COMMON COMMODITIES AND INDUSTRIES

COCOA AND CHOCOLATE

A. W. Knapp.

1923

COCOA AND CHOCOLATE 1923

ELDER DEMPSTER LINES

THE STEAMERS AND MOTORSHIPS OF THE

African Steam Ship Company

(INCORPORATED IN 1852, BY ROYAL CHARTER).

AND

The British And African Steam Navigation Co., Ltd.

MAINTAIN REGULAR SERVICES BETWEEN

LIVERPOOL · LONDON · HULL

HAMBURG · ROTTERDAM · ANTWERP

NEW YORK · MONTREAL & WEST AFRICA

For the convenience of Passengers, the ships on the Lagos Express and Calabar Services call at Plymouth, HOMEWARD BOUND

CANADA TO SOUTH AFRICA (Monthly)

Under Contract with the Canadian Government for the conveyance of Cargo and Mails, and the development of Trade with South Africa

TAKING CARGO FOR CAPE TOWN, PORT ELIZABETH, :: EAST LONDON, DURBAN AND DELAGOA BAY ::

:: LIVERPOOL—GALVESTON ::

GALVESTON—LIVERPOOL & HAVRE

ELDER DEMPSTER AND CO., LIMITED

Head Office: COLONIAL HOUSE, LIVERPOOL

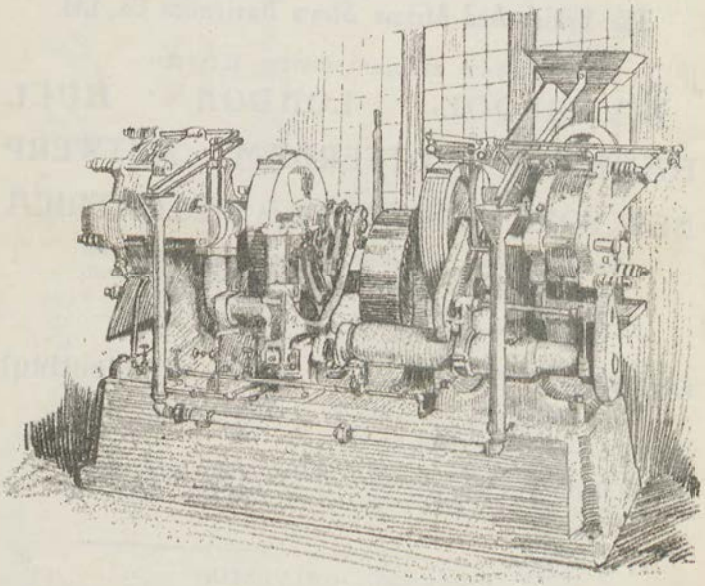
4, ST. MARY AXE LONDON, E.C. 3

Manchester, Cardiff, Birmingham, Hull, Hopfenmarkt 2, Hamburg, Montreal, New Orleans & Galveston,

AND THROUGHOUT WEST AFRICA.

P. A. Van Es & Co., Rotterdam: Agence Maritime Internationale S.A., 67, Rempart Ste. Catherine Antwerp: Daniel Bacon, 26, Beaver Street, New York: Nordisk Express, Gothenburg, Stockholm, and Malmo: Det Bergenske Dampskibsselskab, Bergen: and Berg-Hansen & Co., Christiania.

BAUSMAN DISC PROCESS FOR LIQUOR



This machine will convert cocoa nibs into high grade liquor in one operation, enabling the manufacturer to eliminate two triple mills.

WRITE FOR FURTHER INFORMATION:

NATIONAL EQUIPMENT CO.

Largest Manufacturer in the World of Candy and Chocolate Machinery

Springfield, Mass. - - U.S.A.

THE COCOA AND CHOCOLATE INDUSTRY

PITMAN'S COMMON COMMODITIES AND INDUSTRIES SERIES

Each book in crown 8vo, illustrated, 3/- net

TEA. By A. Ibbetson
COFFEE. By B. B. Keable
SUGAR. By Geo. Martineau
OILS. By C. Ainsworth Mitchell
WHEAT. By Andrew Millar
RUBBER. By C. Beadle and H. P. Stevens
IRON AND STEEL. By C. Hood
COPPER. By H. K. Picard
COAL. By F. H. Wilson
TIMBER. By W. Bullock
COTTON. By R. J. Peake
SILK. By Luther Hooper
WOOL. By J. A. Hunter
LINEN. By Alfred S. Moore
TOBACCO. By A. E. Tanner
LEATHER. By K. J. Adcock
KNITTED FABRICS. By J. Chamberlain and J. H. Quilter
CLAYS. By Alfred B. Searle
PAPER. By Harry A. Maddox
SOAP By W. A. Simmons
THE MOTOR INDUSTRY. By Horace Wyatt
GLASS. By Percival Marson
GUMS AND RESINS. By E. J. Parry
THE BOOT AND SHOE INDUSTRY. By J. S. Harding
GAS. By W. H. Y. Webber
FURNITURE. By H. E. Binstead
COAL TAR. By A. R. Warnes
PETROLEUM. By A. Lidgett
SALT. By A. F. Calvert
ZINC. By T. E. Lones
PHOTOGRAPHY. By Wm. Gamble
ASBESTOS. By A. L. Summers
SILVER. By Benjamin White
CARPETS. By Reginald S. Brinton
PAINTS AND VARNISHES. By A. S. Jennings
CORDAGE AND CORDAGE HEMP. By T. Woodhouse and P. Kilgour
ACIDS AND ALKALIS. By G. H. J. Adlam
ELECTRICITY. By R. E. Neale
ALUMINIUM. By G. Mortimer
GOLD. By Benjamin White
BUTTER AND CHEESE. By C. W. Walker-Tisdale and Jean Jones
THE BRITISH CORN TRADE. By A. Barker
LEAD. By J. A. Smythe
ENGRAVING. By T. W. Lascelles
STONES AND QUARRIES. By J. Allen Howe
EXPLOSIVES. By S. I. Levy
THE CLOTHING INDUSTRY. By B. W. Poole
TELEGRAPHY, TELEPHONY, AND WIRELESS. By J. Poole
PERFUMERY. By E. J. Parry
THE ELECTRIC LAMP INDUSTRY. By G. Arncliffe Percival
ICE AND COLD STORAGE. By B. H. Springett
GLOVES. By B. E. Ellis
JUTE. By T. Woodhouse and P. Kilgour
DRUGS IN COMMERCE. By J. Humphrey
THE FILM INDUSTRY. By Davidson Boughey
CYCLE INDUSTRY. By W. Grew
SULPHUR. By Harold A. Auden
TEXTILE BLEACHING. By Alec B. Steven
WINE. By Andre L. Simon
IRONFOUNDING. By B. Whiteley
COTTON SPINNING. By A. S. Wade
ALCOHOL. By C. Simmonds
CONCRETE AND REINFORCED CONCRETE. By W. N. Twelvetrees
SPONGES. By E. J. J. Cresswell
WALL PAPER. By G. Whiteley Ward
CLOCKS AND WATCHES. By G. L. Overton
ANTHRACITE. By A. L. Summers
INCANDESCENT LIGHTING. By S. I. Levy
THE FISHING INDUSTRY. By W. E. Gibbs
OIL POWER. By S. H. North
STARCH. By H. A. Auden
TALKING MACHINES. By O. Mitchell
NICKEL. By B. H. White
INTERNAL COMBUSTION ENGINES. By J. Okill
DYES. By A. J. Hall
MOTOR BOATS. By F. Strickland
VELVET AND CORDUROY. By J. H. Cooke
STRAW HATS. By H. Inwards
THE BRUSHMAKER. By W. Kiddier
PATENT FUELS. By J. A. Greene and F. Mollwo Perkin
FURS. By J. C. Sachs

PODS ON TRUNK OF CACAO TREE

(1463E) *Frontispiece*

PITMAN'S COMMON COMMODITIES AND INDUSTRIES

THE COCOA AND CHOCOLATE INDUSTRY

THE TREE
THE BEAN
THE BEVERAGE

BY
ARTHUR W. KNAPP, B.Sc., F.I.C.

LONDON
SIR ISAAC PITMAN & SONS, LTD.
PARKER STREET, KINGSWAY, W.C.2
BATH, MELBOURNE, TORONTO, NEW YORK

1923

PRINTED IN GREAT BRITAIN
AT THE PITMAN PRESS, BATH

TO MY BROTHER

PREFACE

WHILE there are several masterly treatises, mainly scientific, on the various natural divisions of the cocoa and chocolate industry, there is no low-priced primer dealing with the whole subject. I have aimed at producing such an introductory handbook and have attempted to present in readable form the mass of historic, scientific and economic facts necessary for a general appreciation of the industry as it exists to-day.

While the general reader may skip the chapter dealing with the cost of production as being too arithmetical, those who are in any way connected with cacao planting will find it the most provocative chapter in the book. I owe the data for this chapter to two experienced planters, Mr. E. W. Keith of Ceylon and Mr. Stanhope Lovell of Trinidad.

The frontispiece I owe to the kindness of Mr. S. H. Davies—it is from a photo by Adhar, of San Fernando, Trinidad. I wish to thank Messrs. Fry & Sons, Ltd.; Messrs. Rowntree & Co., Ltd.; and Messrs. Cadbury Bros., Ltd., for allowing me to reproduce photos showing machinery in their factories. To the last named I am also indebted for a number of photos showing cacao cultivation. I acknowledge with pleasure the help received from several of my colleagues, in particular Mr. W. Pickard, Mr. E. J. Organ, and Mr. A. B. Hall. I thank Mr. W. E. Cossons for reading the proofs.

A. W. KNAPP.

BIRMINGHAM,
1923.

CONTENTS

ILLUSTRATIONS

THE COCOA AND CHOCOLATE INDUSTRY

CHAPTER I

INTRODUCTORY

Cocoa and chocolate do not appear to be important articles of commerce until one remembers that every grocer sells cocoa, and that the principal sweetmeat in the multitude of confectioners' shops is chocolate. The magnitude of the trade is perhaps better realised when one is reminded that the cultivation of cacao is the chief industry in several of our colonies, and that a single firm, manufacturing cocoa and chocolate in the Midlands, employs over 9,000 people. It is proposed in this little handbook to describe briefly the various stages in this industry, from the cultivation of the raw material to the sale of the finished product, or—to use a slick phrase after the manner of an American advertisement—to sketch the career of cacao from the pod to the palate. A short description of the cacao tree will be given for the benefit of those readers who approach the subject for the first time. This will be followed by a chapter dealing historically with the main events in the development of the cultivation of cacao, and the manufacture of its products. The remainder of the book will describe in logical sequence, as far as possible, how the cacao bean is produced and prepared for the market at the present time, and the

various processes through which it passes before it becomes the cocoa and chocolate of commerce. The cultivation of cacao, like the manufacture of chocolate, is partly a science and partly an art. It affords numerous examples of the importance of commercial considerations. While these, unlike the scientific and artistic aspects, make little or no appeal to the finer instincts, they determine whether or not an industry shall exist, and when they can be sublimated into economics, become an interesting intellectual study.

It is advisable at once to explain the difference between "cacao" and "cocoa." The correct name of the raw product is cacao; thus the French, Dutch, and Spanish call it "cacao," the Italians "caccao," and the Germans "kakao." Only the English, as the outcome either of confusion or laziness, call it "cocoa." Whether our English ancestors thought cocoa came from the coconut, (or cocoanut, as some incorrectly write it, Dr. Johnson having given currency to this error in his dictionary), or whether they found the original Mexican word too difficult to pronounce, is undecided, but the mis-spelling of these words continues to confuse the "man in the street" to this day. In the case of "cocoa butter," as it is spelled in market reports, even amongst business men and manufacturers confusion has arisen between the butter obtained from cacao beans and that from coconuts, so that scientists and technicians have determined to call the product from cacao beans "cacao butter," and that from the milky coconut "coconut oil." Even though a name has been accepted for over 200 years, it is better that it should be discarded than that it should cause confusion. In this book the writer proposes to retain the word "cocoa" only for the finished product, the cocoa-powder which one purchases in grocers' shops. "Cacao"

will be used to indicate the raw material, cacao seeds or beans ; it will also be used as a descriptive adjective for the tree, the butter and the shell. In this way we may reap an advantage from the seed of error, because the use of the two spellings will prevent any possible confusion between the raw material and the finished product. The whole of the scientific world is with the writer on this question of spelling, but the world of trade is as conservative about names as it is about weights and measures, and slow to change without obvious monetary advantage. The manufacturer's representative says convincingly to the grocer, " I am sure this cocoa will please your customers," when referring to *cocoa* powder ; the broker says, " Cocoa is up to-day," meaning that *cacao* beans are higher in price ; and the planter very genially says, " Let us go into the cocoa," when he wants you to see the *cacao* (not the coconut) plantation. There is little reason for the broker or planter to change the word ; they may even be excused a little irritation at what they probably regard as an unnecessary alteration. In this book the more scientific spelling is adopted, not from pedantry, but because the writer wishes to avoid the possibility of confusing any seeker after knowledge.

CHAPTER II

DESCRIPTION OF THE CACAO TREE, ITS FLOWERS AND FRUIT

THE cacao plantation might be described as a tropical orchard. It resembles an orchard in that it contains trees, planted at more or less regular intervals, of about 15 ft. to 25 ft. in height, that is about as tall as, or a little taller than, our fruit trees. The resemblance does not go much further ; here and there in the cacao plantation a huge tree towers above the cacao trees, as one may imagine oaks towering above the apples. The curious reason for having these giant trees will be explained later when cultivation is discussed. If one thinks of an English orchard one may picture the black straggling branches against a November sky, or the brief pink and white glory of the blossoming boughs in the spring sunlight, or the ripe fruit hanging in the leafy tree on a summer's day. The cacao plantation is in all seasons like an orchard in summer time, in that all the year round the fruit may be seen hanging on the tree, the branches of which are thickly covered with dark-green leaves. The leaves are sufficiently large and numerous to act as an almost perfect screen to the fierce tropical sun, and one steps with grateful feelings from the too brilliant sunshine outside to the cool shade under the cacao trees. The winter aspect of our orchards is never seen with cacao trees, save when they have been denuded by the wind, and then they soon become covered with young flaccid leaves through which the light shows red. At no time do cacao flowers make a brave show like our apple blossom ; they are very small

and frail, and, like most tropical flowers, have no scent. The eye has to seek for cacao-flowers, but when found, one admires them for their pale-pink and yellow colour and delicate form. They grow in tufts or clusters and have five yellow petals on a rose-coloured calyx. To the astonishment of the visitor from England, these flowers do not grow on the ends of the twigs, but spring only from the trunk and main branches of the tree.[1] The flowers usually grow from a cushion or boss in the bark, and may sometimes be found on the trunk not a foot from the ground. One's ignorance might be excused if one mistook them for a novel kind of club moss.

