem.—Knowing the number of revolutions of both "driver" and "driven" and the diameter of the "driven," it is required to know the diameter of the "driver."

Method.—Multiply the diameter of the "driven" by its number of revolutions and divide the result by the number of revolutions of the "driver."

2nd Problem.—Knowing the diameter and number of revolutions of the "driver," it is required to know the diameter of the "driven" to give a certain number of revolutions in the same time.

Method.—Multiply the diameter of the "driver" by its number of revolutions and divide the product by the number of revolutions required.

3rd Problem.—Knowing the diameter and number of revolutions of the "driver" and the diameter of the "driven," it is required to know the number of revolutions of the "driven."

Method.—Multiply the diameter of the "driver" by its number of revolutions and divide the product by the diameter of the "driven."

4th Problem.—Knowing the diameter of the "driver" and "driven" and the number of revolutions of the "driven," it is required to know the revolutions of the "driver."

Method.—Multiply the diameter of the "driven" by its number of revolutions and divide the product by the diameter of the "driver."

Toothed Wheels.

To calculate the speed of toothed wheels, the same problems can be applied as for the pulleys. Multiply or divide by the number of teeth instead of by the diameter in inches.

Example—Problem 1 for Pulleys—

Number of revolutions of "driver" .	60
Number of revolutions of "driven" .	120
Diameter of "driven"	20″

Find diameter of "driver."

$20 \times 120 = 2400 \div 60 = 40''$, diameter of "driver."

Example—Problem 4 for toothed wheels.

Number of teeth of "driver" wheel .	80
Number of teeth of "driven" wheel .	40
Number of revolutions of "driven" wheel	200

Find number of revolutions of "driver" wheel.

$40 \times 200 = 8000 \div 80 = 100$, revolutions of "driver" wheel.

Method of calculating the horse-power that turned shafting is capable of transmitting.

To know the maximum capacity of horse-power of a turned steel shaft within the limit in which it is capable of doing properly its duty, multiply the cube of the diameter of the shaft by the number of revolutions per minute and divide the product by the co-efficient 80.

Example.—What horse-power could a 3-in. shaft transmit running at 100 revolutions per minute?

Method.—The cube of 3 is 27.

$27 \times 100 = 2700 \div 80 = 33{\cdot}75$ horse-power.

The following table shows the horse-power that can transmit shafts of various diameters running at speeds of from 50 to 250 revolutions per minute. The power that same

shafting is capable of transmitting at other speeds can be ascertained by the same relation.

Diameter of Shaft in inches.	At 50 Revs.	At 100 Revs.	At 125 Revs.	At 150 Revs.	At 175 Revs.	At 200 Revs.	At 250 Revs.
$1\frac{3}{16}$	1·2	2·4	3·1	3·7	4·3	4·9	6·1
$1\frac{7}{16}$	2·15	4·3	5·3	6·4	7·4	8·5	10
$1\frac{15}{16}$	5	10	12·5	15	17	20	25
$2\frac{3}{16}$	7·15	14·3	17·8	21	25	28	35
$2\frac{7}{16}$	9·75	19·5	24·4	29	34	39	49
$2\frac{15}{16}$	16·9	33·8	42·2	51	59	67	84
$3\frac{3}{16}$	21·5	43	53·6	64	75	86	107
$3\frac{7}{16}$	26·8	53·6	67	79	94	107	134
$3\frac{15}{16}$	40	80	100	120	140	160	200
$4\frac{7}{16}$	56·5	113	142	171	199	228	285
$4\frac{15}{16}$	78	156	195	234	273	312	391
$5\frac{7}{16}$	104	208	260	312	364	416	520
$5\frac{15}{16}$	135	270	337	405	472	540	675

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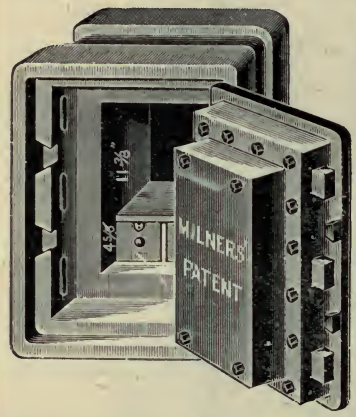

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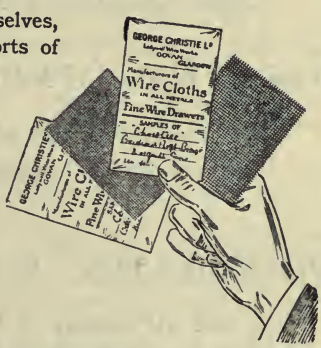

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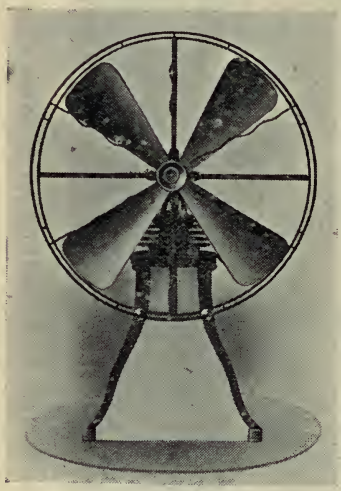

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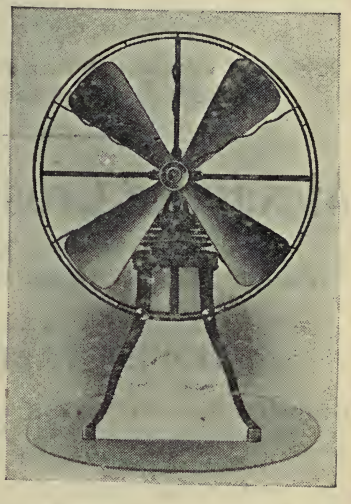

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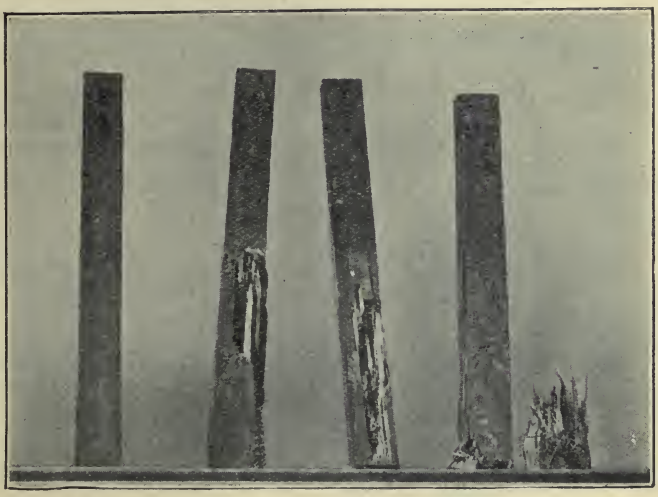

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