A full-grown tree will bear in one year over 6,000 flowers, but of these only 10 to 60 will become mature fruit. According to the *Bulletin of the Imperial Institute*, p. 44, 1919, "the flowers are invariably fertilised by insects." According to Dr. von Faber's research, self-pollination is the rule. Judging from these figures, whatever the method, fertilisation does not take place very completely, nor do wind or other agents in cross-fertilisation appear to be very effective. The writer once ventured to suggest that the planter might pollinate the flowers with a brush and thereby materially increase the yield. One authority pointed out that this might be difficult to apply on a large scale, and further, one cannot force nature, and the apparently needless waste was to prevent over-taxing the energy of the tree. Another authority has written that "many cases have been observed where numerous and very large clusters of young cacao fruits have begun to set, but where the local food supplies appear to have been

[1] The writers of modern scientific text-books are not always aware of this fact. There is an amusing drawing of a branch of a cacao tree in *Confectioners' Raw Materials*, by James Grant (1921).

deficient, and dying back was inevitable." Nevertheless, considering how vital this question of yield is to the whole industry, the writer continues to hope that experiments in fertilisation will be made. One does not expect to get 10,000 pods on a tree, but an average of 80 pods would delight the planter, and this number may reasonably be hoped for.

Flowers, small fruit, resembling gherkins, and mature fruit are to be seen growing side by side on the same tree, practically all the year round. In many places the flowers are most numerous in June, and, as the time taken from the opening of the flower to the production of the mature fruit is about five or six months, the greatest quantity of ripe fruit is gathered in November and December, when people in England are shivering by their fires.

The mature fruit is a pod about 6 ins. to 8 ins. long, and weighs from 10 ozs. to 20 ozs. The shape and size vary according to the botanic species and variety. The colours of the pods are remarkable for their richness. When unripe they may be as green as grass, and when mature golden-yellow, or maroon, or crimson tinged with purple. Since it was christened by the great Swedish scientist, Linnæus, the tree has been known to botanists as *Theobroma cacao* (Greek, *theos*, a god ; *broma*, food). Lovers of cocoa and chocolate will consider it poetic justice that this tree should be called the "food of the gods." Botanically it is classified thus : *FAMILY :* Sterculiaceae. *GENUS :* Theobroma. *SPECIES : Theobroma cacao, Theobroma pentagona, Theobroma sphaerocarpa.* The family of the Sterculiaceae is related to the mallows and the linden tree. There are only two important genera : the cacao tree and the kola-nut tree, the fruits of which very much resemble one another externally. There are,

CACAO TREE, WITH A GOOD CROP OF PODS

perhaps, a score of species of Theobroma, but the only ones of commercial importance are Theobroma cacao, Theobroma pentagona and Theobroma sphaerocarpa, and of these, Theobroma cacao produces at least nine-tenths of the world's cacao.

There are two principal varieties of Theobroma cacao, called *Criollo* and *Forastero*. These names have been wrested from their original meaning, which was "Creole" and "foreign," implying respectively, that one kind of cacao was native, and the other imported from a foreign country. The use of these names in this sense could only lead to confusion, and botanists have agreed to classify the trees according to the character of the pods and the seeds they contain. The pods of Theobroma cacao show small but appreciable variations as one passes from country to country, and out of this chaos the botanist attempts to make order by noting the more fundamental resemblances and differences. Of the various classifications, the simplest is that mentioned above, which divides into two main varieties, Criollo and Forastero, and then into local types and sub-varieties. The table below, after Van Hall, illustrates this—

THEOBROMA CACAO

Criollo	Forastero
Local Types	*Sub-varieties*
Venezuela Criollo	Angoleta (Trinidad Forastero)
Ceylon Criollo	Cundeamor (bottle-necked, so-called Trinidad Criollo)
Java Criollo	Amelonado (melon-shaped)
Samoa Criollo	Calabacillo (round and smooth)
Madagascar Criollo	
Nicaragua Criollo	

Criollo. The pods of this variety are as embossed as a crocodile's back or the bark of an ancient oak. The shape is somewhat like an elongated lemon, only that it is broad at the point where the stalk is attached and

tapers at the other end. The wall of the pod has ten longitudinal furrows, five of which are very marked ; it is soft and can easily be cut with a knife.

Forastero. This variety has less warty pods than the Criollo, and the walls are more woody in character. The shape of the pod varies considerably ; one kind, *Angoleta*, resembles Criollo ; another, *Cundeamor*, is bottle-necked ; another *Amelonado*, resembles a melon ; and a fourth kind *Calabacillo*, is as globular as a calabash. In a single Trinidad plantation one may find not only all these kinds, but all manner of intermediate and indeterminate types. It is interesting, with the above differences in mind, to walk through a plantation and attempt to name the varieties. One can best determine whether one has been successful by taking a pod from the tree and cutting it open. The more easily one cuts open the pod, the more sure one is that it is Criollo, but it is the colour of the seeds inside which enables one to make a final decision. On opening the pod there is a pleasant odour resembling melon. The inside of the pod, like a young chestnut burr or the pod of a broad bean, is lined with white pulp. Inside there are 20 to 40 seeds packed closely together. These seeds are also thinly covered with a glistening snow-white or pale-heliotrope pulp, so that they slip through the fingers with the same facility as the seeds of a melon or cucumber. On putting one of the seeds in the mouth the pulp is found to be sweet and faintly acid. On biting through the seed one finds that it is bitter and astringent, particularly if it is the Forastero variety, and one spits it out as not being sufficiently pleasant to eat. This discovery strikes one as curious, since from these same seeds are prepared those delightful food-stuffs, cocoa and chocolate. When prepared for the market the cacao seeds are always known incorrectly

as beans. On examining the seeds after the pulp has been removed, one finds that in the Criollo variety the seeds are large, plump and white, or almost white in colour ; whilst the Forastero beans are smaller, flatter, and heliotrope in colour (the Calabacillo sub-variety being the smallest and most deeply coloured). The simplest and most satisfactory classification for commercial purposes is by means of the colour of the seeds. If they are white they are Criollo, and if they are heliotrope or purple they are Forastero. The weight of pulp-covered seeds from a pod varies naturally with the size of the pod, the type of cacao and the amount of pulp ; it may be taken as being roughly one-quarter of the weight of the pod. Thus a pod weighing 1 lb. contains on the average about 4 ozs. of pulp-covered seeds which would yield about 1½ ozs. of the dry, cured cacao-beans of commerce. This impresses one as a small amount, but the weight of cacao yielded by the tree is even more surprising. On a first-class property the average yield of the tree may reach as a maximum, 3 lbs. a year. Taking all the cacao trees in the world, it is doubtful if the average yield of commercial cacao exceeds 1½ lbs. to 2 lbs. to the tree per annum. This fact may well stagger the economist and cause the would-be planter to pause. The reader will wonder how the planter makes the cultivation of cacao pay, and may inquire how vast a multitude of people are employed to look after the 500,000,000 cacao trees required to produce the crop. An attempt will be made to answer these questions in a later chapter.

CHAPTER III

OUTLINE OF THE HISTORY OF COCOA AND CHOCOLATE

1. BEFORE A.D. 1500

The Origin of Cacao Cultivation and Chocolate Preparation

THE early history of cacao is lost in antiquity. If we may believe the Mexican mythology (much virtue in an if), chocolate was consumed by the Gods in Paradise, and the seed of cacao was conveyed to man as a special blessing by the God of the Air. The problem of discovering the original home of the cacao tree is generally admitted by botanists to be beset with well-nigh insuperable difficulties. Various writers state that they have seen cacao growing wild in Central America, in Martinique, in Trinidad and in Guiana, but the evidence that these trees were not descended from cultivated trees is considered inconclusive. On the whole, Von Humboldt's belief that cacao was indigenous to the forests of the Amazon and Orinoco remains to this day the most acceptable theory. From this region it was probably taken by wandering tribes to other parts of tropical America. Thus it is well known that the Aztecs of Mexico and the Incas of Peru cultivated cacao. Cortes, that brave but callous conquistador, made in 1519 the discovery that cacao was widely cultivated in Mexico, and the drink prepared from it consumed in large quantities by Mexico's ruler, Montezuma, and his court. Such was the knowledge of both cultivation and preparation displayed by the

Aztecs, that one can only conclude it had already been grown by them for many generations.

De Candolle, in his *Origin of Cultivated Plants*, asserts that the cacao tree has been cultivated in America for 3,000 or 4,000 years—a prodigious period, hard to conceive. Certain it is that many chieftains of Mexico, either Toltecs or Aztecs, must have consumed chocolate before Montezuma indulged his fancy for this delicacy, but, until Columbus discovered the great continent of America, Europe knew nothing of the Western hemisphere and no European had ever seen a cacao bean. The Aztecs, besides their vast palaces and ingenious forts, possessed other evidences of a civilisation equal, if not superior, to that of Europe. In spite of these, and of the fact that they had elaborated independently the art of picture-writing, their early history is a mere "distillation of rumour." There is evidence that they conquered the more peaceful Toltecs, and first reached the City of Mexico in 1324. How and when they acquired their knowledge of cacao are open questions.

Where history is vague and indefinite, the imagination elaborates its own forms when the mind peers with eager eyes into the dark caverns of the past. It is probable that in ancient times, long before the Britons had learned to daub their bodies with woad, an early Aztec or possibly a Toltec, who was in the habit of quenching his thirst by sucking the juicy pulp of the seeds in the cacao pod,[1] accidentally threw some into a fire. Soon he became conscious of scented odours and a spicy air, and, having found their origin, tasted for the first time the roasted bean. One can but admire

[1] "We met with no tribe on the Orinoco that prepared a beverage from the seeds of the cacao tree. The savages suck the pulp of the pod and throw away the seeds." Von Humboldt's *Travels in America* (1799–1804).

his dietetic courage. His statue should stand beside those of the men who first consumed a mushroom, a tea leaf, and a coffee berry. Often by accident, when he was sucking the raw seeds of cacao, his teeth must have bitten through the pulp into the interior, and his palate have perceived an unpleasant bitter flavour. Now, however, he would find that the roasted seed, although still bitter, had acquired a very attractive aroma and taste. After that experience he would be always flinging cacao seeds into the fire, and little by little would learn to roast them to just the right degree to suit his taste. Later, a man of more delicate digestion would grind the beans and the beginnings of the manufacture of chocolate would be established.

2. THE SIXTEENTH CENTURY

The Spanish gain Knowledge of Cacao and Chocolate from the Mexicans

Columbus not only discovered America, he also discovered the cacao bean and brought a few home to Spain with him as curios from the new world. What remark King Ferdinand made when he saw these brown beans, which somewhat resemble almonds in appearance, is not recorded. Possibly it was not very complimentary. It was the adventure of another Spaniard, Cortes, that revealed the probable commercial importance of these strange seeds. It has already been mentioned that Cortes, in his ruthless conquest of Mexico (1521), encountered the Emperor Montezuma, who entertained him royally. This contemporary of Henry VIII, this chieftain styled emperor by his conquerors, is worth more than a passing reference because of the important part which the drinking of chocolate played in his feasts. Montezuma was " haughty and

fiery proud," with tastes as magnificent as his pride, and his imperial sway was like that of an Oriental despot, both in severity and splendour. Prescott, in his classic work on *The Conquest of Mexico*, states that " the emperor took no other beverage than the *chocolatl*, a potation of chocolate, flavoured with vanilla and other spices, and so prepared as to be reduced to a froth of the consistency of honey, which gradually dissolved in the mouth and was taken cold." At one banquet they brought in 50 great jars and drank it from golden goblets, while 2,000 jars were served to the guards and attendants. So writes Bernal Diaz del Castillo, who was present at the feast. And reading between the lines one knows that the Spaniards, despite their arrogance, were impressed. Whether they enjoyed this amazing beverage is another matter, for one must remember that it contained no sugar. The Aztecs had never seen a sugar-cane, although the Spaniards knew it well, having a few years before introduced it into the West Indies.

The Mexicans used cacao beans, as others use cowrie shells to-day, as a medium of exchange. The lords of Mexico paid tribute to their emperor in cacao beans. It is not easy to fix the value of this currency. One reads that a tolerably good slave could be obtained for 100 beans, so either slaves were cheap or cacao dear. A more exact idea of their value can be obtained from the statement of Thomas Cavendish (1586) to the effect that 150 beans were exchangeable for a Real of Plate (about 6d.). This would make the cacao worth about 1s. 4d. a pound. Considering the purchasing power of a penny in the 16th century, one can agree that those who drank chocolate then were, both literally and metaphorically, drinking money.

The Spaniards with Cortes, and others who came

later, scented profit. They noted how the tree was cultivated, and watched how this drink, this *chocolatl*, as the Mexicans called it, was prepared. The Spaniards were thus the first Europeans to gain knowledge of this remarkable drink, which was at once both substantial belly-timber and kick-shaw. Quick to appreciate its commercial possibilities, they planted cacao in other of their foreign possessions. With all the finesse of their race they kept the methods of cultivation and preparation a secret for nearly 100 years, so that though popular in Spain it was practically unknown in other countries until the next century. Those who sing the delights of Elizabethan England should remember that it lacked many priceless things, for example, tea, the solace of old maids ; coffee that " makes the politicians wise " ; the prosaic potato, the housewife's stand-by ; and above all, man's most useful weed, tobacco, and woman's most luxurious necessity, chocolate. Cacao was, however, mentioned in one or two places, namely, in MS. in the British Musuem entitled *A Voyage to the West Indies and New Spain* (*Yucatan*) *made by John Chilton in the year* 1560, and in the book by Bernal Diaz del Castillo on the Conquest of Mexico (1568). In a treatise by Clusius (Charles l' Écluse ?) on *Plantae exoticae* (1582) cacao seeds were figured for the first time.

The earliest illustration of the cacao tree occurs in a book entitled *The History of the New World*, which was originally published in Venice in 1565. In this book, the author, Girolamo Benzoni, describes his adventures in tropical America. He mentions that Nicaragua contains an incredible number of parrots, and also two things not found elsewhere in the Indies " save in Guatimala, Cape Fonduri (Honduras) and Mexico and along the shores of New Spain " : a peacock

and "cacauate."[1] No one seems to have pointed out that the word in the text of Benzoni's book "cacauate" is almost certainly a printer's error. What Benzoni wrote was probably *cacauatl*, which the reader will

CACAO TREE AND SHADE TREE
(From Benzoni's *History of the New World*, 1565)

note the draughtsman has incorrectly written as *cacauaté*. Whether this be true or not, *cacauatl* was the Mexican name for the cacao tree, and all nations derive their words for cacao from this source. Benzoni observed the use of larger trees to shelter and shade the cacao tree. He states that they doubled down the

[1] "Cacauate" is incorrectly spelled "cacavate" in some translations.

head of the larger tree to accomplish this, as is shown in the illustration. This seems incredible, yet Benzoni was an honest man and a careful observer.

The method of preparing the drink was naturally primitive. The beans were dried in the sun, and then roasted in an earthen pot. The shells of the beans were then removed and the beans ground in the following manner : the cacao was placed on a flat or concave stone, and another stone, shaped like a rolling pin, was rubbed to and fro upon it. The Mexicans used the same kind of stones for grinding maize.[1] The liquid or paste so obtained, mixed with spices, was kneaded into cakes with the hands and allowed to solidify. A piece of one of these cakes was triturated and mixed into a froth with water with a special stirrer or whisk, a kind of combined grinder and swizzle stick, called a *molinet*. This was presumably a Mexican invention, as it is always exhibited in the old pictures of Mexicans. Honest old Benzoni says that at first, much to the natives' amusement, he refused to taste this drink, considering it " more suitable for pigs than for men." " But," he adds, " subsequently, wine failing, and unwilling to drink nothing but water, I did as others did. The flavour is somewhat bitter, but it satisfies and refreshes the body without intoxicating. The Indians esteem it above everything, wherever they are accustomed to it."

The Indians (as Columbus called the natives of tropical America, thinking it was another part of India) were the first to esteem chocolate, and then the Spanish began to value it highly. It will be explained how, in

[1] Hence possibly the curious error in Van Hall's well-known book on *Cacao*, in which the reproduction of the illustration from Benzoni's book, showing the method of making bread from maize, is entitled " Indians roasting and kneading cocoa."

the next century, the rest of Europe followed suit. In engravings in old books the Mexican Indian always stands for chocolate, just as the Chinaman stands for tea and the Arabian for coffee. The association of the Aztecs with chocolate will remain for all time, though curiously enough no manufacturer appears yet to have used the name *Aztec* to designate a brand of chocolate.

3. THE SEVENTEENTH CENTURY

Chocolate becomes a Fashionable Drink

With the decline of the power of Spain the methods of making drinking chocolate gradually leaked out, and the information was spread all over Europe, not only by travellers and monks, but also in learned treatises on the subject. Hitherto, as we have seen, the references to chocolate had been casual and scattered, but now, for the first time, works devoted entirely to chocolate began to appear. The first of these, entitled *Del Chocolate*, by Cardenas appeared in 1609, and, being published in Mexico, passed almost unnoticed. In 1631, there was published in Madrid a book on chocolate which became the standard work of the century. Its author was Colmenero, and the title of the book when translated into English was *A Curious Treatise of the Nature and Quality of Chocolate*. It was translated into many languages and passed through several editions.[1] The following recipe taken from this book gives one an idea

[1] It was translated into English by Don Diego de Vades-Forte (J. Wadsworth) in 1640, into French by René Moreau in 1643, into Latin by J. G. Volckamer in 1644, into Italian by A. Vitrioli in 1667. Then came Sylvestre Dufour, who gave it new life by publishing it in 1671 along with treatises on coffee and tea. This compilation was so popular that it was revised and published again in 1685, 1688, and 1693. In 1685 it was translated into Latin by J. Spon and into English by J. Chamberlaine.

of the character of the beverage prepared from the cacao bean in the seventeenth century :

> Take a hundred cacao kernels (that is about a quarter of a pound), two heads of Chili or long peppers, a handful of anise or orjevala, and two of mesachusil or vanilla,—or instead, six Alexandria roses, powdered,—two drachms of cinnamon, a dozen almonds, and as many hazel-nuts, a half-pound of white sugar, and annotto enough to colour it, and you have the king of chocolates.

From an English edition we learn that the new drink, chocolate, was taken frequently at Oxford in 1650, that is a year after King Charles was beheaded. The first cocoa house was advertised in 1657, and was to be found in Bishopsgate Street in Queen's Head Alley. Other houses, both in London and Amsterdam, were soon opened, and chocolate became and remained a fashionable drink, the different chocolate houses and clubs being the resorts of characteristic sections of the *élite*. This was about the time that the frequenting of coffee houses was passing from the fashionable to the populace, and the elegant and refined began to forgather at the chocolate houses. After the Restoration the price of chocolate was about 10s. to 15s. a pound. As chocolate was new, costly and delicious, one can understand that it added to the self-satisfaction, already exquisite, of those who sipped it.

The seventeenth century saw cocoa pass triumphantly through the war of wit that all new things must encounter. Those who knew a little praised it as a poet sings of his love, and those who knew less condemned it lavishly out of the wealth of their ignorance. According to some writers one could live fully on chocolate alone ; it quenched the thirst and allayed fevers ; it was the milk of old men, and was a hive of secret virtues. On the other hand, Joseph Acosta in his *Historie of the East and West Indies*, 1604, wrote :

" the chief use of this cocoa is in a drincke which they call chocolaté, whereof they make great account, foolishly and without reason ; for it is loathsome to such as are not acquainted with it, having a skumme or frothe that is very unpleasant to taste, if they be not well conceited thereof."

Some writers passed from depreciation to denunciation. Thus Joan Franc Rauch, in 1624, published in Vienna a treatise condemning chocolate as a violent inflamer of the passions, and asking that the monks should be forbidden to drink it. Another writer complained that the very addition which had made chocolate popular, namely sugar, had destroyed its value, because sugar was a corrosive salt and a hypocritical enemy of the body. In spite of these diatribes, from being drunk chiefly by wealthy epicures and cranks, mainly as physic, chocolate became widely appreciated, and by the end of the century its cost and rich nature alone prevented it from becoming universally popular. It should be noted that the original Mexican beverage was a coarse mixture, generally containing no sugar and often flavoured with hot spices, and that it was served cool or as cool as the tropical climate permitted. Such a drink could never have found favour in Europe. Served hot, with a generous helping of sugar, everyone agreed with Mr. Samuel Pepys that " jocolatte " was " very good."

Many of the chocolate houses in later days became famous as clubs. Most readers will have heard of White's Chocolate House, adjoining St. James's Palace, and of the " Cocoa Tree " Club, 64 St. James's Street, Piccadilly.

Although the use of chocolate spread over Europe, Spain continued her hold on the trade. The whole of the raw cacao was obtained through Spain from tropical

America until toward the end of the seventeenth century. It seems probable that the English chocolate houses purchased their chocolate ready-made, from Spain or France. That the greater part of the chocolate was imported is indicated by the fact that the first duties were imposed not on the importation of raw cacao, but on the sale of the finished product. Thus in 1660 parliament granted to Charles II a duty of 8d. on every gallon of chocolate made and sold, and in the reign of William and Mary (1690) a law forbade the sale of drinking chocolate without a licence. Although no doubt here and there individuals ground their own cacao beans, it was not until the next century that the manufacture of chocolate was the general rule in Britain.

4. THE EIGHTEENTH CENTURY

The Passing of Preparation by Hand

During this century chocolate began to be made and sold in little shops in many towns in England, and in one instance at least the shop developed into a small factory using a steam engine to drive its grinding mills. It would be interesting to attempt to trace what were the factors which determined that, of many small makers, Fry & Sons in England (founded 1728) and Walter Baker & Co. in America (founded 1780), should survive and flourish continuously right down to the present day. They resemble one another in that they were both founded by doctors, and in that they were the first chocolate makers in their respective countries to establish mills run by water-power. The doctors of those days were generally apothecaries, and hence were naturally fitted to become chocolate makers. They were experienced in the use of mortar and pestle for grinding, had knowledge of flavourings and spices,

and were generally adepts in the art of mixing confections, for a confection originally was an unpleasant medicine made palatable by the use of sugar and aromatic substances. When Dr. Joseph Fry began to make chocolate in 1728, having secured a valuable patent from Walter Churchman, the whole of the work was done by manual labour. A chocolate factory was built at Steinhunde by Prince Wilhelm von der Lippe in 1765, and the firm of Lombart, " la plus ancienne chocolaterie de France," was founded in 1760, but apparently, in both of these factories, the whole of the chocolate-making was done by hand. Cacao beans are by no means easy to grind, and the introduction of water power to drive the mill must have been a great step forward. Messrs. Fry had their famous " water engine " at Castle Mills, Bristol, and Dr. James Baker had his on the Neponset River, U.S.A. By about 1770 Watt had perfected his steam engine, and in 1795 Messrs. Fry made a further step towards mass production by erecting one of these powerful engines, the first in Bristol, for what the chroniclers of the time described as the " trifling object of grinding chocolate."

The price of chocolate was lowered during this century ; for example, that produced by Walter Churchman's patented process in 1730 could be sold, the plain kind at 5s. a lb. and that with vanilla at 6s. a lb. High excise duties continued to hamper the trade. In the *Humble Memorial of Joseph Fry*, 1776, he states that not only do cacao beans pay 10s. per cwt. duty, but the chocolate obtained from them pays 2s. 3d. a lb. He adds that " smuggling is vastly increased in Bristol by a desperate Gang of Villains " and that the smuggled chocolate was daily hawked about the streets of Bristol, Bath, Salisbury, Worcester, and Birmingham. With such high duties levied upon it,

chocolate could not be sold at a price low enough to suit the incomes of the mass of the people, and it is not surprising to find that the total quantity of raw cacao imported into Great Britain by the end of this century, did not exceed 100 tons per annum.

So far in this history, whenever chocolate has been mentioned, the reference has been to chocolate for drinking purposes. Chocolate for eating and cocoa powder were both as yet unknown to the public. The absence of the former may possibly be accounted for in this way: chocolate cannot be moulded unless it contains about 25 per cent of cacao-butter. If this is obtained by mixing cacao beans and sugar, we require to have present about 50 per cent of cacao bean, which makes a chocolate too bitter for eating to satisfy the public taste. It became possible to produce an eating chocolate sweet enough to be palatable, only when a supply of cacao-butter was available. This did not occur until the next century, and was intimately connected with the production of cocoa powder.

5. FROM 1800 TO THE PRESENT DAY

Popularity Achieved and Perfection Approached

Since 1800 the rise to popularity of cacao preparations has been steady and continuous. Of innovations and changes, those which have had the most marked effect in increasing the consumption of cacao are as follow—

1. The introduction by Van Houten in 1828 of cocoa-powder as we now know it.
2. The reduction of the duty to a low figure which was maintained constant for a number of years.
3. The great improvements which have taken place in the methods of transport.

4. Improvements in the manufacture of eating chocolate.

The beverage, chocolate, had one quality to which objection was often made. This was the richness due to the presence of a superabundance of fat, and, when Van Houten hit upon the idea of pressing out part of the butter, he obtained a product which gave a more easily prepared and more palatable drink. The British Government have always believed in cacao for the Navy, and in the early years of the nineteenth century the amount taken by the Navy formed the mainstay of British consumption. In 1830 the British Navy consumed 176 tons. The British sailor to this day is given the old-fashioned chocolate, and excellent fortification it gives him against the salt breezes. A land-lubber would hesitate to sip this rich drink, on which floats a layer of fat ; he would always prefer the lighter beverage obtained from cocoa powder, and one suspects that most sailors would also. The method of cocoa production by pressing out part of the butter was not adopted in England until 1866, when Cadbury Bros. introduced their " Cocoa Essence." Fry & Sons adopted the process for their " Cocoa Extract " two years later.

Another, and older, method of reducing the fatty richness of the ground cacao bean was to mix with it some cereal product. This had been done from the earliest times ; thus the Mexicans used maize. This addition, however, was condemned even as early as 1685. In J. Chamberlaine's translation of Colmenero's book, it states : " those that mix maize in the chocolate do very ill, for they beget bilious and melancholly humours. It is certain that it begets Choler and Windyness, and that they do not make use of this ingredient but for their own profit and the quantity of the chocolate." The objection to maize on the ground

that it produces biliousness is amusing, but the motive for adding it is shrewdly stated. In 1837 Daniel Dunn invented the use of arrowroot in place of maize and described the mixture as " soluble cocoa." The battle for public favour between cocoas containing farinaceous material, and those which consisted simply and solely of the cacao bean from which part of the butter had been expressed, was a lengthy one, but it was evident that the victory had been won by the latter, from the day that it became recognized as a punishable offence to sell anything under the description of cocoa which contains any other substance than the cacao bean, unless the presence of these substances is fully disclosed.

The author keeps in affectionate memory the thick, heavy, glutinous liquid called cocoa that he once drank in his early youth ; it was as sturdy as gruel. These mixtures of sugar and starchy foodstuffs with cocoa were very popular until the introduction of the pure cocoas, which have slowly but surely gained the day. The mixtures continue to occupy a place in the national dietary because of their low price.

While chocolate for drinking is an ancient beverage which Europeans first saw, and possibly heard, drunk by the Aztecs over four centuries ago, chocolate for eating is a comparatively modern invention, and was not manufactured in England until after Queen Victoria came to the throne. The exact date is a matter of conjecture ; Fry & Sons certainly sold " Chocolat Délicieux à Manger " in 1847, and Cadbury Bros. displayed chocolate at an exhibition in Bingley Hall, Birmingham, in 1849.

The circle of consumers in the latter half of the eighteenth century was widened by the reduction in price made possible by low duties. In the first few years of the century, cacao beans paid a preferential excise duty of 1s. 10d. a lb. if from British Possessions and

5s. 10d. a lb. if from foreign countries, while the customs also claimed 2½d. a lb. on entry for home consumption. Commerce in cacao was unsettled by the continual alteration of these duties, until in 1853, Gladstone fixed the uniform rate of 1d. a lb. This remained constant for over 60 years, and would doubtless have continued to the present day but for the Great War. Under these fair conditions the charms and virtues of cocoa and chocolate have become universally recognised and the consumption has increased by leaps and bounds, until to-day it is four hundred times as great as it was a century ago. Much has been written in praise of cocoa and chocolate. To those who have examined the dry statistics of consumption all these words are unnecessary. It is one of those cases where a column of figures is more convincing than a volume of rhetoric.

A Hundred Years of Cacao Consumption in Great Britain.

	Tons.
1822	126
1830	176
1840	910
1850	1,375
1860	1,442
1870	3,099
1880	4,713
1890	9,029
1900	16,888
1910	24,596
1920	50,651
1922	50,530

To the planter with his eye ever on the market price, who knows how rapidly the production of cacao beans has increased, the above figures are cheering. He likes to hear that plenty of cocoa is being drunk, for he knows that it takes 2 lbs. of beans to produce 1 lb. of cocoa-powder. He is not so much interested in chocolate, because it takes only about 10 ozs. of beans to produce

1 lb. of chocolate. The planter should note, however, that it is the chocolate industry which absorbs the cacao-butter which is a by-product of the cocoa industry. The chocolate industry not only absorbs it, but also pays a high price for this by-product, which thus enables cocoa-powder to be sold at a figure which encourages consumption.

Chocolate for eating can be regarded either as sugar added to cacao or as cacao added to sugar. The makers of cocoa naturally became makers of eating chocolate. The three greatest firms in England have always run the two interdependent industries, cocoa and chocolate, side by side, but in recent years a number of confectionery firms have developed chocolate as an important side line. One of the oldest of these is Messrs. Joseph Terry & Sons, of York, who were founded in 1767, and were known for over 100 years for their candied peels and boiled-sugar sweets before they built their chocolate factory in 1886.

Two important events in the history of eating chocolate will only be casually mentioned here ; one is the invention of milk chocolate by M. D. Peter of Switzerland in 1876 ; the other is the introduction of the so-called " fondant " chocolates, beautifully smooth productions, which in the last few years have practically driven the coarsely ground chocolate from the market. Both of these will receive further comment when the manufacture of chocolate is discussed.

All writers on the history of cocoa and chocolate are indebted to the late Richard Cadbury for his volume entitled *Cocoa*: *All about it*, by *Historicus* (1892). It is packed with curious old quotations that make it a mine of delight to the cocoa historian and must have entailed many peaceful hours of reading. It is not easy to picture a successful business man, in the full

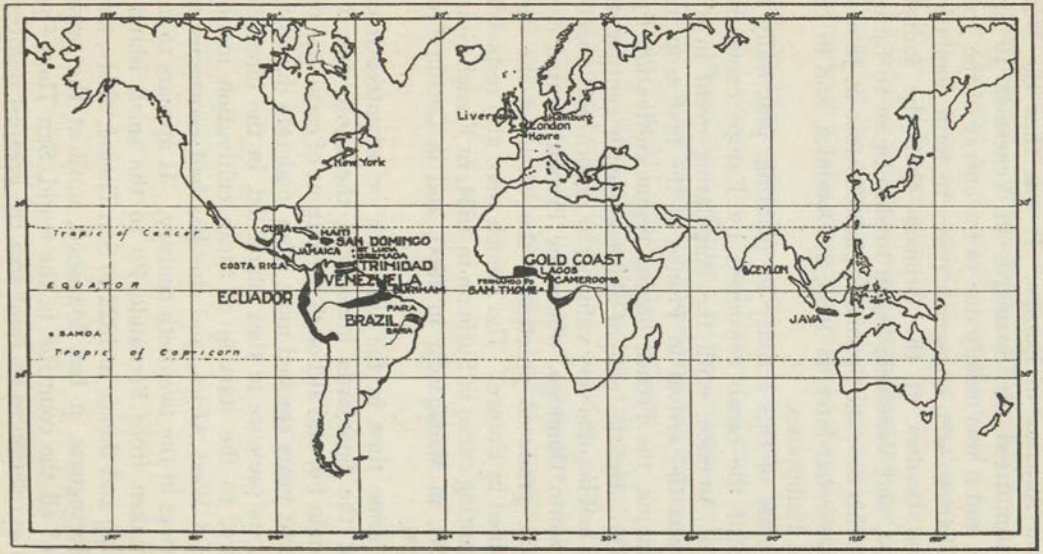
stream of his career, poring over the old books and manuscripts in the British Museum. The three principal English cocoa and chocolate firms, Messrs. Cadbury, Fry, and Rowntree, have all been founded by men of character, all Quakers as it curiously happens, possessing a broad interest in humanity. Possibly the late Richard Cadbury found relief from the turmoil of business and the roar of the grinding of mills in the tranquil seeking after knowledge and the lisping of turned leaves. He may be taken as a practical illustration of one who followed the Shakespearian precept :

> No profit grows where is no pleasure ta'en ;
> In brief, sir, study what you most affect.

The Spread of Cultivation. It would not be fitting to close this chapter without some reference to the growth of cacao cultivation. In the 50 years that followed the discovery of America, the cacao tree was found to be growing in many places in the tropical parts of that continent, for example, in Brazil, Ecuador, Venezuela and Mexico. It does not, however, appear to have been introduced into Bahia until 1780.

The Spanish were the first to begin planting cacao in other countries. They are reported to have planted it in the West Indies, in Trinidad, as early as 1525, and to have introduced it into the East Indies in Celebes in 1560. It was no inconsiderable achievement to carry the live cacao seeds half-way round the world, a journey which in those days would take several months. It has not thrived there, but Java, only recently of importance as a cacao-growing country, owes its first cacao plantations to this enterprise.

In 1634 the Dutch took possession of the island of Curaçao (where the famous liqueur oranges grow) and made this a port for the passage of the produce of



MAP SHOWING CACAO-PRODUCING COUNTRIES AND CHIEF MARKETS

tropical America to Europe. It was thus the Dutch who stimulated the Spaniards in Venezuela to grow cacao, and it was mainly due to the energy of the Jesuit missionaries—who engaged natives to form plantations on the borders of the Orinoco—that the industry thrived, and Venezuela began to ship cacao to Europe. About this time the Spaniards planted cacao in Jamaica, and somewhat later, in 1665, in Dominica, and in 1671 in the Philippines.

In spite of this activity in planting, practically the whole of the cacao consumed by Europe came from tropical America, until the stimulating event in 1679. This was the arrival in France of the first crop from Martinique, the French having begun cultivation there in 1660. By the end of the eighteenth century this island had become very valuable to France, and, together with Santo Domingo, where the French planted cacao in 1665, produced practically the whole of the cacao consumed in France. The French were also responsible for planting cacao in Surinam in 1684, in French Guiana in 1734, in Madagascar in 1800, and in Cochin China in 1870.

At some time in the sixteenth or seventeenth centuries, the Spaniards introduced the cacao tree into Fernando Po, and although the output of cacao has only in recent years reached more than moderate dimensions there, its presence in that island led, in the nineteenth century, to the starting of cacao cultivation in other parts of West Africa, and this has had enormous consequences in the twentieth century. It appears to have been taken from Fernando Po to the small island of Principe and thence in 1822 to San Thomé, where, under the Portuguese, it has flourished, until at the present day, of all the countries in the world, San Thomé produces in relation to its total area the greatest number of

tons to the square mile. With less than half the area of County Surrey, it is the fourth largest producer in the world. The first cacao planted in the Gold Coast was also brought from Fernando Po. This was as recently as 1879, but the development here has been amazing, and the Gold Coast now yields one-third of the total production of the world. The original cacao grown in the Cameroons also came most probably from Fernando Po.

While half the cacao produced in the world is grown in British Colonies, the British have had only a small share in the original planting. One instance, to their credit, not yet mentioned, is the case of Ceylon, in which cacao from Trinidad was planted in 1834.

A map of the world showing the twenty principal cacao-producing countries will be found on p. 29. The relative importance of the various producing areas is roughly indicated by the size of lettering.

CHAPTER IV

THE RAW MATERIAL—CULTIVATION OF THE CACAO BEAN

In this chapter it is proposed to deal with the cultivation of cacao as practised to-day. The word cultivation conveys the idea of careful tilling of the soil, the application of manures, and generally the attention to all the details that keep the plant healthy and increase the yield. In this sense the word cannot be fairly used in relation to much of the cacao produced in the world. There are many cacao planters but few cacao cultivators. Roughly, one may say that cacao receives the same amount of cultivation, and the same varying degrees of attention, as the trees in our English orchards. Mr. Barrett once said to the planters of Trinidad, "Gentlemen, you have not *cultivated* cacao, you have only *picked* it." This pungent remark was doubtless intended to sting the Trinidad planters into greater activity; it would have been literally true if spoken to many thousands of cacao producers in other parts of the tropics. Yet in all countries a little care is taken, and such things as are traditionally considered beneficial are either done or intended to be done. Agriculture is the growth of centuries and the ways of men change slowly. In some parts of tropical America the way of cultivating cacao has been the same for several hundred years. Gradually, in each country, a method of cultivation and preparation for the market has been evolved suitable to the environment. Each method has distinctive features. As it will not be possible in the space at our disposal to describe all these methods,

an attempt will be made to give the most approved procedure, with an occasional note on some of the more important variations.

Where does Cacao Thrive? The first question which the would-be planter has to decide is the choice of a suitable site. Cacao is essentially a native of the tropics, and plantations are unlikely to be successful outside the narrow margin of 20° north or south of the equator. The mean shade temperature should be about 80° F. and the temperature should very rarely rise or fall more than 15° F. above or below this point. The ground should preferably be a few hundred feet above sea-level, but the altitude should not exceed a thousand feet. Usually, as in Trinidad, which is about 11° north of the Equator, cacao does not bear well at a thousand feet, although on the Equator, in San Thomé, it is possible to cultivate it at that elevation, and in places in Java and Venezuela even higher.

The cacao tree is very sensitive to wind. Like other trees it cannot stand against hurricane or tornado. On the Gold Coast and in Jamaica cacao is grown in spite of occasional hurricanes and tornadoes, but these are only exceptions that prove the rule, and a sheltered position should always be chosen. So sensitive is the cacao tree to the effects of the wind that it cannot thrive in a steady trade wind such as blows over a flat island like Barbados. It flourishes in sea-air, not in sea breezes; and the same problem faces the planter as faces the ventilating engineer—to provide plenty of fresh air without a draught. A gentle slope in a valley is generally ideal because it is sheltered and has the further advantage that the soil is rich and deep.

The rainfall also is very important. According to H. Wright, 50 ins. is about the minimum and 200 ins. about the maximum rainfall in the year for successful

cacao cultivation. An even distribution throughout the year and a moist atmosphere compensate to a considerable extent for a low rainfall. Thus on the Gold Coast, at Aburi, where the Government Botanical Gardens (with successful cacao plots) are situated, the rainfalls for the three years 1918–1920 were remarkably low : 42 ins., 35 ins., and 36ins. respectively.

Cacao grows in a great variety of soils. Some planters look for a light loamy soil ; all prefer a soil which is fairly porous, rich in humus and of considerable depth. Mr. Stanhope Lovell finds in Trinidad that light sandy loams have many advantages and few disadvantages. They retain a more even temperature than heavier soils, they require less tillage and they respond rapidly to treatment with pen-manure or mulch. They give trees which are healthier and grow less moss, but which do not withstand drought as well as those on some of the heavier loams.

Knowledge of soils is best learned by observation and practical experience. Chemical analysis is of some value, but until it can give us the amount of various constituents available to the plant-life in question, it will not be so useful, for judging the suitability of the soil, as observation on the spot of the condition and kind of vegetation growing upon it. This, together with the opinion of other planters in the district and of the local Agricultural Department, should be a sufficient guide. Good drainage is important, and water-logged soils are recognised as bad. Soils vary considerably in their power of retaining water and in their ability to raise water from a depth against gravity. The capacity for holding water should be high. An interesting observation by Sir Francis Watts appears to be related to this : he found in certain valleys in Dominica that, if the linear shrinkage of the soil on drying

exceeds 10 per cent, cacao grown thereon will not thrive.

Every site has its peculiar problems. In Jamaica many estates would fail if it were not for elaborate systems of drainage. In Surinam, the plantations along the river-side are actually below water-level at high tide and have to be surrounded by massive embankments to keep out the water. In such a situation it is evident that the draining of the plantation must require great skill. On the other hand, in some places in Venezuela and Nicaragua, irrigation is essential to success.

In choosing the place for a plantation, the planter will not only select an area where his cacao trees are likely to bear well, he will also take into account certain economic considerations, of which labour conditions and transport are perhaps the most important. His crop has to be collected and conveyed to the market, so that he will preferably choose ground near to a well-made road and convenient to rail and shipping.

Felling and Clearing. The planter having made his choice, the land has to be cleared of its wild growth before he can start planting. The outskirts of the primeval forest are a dense mass of matted vegetation ; as we get deeper into the forest where the light is dim, the undergrowth begins to be less in evidence, and walking becomes easy save for the *lianes* which climb the trunks, reach the tree-top and then hang down in graceful pendants to the very earth. The soil is black and almost bare. The felling is done in the dry season so that everything may be burned and, to facilitate this, the small trees and undergrowth are heaped and the large trees cut into sections. The planter has already carefully marked out the position for his bungalow, the drying platforms and fermentaries, and, in clearing, any

suitable timber will be cut and put on one side to season. Much labour is required, and according to the character of the forest, high-woods or bush, the felling and clearing may cost anything from £3 to £6 an acre.

It is usual to leave all trees and bushes on the ridges for 50 ft. to 100 ft. each side. This serves several useful purposes, the chief of which is that of protecting the cacao from wind. To ensure this it is advisable to plant "wind-breaks," belts of native trees which are known to withstand gales, at right-angles to the prevailing wind, at intervals of about 1,000 ft. Useful trees for this purpose are mango, Para rubber tree and galba (*Calophyllum calaba*). Bamboo is approved by some planters, but others contend that its roots spread too readily, that it dries the soil, and that it is dangerous in case of fire. A good wind-belt consists of mango-trees interspaced with a hibiscus hedge. (Strange, is it not, that the hibiscus, cultivated in England—in greenhouses—for its glorious crimson flowers, should be used in the tropics merely to "stop a hole to keep the wind away!")

Planting and Seed Selection. Having determined the position of roads and drains, and having got the ground cleaned and thoroughly well turned, the planter proceeds to line out the ground and put stakes where the cacao is to be planted. The distance these stakes are apart will depend on the fertility of the soil and the kind of cacao planted—for Forastero, 18 ft. on rich land, 15 ft. on good land, and 12 ft. on poor land. Criollo trees have generally been planted about 12 ft. apart but Van Hall considers 15 ft. a more suitable distance. What a wonderful difference it would make to ease of cultivation if all trees were planted a sufficient distance apart to use a plough! In most countries the trees occupy the corners of squares; there are advantages in the

triangular planting (or rather in the quincunx form). If the lines are not straight, then later on (as Mr. W. MacLellan-Wilson points out in *Tropical Life*) " the plantation will appear all awry and crooked, and will be an offence to the meticulous and mathematical eye." " Well, well," the onlooker will say, " he *was* a careless planter who planted this field." Whereas, if the marking is carefully done, then from any spot on the plantation straight lines of stakes, and afterwards of cacao, will be seen radiating out, and the careful work done will be repaid a hundred times in the economic working of the plantation.

Another detail which has a great effect on the future value of the plantation, is the seed selected. As mentioned in the chapter on the cacao tree, there are three species producing the cacao bean of commerce: *Theobroma cacao*, which is grown in all producing areas ; the rarely-grown *Theobroma pentagona* or alligator cacao, the pod of which has five well-marked ridges and is as nodular as an alligator's hide, and the seed of which resembles the Criollo variety of Theobroma cacao ; and *Theobroma sphaerocarpa*, which is grown to a limited extent in San Thomé.

Of *Theobroma cacao* the planter can choose either the high-priced Criollo variety which only gives a moderate yield and is a delicate tree requiring rich soil, or the more hardy Forastero variety which gives a good yield of medium grade beans. The tendency, in recent times, has been to plant Forastero. Whatever variety is selected, the seeds should be taken from healthy, mature pods, growing on trees possessing high vitality and good bearing properties. Experiments conducted for the Director of Agriculture in Trinidad have conclusively shown that certain trees in any plantation consistently give high yields year after year, and further work is

being done to determine whether the seeds of heavy bearers will produce trees giving heavy yields, or whether better results can be obtained by budding heavy bearers on hardy stocks (Calabacillo). It would appear to be possible by budding to increase the present average yield per annum of about 20 pods to the tree to four times this number. Until this is conclusively proved it is unlikely that planters themselves will try budding or grafting on a large scale, as it is said to be ten times as expensive as planting seed. The production from seed, however, is uncertain, as the tree produced may resemble one of its "grandparents" or "great-grandparents" more than its "parents." On the other hand, with budding it would be possible to produce a set of trees giving beans of exactly similar character, and everyone knows the high value put on a uniform product in the commercial world. The objection of expense, moreover, is almost removed if the budding is done, as in Trinidad, on a large scale by the Agricultural Department, and the budded plants purchased by the planter.

On Mr. R. McLean's estate in Los Bajos (Trinidad) there are 4,000 budded cacao plants, propagated from those trees on the Government Estate which gave at least 80 pods per tree. The first lot were planted at the end of 1918, and came into bearing in 1922. The record of the yields are looked forward to with great interest.

Cacao may either be planted at the stake, or first grown in a nursery and transplanted. In either case a hole 2 ft. cube is dug and filled with top soil. In the first method, when the soil has settled, three or four seeds are put in, all save the healthiest plant being removed later. If grown in a nursery the seeds are set about 1 ft. apart, or planted in bamboo pots or in plaited coconut palm leaves. This means considerable labour ;

thus, for a small estate of 20 acres one will need 6,000 plants. Robert Louis Stevenson in his *Vailima Letters* gives an amusing account of the planting when he introduced cacao into Samoa in 1891. "You should have seen us; the veranda was like an Irish bog, our hands and faces were bedaubed with soil." The seeds are carefully shaded and watered in the nursery and are ready for transplanting about two months later, when they are from 1 ft. to 2 ft. high. The transplanting should be done just at the beginning of the wet season, after the first rains have fallen. Mr. W. MacLellan-Wilson has admirably conveyed the young planter's excitement during this process; it is true he talks of coffee, but his remarks apply equally to cacao. "Forgetting to drink his morning cup of coffee, neglecting to ring even the first bell (which by the way is an old bit of railway iron) to call his workers, he rushes off to the plantation to see if the rain has made any impression on the still empty coffee holes. Yes, there are marks where the welcome water filled the holes to varying depths of two, three, and four inches. That is surely sufficient moisture to start on! He thrusts his hand into the soil, incidentally in his excitement wiping it afterwards on his pyjama pants, and finds that it was a good soaking rain and the fates are propitious for planting. The excitement of that day he will never forget! From the nursery to the field, from the field to the nursery he ran; yes, actually ran! He re-arranged his men not once, but often, so that the digging out of plants, the carrying and the planting should have a relative balance in the operations. Finding finally a really careful native for the digging out in the nursery, the planter confined his attention entirely to the planting-out process. From hole to hole he danced, keeping a watchful eye upon his men, ensuring that

tap roots should not be bent, that hair rootlets should not be clumped, and that the plants should be in the middle of the holes."[1]

The Question of Shade. In the chapter on history it was mentioned that from the earliest times it was the

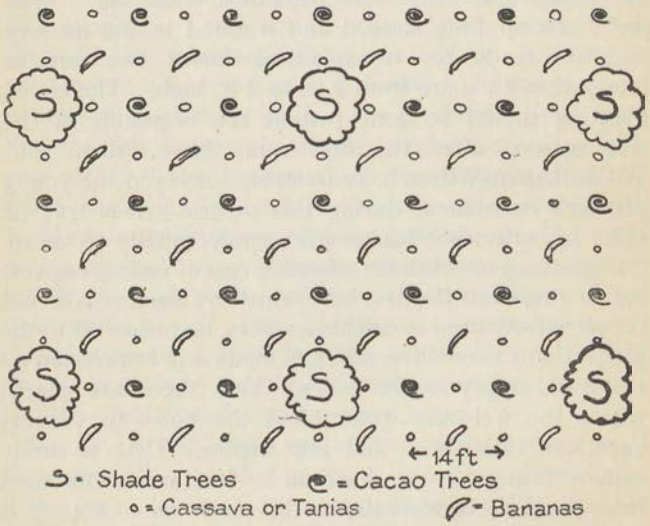


DIAGRAM SHOWING LAYOUT OF CACAO PLANTATION

habit of those who cultivated cacao to plant shade trees. It is agreed that the young plant just out of the nursery requires protection, and for this purpose the interplanting of bananas and tanias, or bananas and cassava, or pigeon pea (*Cajanus indicus*) is effective. The planter has to wait and watch more or less nervously for five years before the cacao is ready for harvesting,

[1] From the *Kenya Graphic*, reprinted in *Tropical Life*, June, 1922.

and these temporary shade plants, which are planted before the cacao, provide profitable " catch-crops " in the meantime.

The need for permanent shade trees is not so obvious. It is a disputed question for cacao and coffee alike, and by sensitive ears a continuous discussion of this question can be heard rumbling round the tropics—

Says old Mr. Trinidad : My cacao would die without shade.

Mr. Grenada : Mine doesn't ; why should yours ? Everyone knows that we planters depend for our crop on a good flowering, and flowering is promoted by light and air. Therefore, don't shade ; don't smother.

Mr. Trinidad : Quite so, but it isn't the tree we aim at shading so much as the soil. And if we didn't protect the soil from sun and wind, we could not conserve the moisture in the soil, and the trees would wither.

Mr. Grenada : Agreed ; and the best way to accomplish that is not by shading. In Grenada we keep the soil in condition by the use of wind-belts, by close planting, and careful tillage of the soil.

Mr. Trinidad : Careful tillage is too costly for me. By the way, did you hear of that mountain estate in Grenada where the shade was taken out and the estate ruined ?

Mr. Grenada : No ! Have you heard of the plots on the Agricultural Department's estate in Trinidad where the shade was taken out and as a result the crops greatly increased ?

Mr. Trinidad : I have. They say since letting in the sunlight the borer beetle has been very prevalent. The crop certainly increased at first, but a wise man would wait a few years before drawing conclusions.

The verdict of the years will be greatly helped by the series of experiments which are being conducted in Trinidad, and the consideration which is being given to the relation of wind-breaks to shade. A cacao tree in one situation dies of what it would live by in another, and planters know well the importance of finding for each situation its appropriate method. The principles on which agricultural science is founded are very general, and their application to particular cases must be equally particular. Save in Grenada, Brazil, Bahia, the Gold

Coast, San Thomé, and Santo Domingo, the use of shade trees is the common practice. All the finest shade trees belong to the *Leguminosae :* in the West Indies and other places the vermilion-flowered *Erythrina* (Bois Immortelle or " mother of cacao ") is generally used and adds to the beauty of the plantations. It is planted at every third stake, that is, 45 ft. to 54 ft. apart. Only in a few countries are shade trees used which give a saleable crop ; thus in Ceylon some use Para rubber and in Java the " kapok " tree (*Eriodendron anfractuosum*), which yields a silky fibre used for stuffing pillows and mattresses.

When shade trees and cacao have been planted, and the roads made, *and* trenches with a V-section dug, *and* weeding attended to, etc., etc., the planter can begin to consider whether he will fork round the plants, whether he will use manure, and how he will train up the tree in the way it should go. In most producing areas the forking or hoeing of the soil on cacao plantations is considered entirely unnecessary, or, in some cases, even harmful. However, planters in some of the more progressive countries (Grenada, Ceylon, and Jamaica) are at one with the poet who says, " You tickle the earth with a hoe and it laughs with a harvest." In Surinam and Trinidad, though approved, it is little practised because of the high price of labour ; in the latter country forking costs from 13s. (a halfpenny a tree) to about £1 per acre.

Manuring. Taking the industry as a whole very little manuring is done, and so rapid is the decomposition of the soil in the tropics that many cacao plantations have flourished for years without any kind of manuring whatever. Whilst " mulching " is fairly common, and pen or farmyard manure is used when easily available, the use of artificial manures is altogether

exceptional. There is a general consensus of opinion that "mulching" is highly beneficial, particularly if it is preceded by forking. To obtain a mulch, the weeds are cut, heaped, and allowed to rot, and then mixed with dried grass and leaves. The effect of a layer of this is to keep the soil in a moist, porous condition. It also has value as a manure. According to the *West Indian Bulletin*, Vol. 10, No. 2, the grass from one acre of cacao plantation contains—

Nitrogen	70·8 lbs.
Phosphoric acid	21·1 lbs.
Potash	94·8 lbs.

At the beginning of the dry season the mulch is spread about 6 ins. deep, over a circle 6 ft. in diameter, round each tree, care being taken not to place it in contact with the stem. It is dug into the earth at the beginning of the wet season.

In certain countries, Grenada and Ceylon for examples, applications of pen or farmyard manure are made. This is a costly process, but so valuable is it, that it is to be regretted that all planters cannot either run a stock and grazing farm or else have their plantation in close proximity to one.

In those rare cases where a planter desires to use artificial manure he can generally save himself expense by consulting the local Agricultural Department, who usually have experience garnered from the use of manures on experimental plots. Basic slag has been found particularly good for soils requiring lime, but no simple rules can be drawn up, and an intimate knowledge of the soil is required to determine the correct mixture of artificial manures to use.

Pruning. In the early years, as with English fruit trees, pruning is devoted mainly to getting the correct

tree-form to obtain maximum bearing. In order to produce a low, spreading and symmetrical tree, everything that grows upwards, save the main stem, is cut off; so is every branch which crosses another and threatens to touch it. A well-pruned tree will cast an equal amount of shade all round it and thus the trunk and roots will be protected from direct sunlight. At five years it will be about 10 ft. high and 10 ft. in diameter.

Many planters subject their trees to a heavy trimming every third or fifth year. There is much to be said in favour of *light* pruning at more frequent intervals, say every year or second year. Light pruning increases the bearing area by promoting a branch crop and this is said to be less liable to disease than a trunk crop. It also encourages the growth of leaves, which protect the pods, when young and delicate, from fierce sun and heavy rain.

In later years, sappy branches may spring from low down the trunk and grow at a remarkable pace. These are called "watershoots" or "chupons," or by the uncomplimentary names of "suckers" and "thieves." They are deliberately permitted to grow by certain planters in Ecuador, Java, San Thomé, Ceylon and Trinidad. In the last named it is the practice on a well-known estate to allow two watershoots to grow, one from the fork and one from the ground. Experts differ, but on the whole the majority agree that with trees of normal growth all watershoots should be cut off.

Planters, like other men, have their superstitions, and one is the considerable effect of the moon on vegetable life. Some planters believe that it is unwise to prune unless the moon is in the correct phase, because of its supposed influence on the flow of the sap. Others

recommend one to plant cacao only at a dark moon and to gather the pods at a full moon as the beans are then at their roundest. It reminds one of the alchemists who could only undertake a transmutation of metals when the stars were in a definite relation. The planters have perhaps more justification than the alchemists; there is always a remote possibility of minute effects of gravity on the sap, or the influence of the moon's light, which, it should be noted, is polarised. As regards the latter, Mr. C. F. Marvin, Chief of the United States Weather Bureau, has shown that one-hundredth of normal daylight does not appreciably stimulate plant activity, and full daylight is 600,000 times greater than full moonlight, so that the influence of moonlight on plant growth must be negligible.

While the excision of live wood to obtain a good tree-form is governed partly by taste, the removal of dead wood is a necessity if the trees are to remain healthy. This form of tree-surgery requires considerable skill. To keep the tree clean and healthy it is necessary also to remove the diseased pods, the little palm-like epiphytes called "wild pines" (Catopsis), which grow on the branches, and parasitic plants like mistletoe. The trees in San Thomé and the Gold Coast do not seem so liable to become covered with orchids and epiphytes as those in the West Indies. In Trinidad the writer has seen cacao trees so tufted with epiphytes that they appeared to belong to an extraordinary new species. On the Gold Coast the tree stems are sometimes allowed to become thickly covered with mosses and ferns. The artist finds the moss on the bark of the cacao tree one of its charms—he is delighted with the beautiful patches of russet-brown, silver and green—but the too luxuriant growth of moss has to be checked by the planter when it threatens to smother the cacao

flowers. Bass and wire scrubbing-brushes are sold for the express purpose of removing it, and in Grenada they spray their trees with a one per cent solution of copper sulphate to destroy it.

Diseases and Pests. " Husbandry is not governed by judgment and labour but by the most uncertain of circumstances, winds and tempests." Although there is not so much truth in this observation to-day as when Cicero made it, it must be admitted that in spite of the advance of science, the planter is still at the mercy of Nature's moods, and particularly of that most uncertain circumstance, the appearance of pests and diseases. It is not possible to estimate the power of insect enemies and vegetable parasites to damage commercial enterprise in cacao-planting, but it is certainly considerable, and however intelligent and industrious the planter may be, he is liable to loss from this cause. These attacks have one advantage, that the planter in his distress appeals, sometimes for the first time, for the best scientific help available. Frequently the advice the " doctor " gives is to tell the planter to maintain on his plantation the conditions which make for healthy trees, together with some specific instruction on how to attack the particular pest or disease. The hand of the planter is being greatly strengthened by the knowledge which the various departments of agriculture are collecting : the departments in Trinidad, Ceylon, Java, Jamaica, Surinam and the Cameroons being pioneers in this direction.

(*a*) *Diseases due to Fungi.* The cause of these diseases was in the past a mystery to the planter, and their discovery has been the outcome of scientific research. A long account of these discoveries would make the danger from fungoid diseases appear greater than it is. The following are extracted from the

formidable list detailed by Van Hall, as being some of the most important—

DISEASES OF THE CACAO TREE

Name of Fungus.	*Name of Disease.*	*Part Attacked.*
Phytophthora Faberi	Canker	The stem
,, ,,	Chupon wilt	The leaves and twigs
,, ,,	Black rot	The pods
Diplodia cacaoicola	Die-back	The stem
Colletotrichum luxificum	Witch Broom	The leaves and twigs
,, ,,	,, ,,	The pods

The reader will notice that a single fungus, *Phytophthora Faberi*, causes stem canker, chupon wilt and black rot of the pods. This and *Diplodia cacaoicola* (Thyridaria tarda) are the most widely distributed of fungoid diseases. The Surinam witch-broom disease, though not widely distributed, is important on account of its disastrous effects. Happily it has not been seen save in Surinam, Demerara and Ecuador. It is called witch-broom because it induces extraordinary growths resembling brooms. The effects of its ravages in Surinam in the years about 1900, were shown by the diminution of the cacao crop ; in 1895 the amount of cacao exported was 4,450 tons and by 1904, it had fallen to 856 tons. The method of fighting the disease consists in removing the entire leaf-bearing crown of the tree, putting black tar on the wounds and then spraying with a three per cent solution of blue stone (copper sulphate) to destroy any spores. The success which has attended this treatment is reflected in the amount of cacao exported, which since 1913 has always been greater than 1,600 tons. In 1922 it was reported that this deadly disease had broken out in Ecuador, in the Balao district, and steps were immediately taken to control it, but whether the planters in Ecuador will

put up as good a fight as those in Surinam remains to be seen. That the more advanced planters are alive to the dangers they run, is illustrated by the approval of the Trinidad planters of the action of the Trinidad Board of Agriculture, which, in 1921, decided not to attempt the experiment of importing Ecuador (Guayaquil) cacao seeds for growing on a large scale. This experiment was interesting and might have proved profitable, but it was vetoed because of the risk that the imported beans might bring in new diseases.

Each disease requires its appropriate cultural treatment, and it is agreed that it is better to prevent their occurence by sound cultural methods, than to attempt their cure by such methods as spraying, pruning, etc. Spraying, on account of its cost, is not a common practice. Copper salts are the fungicides most frequently tried; thus for *Phytophthera faberi* the spray used is Bordeaux mixture. One gallon of this is required to spray each tree, and Mr. J. B. Rorer stated in 1911 that the labour and chemicals cost 10 dollars per 1,000 trees, or about one halfpenny per tree. The spraying must be repeated at intervals to obtain material improvement.

(*b*) *Pests.* Besides the diseases due to fungi, there is another large group due to insects. The following are examples of some of the common pests—

INSECT PESTS OF THE CACAO TREE

Name of Insect.	*Popular Name.*	*Part Attacked.*
Scapteriscus didactylus	Mole cricket	The root and stems of young plants
Steirastoma depressum, etc.	Borer beetles	The stem
Heliopeltis	Heliopeltis bugs	The twigs and pods
Physopus rubrocincta	Thrips	The leaves and pods

Although, no doubt, healthy trees are more able to withstand the attacks of insects, a number of these pests are always present even in countries were cultivation is carefully and scientifically carried out. Thus in Grenada in 1920, the following insects were recorded (in the *West Indian Bulletin*) as locally severe : Thrips (*Heliothrips rubrocinctus* Giard), the acrobat ant and termites ; while the presence of borer beetles, scale insects and mealy-bugs was also noted.

The planters have generally recognised these insects as enemies ; they have not, however, always known sufficient of their habits to determine the most satisfactory means of destroying them, and the researches carried out by the various departments of agriculture have been of material help in this direction.

Spraying is moderately successful in some cases ; thus to destroy the mole cricket a spray of Paris green is recommended, and thrips are killed by spraying with kerosine emulsion, or an emulsion of tar in caustic alkali. In Navel's book[1] on the principal enemies of cacao there are illustrations showing a small army of workers in San Thomé going into the plantation to fight the thrips with spraying machines. The heliopeltis bugs have an annoying indifference to sprays, and an attempt is made to reduce their numbers by catching them with the help of cobwebs or sticky substances. Sprays are useless for the borer beetle as the larvae (whitish translucent grubs about 1 in. long) spend their time cutting spiral tunnels underneath the bark. The usual method of dealing with this pest is to cut along the tunnel, destroy the larvae and tar the wound.

Before leaving the subject of pests, mention must be

[1] *Les Principaux Ennemis du Cacaoyer aux Iles de San Thomé et de Principe*, by H. C. Navel (1921).

made of rats and squirrels, which are responsible for losses of cacao as a result of their attacks on the pods. According to Van Hall, in San Thomé the loss caused by rats is estimated to be about one-fifth of the whole crop. Everyone thinks the squirrel a pretty little fellow, but he is a wanton waster of cacao. He has a playful way of gnawing a hole in the pod to get at the sweet pulp, and scattering the beans on the ground.

Books on Cacao Cultivation. The account of pests and diseases given above is very fragmentary, but the writer felt it was better to give a few brief notes than to ignore entirely so important a subject. This may be a suitable place to refer to the chief works on cacao cultivation, for the benefit of those readers who wish for a detailed study. The first modern work on the subject was *Cacao, How to Grow it*, by Sir Daniel Morris of Jamaica (1882). Since then a number of fine works have been written by Olivieri and Hart in Trinidad, by Wright in Ceylon, by W. H. Johnson in Nigeria, and by Van Hall in Java. *Cocoa* by C. J. J. Van Hall (1914) is, in the writer's opinion, the most up-to-date and comprehensive book on cacao cultivation.

CHAPTER V

HARVESTING AND PREPARATION FOR THE MARKET

Harvesting the Crop. The cacao tree usually bears at five years, may be considered mature at ten or twelve years, and continues to bear for thirty or forty years. This is only true if reasonable care is taken—the average life of a tree on the Gold Coast being much less.

At all seasons of the year a few pods are ripe for picking, but in most countries the principal harvest is either in the concluding months of the year or in the spring, thus the crop is heaviest from October to December in the Gold Coast, San Thomé and Bahia, and heaviest from March to May in Ecuador.

Having studied the cacao tree one becomes curious to know how the fruit will be picked. The trees are not stout enough to bear climbing, the pods do not fall when ripe, and to drag them off, as they do in Para, with a loop of rattan, injures the "cushions" from which they spring. While those on the trunk and lower branches are cut off with a sharp cutlass, a special picker is used to bring down those high in the branches. This consists of a knife on a long rod, and as wounds on the tree are dangerous to its health, considerable ingenuity has been exercised in making a knife which easily cuts off the pods, but which cannot, however carelessly handled, cut the bark of the tree. This curious method of picking the fruit, by means of a knife at the end of a long pole—the instrument is called a goulet, cocoa hook or podadera—is used all over the world, and is, as far as the author knows, peculiar to

cacao. In some places, e.g. the Gold Coast, one sometimes sees pruning scissors worked by a cord.

At first one wonders at the keen eye of the native pickers, which enables them to detect the subtle colour changes in the pods which denote ripeness, until one remembers how readily one can judge the ripeness of the various kinds of apples in which the colour changes are equally subtle.

The pods which fall to the ground are gathered by the women into baskets which, when full, they carry on their heads, and convey with a graceful leisurely motion to an appointed place in the plantation. Gradually a heap of the ripe fruit is made. It would be an advantage to leave these pods for a day or two before breaking them, but, in spite of watchmen, the danger of theft is too great to allow of this. The workers squat round the heap and cut the pods open. The old methods of striking one pod against another, or banging them on the ground or against a log of wood, are now happily rare. A sharp cut with the cutlass, a neat turn of the wrist and the top half of the pod is off. The beans are now scooped out, preferably with a wooden spatula, and heaped on banana leaves. Any defective beans or diseased pods are carefully kept separate from the rest.

The glistening, snow-white, or heliotrope-tinged mass of beans is wet and mucilaginous, and the fruity juice drips from it as it is conveyed in baskets on the backs of mules, or in small railway trucks as in San Thomé, to the fermenting house.

The Fermentation Process.[1] In the preparation of the raw cacao for the market, no process which it

[1] The major part of this section was originally published in the Handbook to the International Tropical Products Exhibition, 1921.

HARVESTING CACAO WITH PICKER AND CUTLASS

undergoes is more curious, or presents more interest to the enquiring mind, than that of fermentation. Although cacao is fermented in nearly all the countries in which it is produced, the exact object and original intention of this process remain obscure. While good methods of cacao fermentation have been practised for many years, the literature on the theory of the subject—already voluminous—contains no full explanation which is generally accepted. The practice of fermentation is comparatively simple, but the actions and reactions which occur are complex and difficult to describe in non-technical language.

One is quite used to the idea of the production of beer by the fermentation of an extract of malted barley, and of the production of wine by the fermentation of grape juice, but to some readers the association of cacao and fermentation will be new. Although the word "fermentation" is correctly used in connection with cacao to indicate a kind of spontaneous decomposition which produces alcohol, it may easily convey a wrong impression, for the small amount of alcohol produced is not the object or the end of the process, the alcoholic liquid being a by-product which is thrown away. In the production of beer, and in the leavening (rising) of bread the presence of yeast is essential; it is equally necessary in the case of cacao, but whereas with the two former the yeast is deliberately added, in the fermentation of cacao the yeast falls in accidentally from the air or comes from the outside of the cacao pods, or from the sides of the vessel in which the cacao has been put, and is distributed by a tiny fruit fly (*Drosophila melanogaster*). In this respect it resembles cider manufacture, the fermentation in which, until recently, had never been started by a selected and carefully cultivated yeast, but by the mixed "wild" yeasts of the air.

BREAKING THE PODS (TRINIDAD)

Yeast cells are nearly always present in the air, and are to be found in quantity in and near places where fermentation is carried on.

There is not yet agreement as to the particular yeast which is mainly responsible for cacao fermentation. Beer and wine yeasts have been found, as well as the wild yeasts occurring on the outside of fruits, etc. While Chittenden mentions *Saccharomyces cerevisiae*, Preyer names a special yeast, *Saccharomyces theobromae* ; Loew says it is *Saccharomyces ellipsoideus*, and Davies states that *Saccharomyces apiculatus* is found in the early stages of fermentation. Probably in different countries different yeasts occur. Possibly, in the near future, some enterprising firm will prepare for sale to the planters a suitable culture of yeast as a " starter," and save the planters 24 hours on every fermentation ; or Nicholls' scheme will be adopted and the local Department of Agriculture supply a culture. Some scientists would wish the planters not merely to add, but to maintain, a pure culture. They have yet to prove, however, that there are practical advantages in this refinement. One cannot obtain a perfectly pure culture on the fermenting beans unless the beans are first sterilised to destroy adventitious organisms, and sterilisation is more than likely to destroy the wonderful substance called an oxidase, which, as will be shown later, plays an important part in the changes in the interior of the beans.

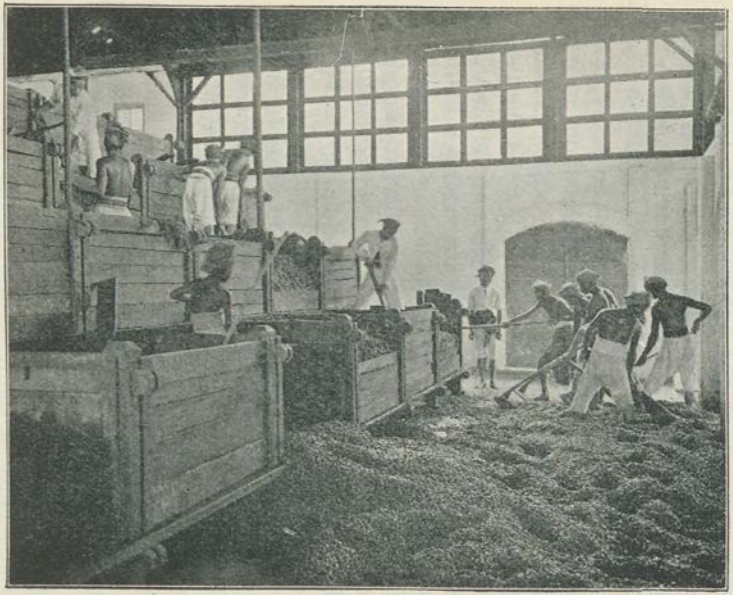
Fermentation of the Pulp on the Outside of the Bean. If the planter were to pack the pulp-covered beans straight from the pod in bags and send them wet and juicy to market, they would rapidly decompose and become mouldy. He must make them stable and prevent them " going bad," and the first method he would naturally try, to obtain this condition, would be to dry

the beans. He would then discover that dried pulp has an unfortunate tendency to absorb moisture from the air and become soft and sticky, in which condition it easily becomes mouldy. It happens, however, that when cacao beans are put in a heap and kept warm they ferment, whether one desires it or not, and it was probably quite accidentally discovered that after fermentation the pulp is diminished in amount and changed in character, and consequently the beans are more rapidly dried, and more easily arrive at a stable state. At the same time it must be admitted that by simple drying in the sun, as is done in a few countries where the more primitive methods exist, a moderately stable product can be produced, but this dried and unfermented cacao cannot be sold at so high a price as the fermented article from the same country, the majority of cocoa and chocolate manufacturers preferring fermented to unfermented cacao. In some countries the " wet " cacao, i.e. the pulp-covered beans fresh from the pod, is simply put in heaps ; in others it is put in boxes fitted with more or less simple arrangements for allowing the liquid which drains from the pulp to run away. The mucilaginous envelope round the beans gradually loses its structure and its glutinous nature, and becomes, when the fermentation is completed, a very thin coat of paste which readily dries on to the outer shell of the bean.

In order to obtain a good fermentation, the planter finds that it is advisable to retain the heat as far as possible, to allow the liquid produced from the pulp to drain away, and to let air have access to the beans. Any arrangement for fermenting cacao which satisfies these conditions will give a good product. Cleanliness is essential, as otherwise unusual fermentations and decompositions may take place with the production of

moulds and mildews. It will be realised from this that a hole in the ground is not a satisfactory fermentary and, happily, this primitive method of making a receptacle is now little practised even on the Gold Coast. A great variety of vessels is used, but boxes are the most popular. The planter calls them "sweating boxes," an expression which is descriptive if not beautiful. They are made of slate, stone, cement, or more usually of some hard native wood. They vary greatly in dimensions, a convenient size being a four foot cube. The floors of the wooden boxes are either perforated or made of slats fixed about ¼ in. apart. This allows the juice to drain away. The same result is obtained in vats by having a sloping floor. The boxes are raised about 1 ft. from the floor on blocks; this allows the air to circulate freely beneath the boxes, and the juice to drop into the channels and run out of the building. The beans, which have been freshly scooped out of the pods, are put in the boxes to a depth of 2 ft. to 3 ft. They are levelled down and covered with one or two layers of freshly cut plantain or banana leaves. This covering prevents the heat produced by fermentation from escaping, and the rising temperature causes an acceleration of the speed of fermentation. In a box containing 5 cwts. to 10 cwts. of Forastero cacao, the temperature will rise in 24 hours to 89° F., 48 hours to 98° F., and 72 hours to 115° F. After that period the temperature is maintained and preferably should not rise above 120° F.

Of fermentation, as we commonly think of it, accompanied by a vigorous evolution of bubbles of carbon-dioxide, one sees little, although on the top of the mass of beans a few bubbles can be found here and there. One would naturally expect if a large heap or boxful of beans were allowed to remain undisturbed,



FERMENTATION OF CACAO (JAVA)

(Reproduced from Van Hall's *Cocoa*, by permission of Messrs. Macmillan & Co.)

the accidental presence of yeast cells would cause a brisk fermentation in isolated patches and not evenly throughout the mass. That this actually happens can be easily tested by plunging in the hand, for the fermentation causes an increase in temperature, and the fermenting beans will feel quite hot while the others are cool. In order that all the cacao beans may be equally fermented, the planter usually mixes them by turning the heap, or transferring the cacao from one box to another, once a day. Turning the beans in the hot atmosphere of the fermentary is a laborious process, and planters are still waiting for some ingenious person to invent a cheap fermentary which enables the beans to be easily mixed. In the illustration of the fermentation of cacao in Java the boxes are arranged in steps, an arrangement which reduces the labour of turning.

Different kinds of cacao require different periods of fermentation, the delicate, fine and thin-skinned kind (Criollo) requiring only two days, while seven days is often necessary for the more hardy and harsher varieties (Forastero and Calabacillo). The fermentation of the pulp, which contains sugars, proceeds in somewhat the same way as the fermentation of grape or apple juice when it is freely exposed to the air : at first alcohol is produced, and later the pulp and juice develop acid and become sour. The production of acid is due to the presence of the well-known bacteria which produce vinegar, and their distribution is said to be effected by a minute fruit fly (*Drosophilia*).

In the vicinity of the fermenting beans one perceives on the first day a faint fruity odour, which in two or three days becomes stronger and more reminiscent of alcoholic beverages, and toward the end of the fermentation the odour begins to resemble that of sour cider. During the same period one sees the pulp

diminish in quantity and change from snow-white to dirty brown. A planter judges entirely from such external signs when the cacao is sufficiently fermented, although the extraordinary changes which occur in the bean itself are of greater importance to the cocoa manufacturer.

Changes Due to Fermentation Inside the Bean. The actions which take place in the fruity pulp are similar to those which occur generally in fruit juices or liquids containing fermentable sugars, but the reactions in the interior of the bean are more rare and peculiar. The acidulous liquid penetrates and permeates the bean changing the violet of the Forastero beans to a red, and spreading the colour more or less evenly throughout the bean. Other and more subtle effects are produced. Of these, only the most important one has received much consideration ; this is a change of colour due to the development of a brown substance in the bean. Whilst this phenomenon is not so well known as that due to yeast fermentation, it is not difficult to cite familiar examples. Everyone has observed the browning of apples and pears when they are bruised or cut and left exposed to the air. Many will have noted the same colour change in peaches, grapes, acorns, horse-chestnuts and broad-beans. Those who know the tropics will have noted the development of a brown colour in kola nuts and in tea and tobacco leaves. The change in colour in cacao beans, as probably in all the cases cited above, is due to the action of the oxygen of the air on a particular constituent which resembles a tannin. The oxidation of the tannin to a brown substance is rendered possible by the presence in the bean of minute quantities of an oxidase, which is a substance of unknown constitution and composition formed in living matter and capable of starting oxidation. The

oxidase, so to speak, lubricates the machinery of oxidation.

At the end of the fermentation everything inside the skin of the cacao bean, originally white or purple, begins to be tinged with brown. The colour change continues during the drying, and by the time the bean is quite dry, if it was originally white or pink, it is now cinnamon brown, and if it was originally purple, this colour is darkened by the presence of more or less brown. This colour change may be likened to that occurring in sliced apples when they are dried in the sun, with this difference, that the cacao bean is neither skinned nor cut. Notwithstanding this, the oxygen penetrates the bean, which gradually becomes browned throughout. This is one of the things the wise planter strives after, to produce a bean with a beautiful brown interior. It has been generally noted that accompanying this change in the colour of the bean is a change of taste, the original bitterness, or rather astringency (due to the tannins) being materially reduced. This reduction of astringency is regarded by manufacturers of cocoa and chocolate as an important and advantageous action. It requires an experienced palate to appreciate it. On the other hand, the difference in *colour* between the fermented and unfermented cacao is obvious to everyone ; thus for example, an unfermented Accra bean when dried is the colour of slate, and when fermented is brownish-purple.

Of the various other effects of fermentation, the loosening of the shell, the opening up of the bean and the development of the acid odour deserve mention. The bean would seem to have a taste for the acidulous beverage which the pulp forms during fermentation, for the bean sucks a small fraction of it in and becomes as round as an egg, the skin being stretched to the

utmost and freed in places from the cotyledons. On drying, the skin wrinkles a little and the inside of the bean contracts and shows interstices. This is another character the wise planter hopes to see on breaking the beans—an open interior.

During the drying which follows the fermentation the alcohol is lost, while traces of pleasant-smelling esters and more than traces of acetic acid are retained. These give to the fermented beans of commerce their characteristic vinegary odour.

Various interesting suggestions for improving the time-honoured methods of fermentation, or of substituting totally different methods to attain the same end, have been made, but not one of these has found favour with the planter or attained commercial importance. Those readers who wish to know more of cacao fermentation should study *The Fermentation of Cacao*, edited by H. Hamel Smith.

The Cacao Juice or Sweatings. Chemists, by their researches, have given value to so many by-products that it seems reasonable to hope that cacao sweatings will one day repay the cost of collection. At best the cacao juice is carried by drains to a stream, at worst it is allowed to saturate the ground in the neighbourhood of the fermentary. The quantity of sweatings obtained varies with the amount lost between plantation and fermentary, the wetness of the season, etc., but it may be taken to be at least 30 gallons for each ton of dry cacao beans produced. Thus on an estate of 200 acres, yielding say 4 cwts. of cacao per acre, about 1,200 gallons could be collected from the fermentary in one year. Like all fruit juices it is an unstable liquid, rapidly developing alcohol and becoming sour ; hence it varies in composition according to the length of time it has been standing. Its specific gravity is about

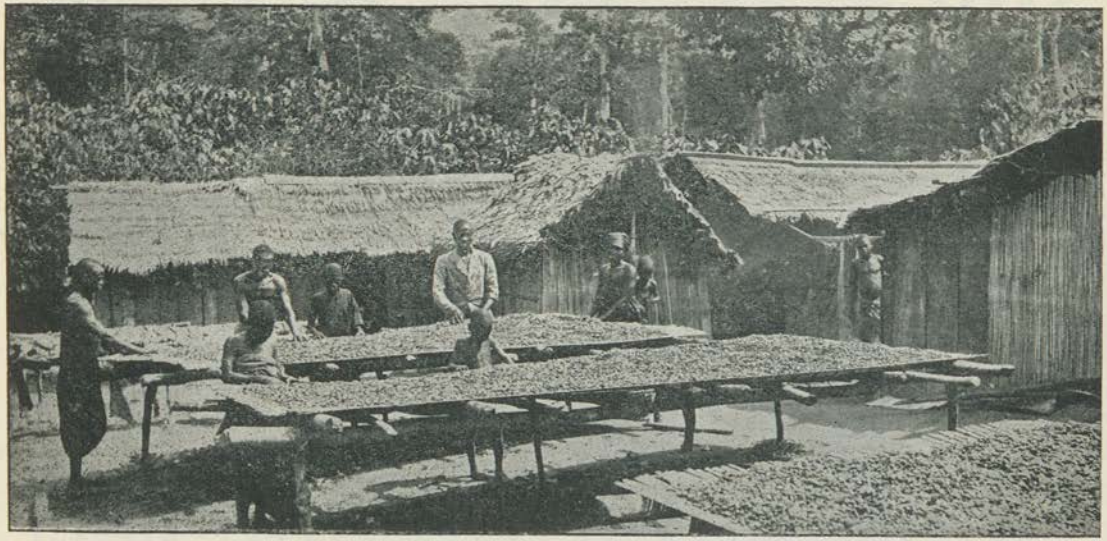
1.060 and it contains about 14·5 per cent of solid substances in solution. The following is the average composition of sweatings from Trinidad cacao. The figures were determined in Messrs. Cadbury's Research Laboratory—

CACAO SWEATINGS

	Per cent
Water	85·0
Cane sugar	trace
Other sugars (reducing sugars)	10·0
Jelly (mucilage and pectin)	2·0
Acids (acetic, etc.)	1·0
Salts (potash, calcium, and magnesium carbonate)	0·5
Albuminoids (N. = 0·05%), tannins, alcohol, etc.	1·5
	100·0

Besides the above there are traces (·03 per cent) of theobromine. Its composition shows that, suitably treated, it might yield an alcoholic beverage, a vinegar or a jelly. That none of these are being produced on a commercial scale is partly due to its unstable character which renders it difficult to maintain a standard article, and partly because the quantity produced per day by each fermentary is small. These objections would be diminished if, by co-operation among the planters in one district, a central factory could be established.

Drying. The processes of fermenting and drying are referred to collectively as curing. The bean contains about one-third (33 per cent) of its weight of water, and to obtain a stable product this must be reduced to 5 or 6 per cent. The great bulk of the cacao produced is dried by spreading it in a thin layer and turning it over and over in the sun for at least three days. In Ecuador this operation is performed on matting, made of split bamboos, which lies on a flat stretch of sandy soil.



DRYING CACAO ON THE GOLD COAST

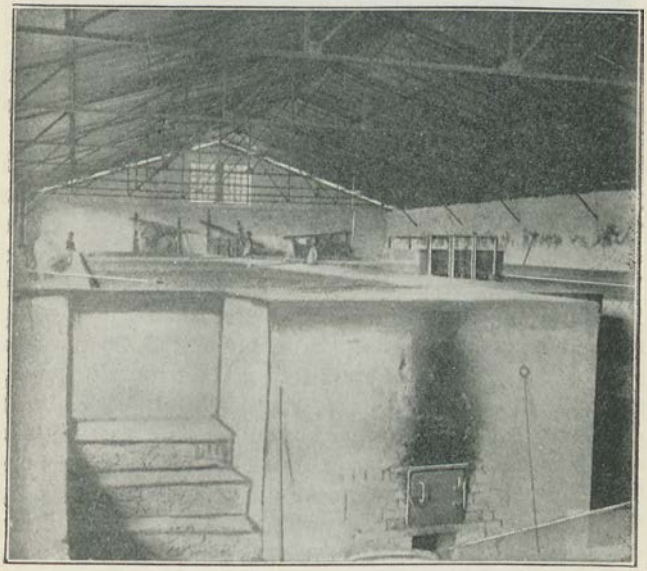
These enclosed drying grounds are called *barbecues*[1] or tendales. On the Gold Coast the merchants and others dry cacao on cement floors, and it has been suggested that a drying floor of Portland cement, made impervious with "pudlo" and coloured black, would be ideal. In the West Indies large wooden trays or platforms are used, called *boucans.*[1] In order to shelter the beans when rain comes on, and to shield them from the excessive heat of the mid-day sun, the platforms are fitted with sliding roofs, or the trays are arranged to run on rollers one under another. The area required to dry the product from each 1,000 trees (about 15 cwts. per annum) is at least 80 sq. ft.

The climate in some districts is such that the cacao cannot all be dried by exposure to air and sun, and unless the planter can assist the drying by artificial means, he is faced with severe losses due to his cacao going mouldy. In some cases a fire can be lighted to heat the platforms, either by hot air or hot-water pipes, when drying is proceeding too slowly. In San Thomé there are covered-in drying platforms which are always heated by artificial means. In Grenada the author saw a room fitted with trays on which, by means of air warmed by hot pipes, the cacao was dried in 36 hours. Various enterprising engineering firms sell drying machines and these are being used in increasing numbers by the planters.

From the point of view of quality, sun-drying is always to be preferred because the changes due to

[1] The meaning of the two words *barbecue* and *boucan* are closely related. Barbecue is Spanish in origin, and meant a framework on which meat was smoked or dried. Boucan is Carib for a similar thing. The French piratical adventurers, who so remorselessly plundered the Spanish in the West Indies during the seventeenth century, dried or smoked their meat on a boucan, and hence were called buccaneers.

oxidation, which occur during fermentation, are continued under natural conditions during drying. Some planters encourage these changes to continue during the night by heaping the cacao on the drying platform, and sufficient oxidation occurs to cause a rise in temperature.



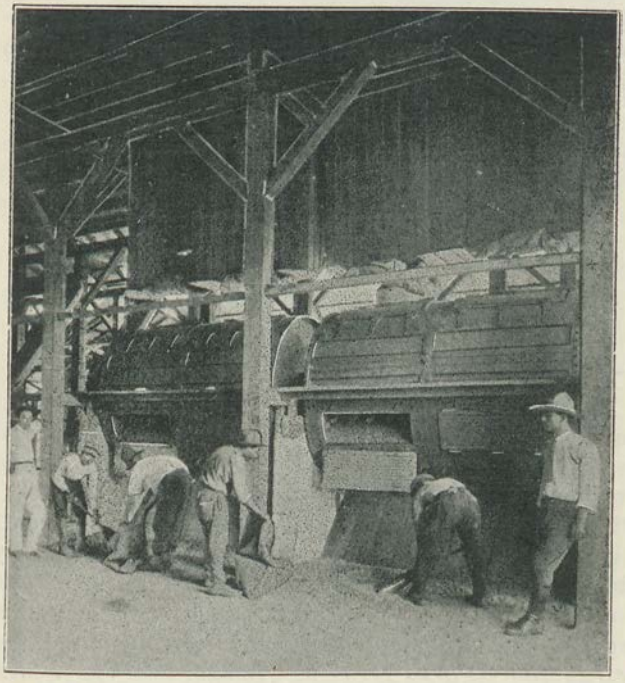
DRYING CACAO BY ARTIFICIAL HEAT (SAN THOMÉ)
(Reproduced from *Les Principaux Ennemis du Cacaoyer*, by permission of the author, H. C. Navel)

It is commonly stated that oxidases are destroyed when heated to 60-65° C. (140-149° F.). Fickendey has shown that the oxidase which occurs in cacao beans is destroyed between 70-75° C. (158-167° F.), so that it is clear that in the early stages of drying the temperature of the beans should never rise above this. Too

often, in artificial drying, quality is sacrificed to a spurious efficiency. There is always a tendency to hasten the process and hence either high temperatures are used which destroy the oxidase, or the drying is done in vacuo and there is no oxygen to complete the oxidation. Sometimes worse errors are committed and the beans become very brittle and even slightly burned, or they may become tainted with the odour of the smoke which comes from the wood fires used for heating. The beans are easily spoiled, and with artificial drying skill is needed to avoid getting a dark uneven product.

So far in our observations on the cultivation and preparation of cacao, there have been few instances where the planter has received assistance from the engineer, but in the case of drying it is the engineer who has pointed out that sun-drying is costly, tedious, imperfect, and uncertain, and a large number of engineering firms have given attention to this subject. There are a great variety of machines on the market for the planter to choose from, and if he does not wish for ever to be at the mercy of the weather, he will be wise to ascertain the costs and see whether they would pay on his particular plantation. The simplest method of drying is by hot air and for small plantations the simple tray-drier, "Mayfarth's Patent," or the well-known Hamel-Smith rotary dryer (D. Bridge & Co.) are the most suitable. For larger plantations which can afford a steam-engine, the Gordon rotary drying machine or the Guardiola (McKinnon & Co.) is probably more suitable. Emil Passburg and George Scott & Co. make excellent vacuum drying machines, but the author has not had the opportunity of judging the characteristics of the cacao dried by this method. The illustration of the Gordon rotary drying machine shows part of an installation in one building containing four machines, each

capable of taking a charge of 10,000 lbs. of wet cacao. It is driven by water-power and the air for the drying machines is heated by steam, one boiler supplying steam



ROTARY DRYING MACHINE (RIO HONDO, COSTA RICA)
(Made by John Gordon & Co., New Broad Street, London)

to the four machines. The cacao is fermented in an outside building, from whence it is lifted by an elevator to a conveyor which carries the wet cacao to a line of bins. The bins will be seen over the dryers, and the cacao is fed from them into the dryers.

Loss on Fermentation and Drying. This is a matter of great importance to the planter who naturally wishes to obtain the highest possible yield of sound cacao.

The following figures, compiled from a paper by J. de Verteuil (in the *Proceedings of the Trinidad Agricultural Society* for August, 1922) will repay study from the economic standpoint—

LOSS ON FERMENTATION AND DRYING

Season.	*Fermented Days.*	*Per cent Loss.*	*Dried Days.*	*Per cent Loss.*	*Total Loss.*
Dry	$1\frac{1}{2}$	6·3	9	50·7	57·0
Wet		7·2		50·1	57·3
Dry	$3\frac{1}{2}$	8·9	7	46·1	55·0
Wet		10·9		46·8	57·7
Dry	$5\frac{1}{2}$	13·7	6	41·3	55·0
Wet		16·1		41·4	57·5

It will be noted that the loss is higher in the wet season, and that cacao fermented for the shorter period requires a longer period of drying, and as drying requires large areas it is generally the " bottle-neck " in cacao production on estates. Had these experiments been carried a little further they might have definitely determined the most profitable period of fermentation for Trinidad cacao. The usual period of fermentation in Trinidad is about 8 days, and then the total loss varies from 62 to 67 per cent. Similar losses have been recorded by Hudson in St. Lucia, and by Van Hall in Surinam. The average yield from 100 parts of Forastero cacao, from the pod, may be taken as 36 parts of cacao beans of commerce. Hudson has shown that if the beans are not fermented at all, but merely dried, that the average yield is 39 per cent, that is 3 per cent by weight more than in the case of fully fermented cacao. In spite of this higher yield, fermentation is

profitable because its use does not increase the total cost of production (one is compensated for the trouble of fermenting by the shorter period of drying) and the fermented cacao always fetches a higher price.

Improving the Appearance of the Bean ; Washing, Claying, etc. In different countries various operations are carried out chiefly with a view to pleasing the eye of the buyer. Other advantages are claimed for these processes, but the claims have not, in the author's opinion, been substantiated. These processes consist of washing, claying, dancing and polishing.

Washing is practised in Ceylon and Java. The beans are well washed before drying to remove the last traces of pulp. The planter suffers a loss on the weight of his cacao of about 6 per cent, and obtains beans, the shells of which have an even red-brown colour, which is very attractive. Some of the loss must occur from the inner part of the bean, for the actual difference in shell percentage between washed and unwashed is about 3 to 4 per cent, and as a result buyers will only give 3 or 4 per cent more for washed cacao. It is clear, therefore, that washing is unprofitable to the planter. It is also unprofitable to the manufacturer as washed cacao does not stand handling or storage as well as unwashed. The presence of a little pulp toughens the shell and prevents it breaking. On washed beans the shell is almost as thin and brittle as a dry leaf, and on handling easily breaks, so that some bags contain much debris on arrival at the factory. A further disadvantage is that this breakage allows insects or mould to gain entry to the beans.

In one area where fine cacao is produced, Venezuela, the curious process of claying is indulged in. It was until recently the custom in Trinidad also. A ferruginous clay, which readily dries to a rich red powder,

is sprinkled on the beans before they are quite dry. On Venezuelan beans the earthy coating is thick and the added earth is from 2 to 3 per cent of the weight of the bean. In Trinidad the natives used literally to dance on the clayed beans, whereby the amount of clay was reduced to about 1 per cent, which adhered tightly to the shell, and the beans assumed an even, smooth, and red appearance. Claying is said to assist the planter in drying his cacao, but from the chocolate manufacturers' point of view it has no advantage. The presence of clay was once the hall-mark of certain plantations producing a fine cacao. Now that this significance is lost, the process of claying has nothing to recommend it. It gives the cacao a uniform appearance which is pleasing to look at, but there is no evidence that it produces any beneficial effects. The clay is said to act as a preservative ; it does not, however, under severe conditions, prevent the cacao going mouldy. It may be of some assistance in preventing the cacao becoming grubby, but cacao which is not clayed (e.g. Grenada) is free from grubs. There is no evidence that it preserves the aroma. To the buyer it has two objectionable features, one is, that by claying inferior cacao can be given the external appearance of good cacao. Thus, taking an extreme case, black cacao from diseased pods, when well clayed, may sometimes be mixed with good cacao. The second objection is that the buyer pays for cacao and obtains clay, the amount on good class cacaos varying from 0·5 to 2·0 per cent. In 1923, at the request of the planters, a law was introduced in Trinidad making the use of clay or kindred substances illegal. In spite of these facts, such is the effect of tradition, that some buyers still prefer clayed Venezuelan cacao and pay extra for it.

A smooth appearance adds nothing to the intrinsic

value of the beans, but it suggests careful preparation and hence predisposes the buyer to a favourable opinion. A slight gloss can be obtained by " dancing," but on large estates it is more efficiently accomplished by a Barnard's Patent Cacao Polisher or by the machine invented by Mr. Malins-Smith of Grenada.

Whilst on the drying platform the beans are picked over and it is usual to get a wastage of from 4 to 6 per cent which consists of broken fragments of beans and dust. This material is usually sold locally. On a few estates the cacao is graded by sieving.

Before passing on to consider how the cacao is marketed, the author proposes to discuss the production of cacao on the Gold Coast. This is such a momentous matter that it will be given a chapter to itself.

CHAPTER VI

THE GOLD COAST—THE MOST IMPORTANT CACAO-PRODUCING COUNTRY IN THE EMPIRE AND THE WORLD

THE dictum that there is nothing new under the sun must be set aside, or the Gold Coast cacao industry cited as an exception. There is surely no record in the history of the world of such rapid development in a native-owned industry. It was a cultivation, be it noted, with which the natives were totally unfamiliar. In 1878 there was not a single cacao tree on the Gold Coast; now there must be 100,000,000. A blacksmith, by name Tette Kwesi, brought the first pods to the Gold Coast in 1879. Optimistic experimenter as he must have been, he could never have imagined when he brought those cacao pods from Fernando Po and planted a few seeds in his garden patch at Mampong, that the planting of cacao on the Gold Coast would spread almost with the rapidity of a bush fire. Yet four years later, in addition to pleasure at the result of his foresight, he may have felt prophetic tremors when he sold his harvest to other natives at £1 a pod.

In 1891 the Gold Coast exported 80 lbs. of cacao; in 1921 the magnificent quantity of 298,356,800 lbs. How did this great development happen without European management and without European capital? It is true that in the early days Sir William Griffith, the then Governor, encouraged the industry, and that he was ably helped by the missionaries of the "Basel Mission." It is true that the climate and soil were

" just right " and that a fatherly Agricultural Department has given many seeds and much instruction to the natives. It may be that the imitative natives noted the pioneer efforts in cacao planting of a handful of Europeans, of which those of Mr. W. F. Hutchison in 1885 and Mr. J. H. Batty in 1888 were the earliest. If we allow these advantages, it still remains a modern miracle—a lesson both to statesmen and economists (the reader will note the distinction). " Cacao," says Mr. Tudhope, the Director of Agriculture, " has indeed had a great civilising influence." The natives were wanderers, in part warlike—notably that tribe of warriors, the Ashantis—practising a very primitive form of agriculture, clearing the bush, growing foodstuffs, and then passing on to clear fresh bush and make gardens anew. They settled down to cacao-growing, became a small nation of peasant proprietors, and after thirty years' effort have, as far as quantity of output is concerned, outpaced all other countries and left them breathing hard in the rear. They promise to produce half the cacao in the world. Indeed it is said they do produce more than this quantity now, but the cost of carrying it to the port is such that only a portion of the crop is exported. This is a difficulty with which they have always had to contend—they have had to get their cacao to the port entirely without the assistance of pack animals, for these cannot live because of the deadly tsetse fly, and a large part of the energy of the people was, and is, absorbed in porterage. This misdirection of energy has been greatly reduced by the enterprise of the Government in building railways and making a network of roads suitable for motor traffic.

The quantity of the cacao produced is enormous, but what of the quality? It is true that the bean of

the Amelonado variety of Forastero, as grown on the Gold Coast, lacks any special character, but the tree has the advantage of being hardy and capable of yielding heavy crops, as much as 5 lbs. a tree, given sound cultivation. The cacao of the Gold Coast had, at one time, as bad a name for quality as the climate had for unhealthiness. Neither cacao nor climate deserves this to-day. It would be unreasonable to expect that in a single generation the natives should learn and practise the whole art of cacao production. With the encouragement and help of the Agricultural Department great improvements have been made. Fermenting and drying now receive considerable attention, and the practice of fermenting for *six* days in heaps, baskets, or " odum " boxes continues to increase. Not only have there been improvements in the preparation of the beans, but more recently there have been signs that care is being taken in the cultivation of the tree. Knives are now generally used for harvesting the pods, and attempts are made in some places to keep the plantations clean. Some of the intelligent natives see the folly of crowded seed beds and crowded plantations, and realise that the planting of trees 6 ft. to 10 ft. apart, as in the past, was an error.

People sometimes talk as though the whole output of the Gold Coast was very inferior stuff ; this is absurd. Although the care in preparation leaves much to be desired, there are probably at least 50,000 tons of good, sound, fermented cacao produced every year. This is more than any other country can boast of. Even if we take the bulk, it is far better fermented than the cacao of Para, or, amazing as it sounds, than the cacao of Ecuador.

It is partly on account of its lack of uniformity, and its mixed and uncertain character, that the cacao

FORESHORE AT ACCRA, WITH BAGS OF CACAO READY FOR SHIPMENT

fetches a low price. Happily, it is produced more cheaply than any other cacao. As Sir Hugh Clifford has expressed it, "there are no charges to pay on account of costly European supervision; no directors' fees and office expenses on the Gold Coast or in London; no dividends to pay upon borrowed capital." In spite of the increasing cost of labour, the Gold Coast remains a very dangerous competitor to the other cacao-growing countries.

The Gold Coast keeps easily first in the race—is there any obstacle in its path which may trip it and send it headlong? It may be remarked that an industry so rapidly built up naturally lacks the solid security of those that have been established for a century or more. Wherein lies its insecurity? Chiefly in this—that, owing to the excessive clearing of the forests and the lack of anything approaching scientific cultivation, the cacao tree may cease to thrive.

The effect of forests on climate is well known. Over a century ago Von Humboldt expressed the opinion that the cacao of Caracas (Venezuela) was no longer so good as it was originally, because the country had become denuded of trees and hence was dryer and more exposed to winds. The effect of "shifting cultivation" with its reckless felling of forests in a country like the Gold Coast, which has already probably the lowest rainfall of all cacao-producing countries, will no doubt be disastrous if persisted in. It is to be hoped that the Agricultural Department will be listened to and their advice followed, for it is contended by experts that, unless 25 per cent of the land remains covered with forest, the climate will become too dry for cacao.

The absolute dependence of the Gold Coast on cacao makes the further question, how the plantations will fare in the battle with disease and pest, one of great

importance. That in the past the natives have generally taken no care in seed selection and have ignored the most elementary principles of agriculture, such as drainage and keeping the plantations clean, is well known. One is justified in the fear that, just as in the Middle Ages, in spite of the wise teaching of the few, because of ignorance and insanitary conditions, the whole population of a city was sometimes wiped out by a plague, so the millions of cacao trees on the Gold Coast may suffer a slower, but equally sure, destruction. So far, however, because fresh areas are continually coming into bearing, the output increases by leaps and bounds. On the one hand we have the experts trembling and crying, " Wolf ! " ; on the other the mass of illiterate natives lacking in foresight and blind to a thousand dangers. The natives appear to regard pests and diseases as being caused by evil spirits, and, as charms cannot be obtained to remove the evil, they are resigned to it, and abandon the plantations so infected. Although a few plantations have recovered when thus abandoned and neglected, there are obviously the very gravest risks that this procedure will spread infection. There are optimists who put their faith in nature, believing it has a bias in favour of healthy trees ; and if nature fails, they trust that the breaks, due to forest growth between the areas planted, will prevent infection spreading. Neither faith nor benevolent feelings will prevent the increase of disease if applied knowledge is lacking. Ask the planters in countries where cacao has been grown for a century or more. Plantations, as they know well, are not saved by good intentions.

The average annual value of the cacao crop in the Gold Coast for the five years 1918—1922 was six million sterling. It may be remembered that the coffee crop in

Ceylon once had an annual value of half that sum; in a few years the crop was reduced by 99 per cent, and the industry ruined, owing to the coffee leaf disease.

Before 1910 one heard little of diseases and pests on the Coast; to-day the list of those that are troublesome is a long one. Of diseases due to microscopic fungi, "Brown pod" or "Black pod" (*Phytophthora*) is the most widespread. Thread blight (*Marasmius scandens*, Massee) and "Die back" (*Diplodia cacaoicola*) are also known. It is curious to read that a kind of Mistletoe (*Loranthus*) causes serious trouble. Of insect enemies, the "Stem Sappers" (*Sahlbergella singularis*, Hagl., and *S. Theobroma*, Distant) are well known for their destructive effects. The natives call them "Sankonuabe," which signifies: give up cacao and "go back and pluck palm nuts." The "Cocoa mosquito" (*Helopeltis Bergrothi*) is also a serious pest. The presence of various borers, the Glenea borer beetle and more rarely *Armatosterua baquetiana* and *Characoma stictigrapta*, Hamps., have also been observed, as well as Thrips and the Megalopygid moth (*Eulophonotus myrmeleon*). The list is formidable, but one knows that everything that can be done in an advisory capacity is being done by the energetic Department of Agriculture and its provincial staff. There is also the Gold Coast Agricultural and Commercial Society, which was formed in 1921, and which issues a very lively journal. The publications of both the Department and the Society show how the intelligent and educated representatives of all classes are alive to the dangers, and it is generally felt that, given sufficient encouragement by prices graduated according to quality, and by the merchants' refusal of any cacao of inferior grade, the standard of cultivation and preparation for the market will continue to rise. The European

CARRIERS CONVEYING BAGS OF CACAO TO SURF BOATS, ACCRA

(Reproduced by permission of the Editor of *West Africa*

merchants have played a valuable part in the past in the development of this industry and are a determining factor in its standing in the future. It is to be feared that not many European and American buyers appreciate their responsibilities in this direction. However, as Sir Hugh Clifford said in 1919, " One or two firms it is true, of which Messrs. Cadbury Bros. and Messrs. Pickering & Berthoud are the principal examples, have consistently refused to buy cacao which is not of approved quality, and the adoption of this policy has been productive of good results."

The natural flow of economic conditions is generally preferable to Government intervention, but, if the majority of the buyers do not adopt the above principles, it is unlikely that the quality of the cacao will automatically improve, and it may be found advisable, as a representative committee has recommended, for the Government to inspect the cacao at the port of shipment.

For a delightful chat about the industry on the Gold Coast one should read Miss E. A. Browne's book on *Cocoa*. Those who require more complete scientific information will find all they desire in the Reports of the Department of Agriculture and the authoritative *Enquiry into the Gold Coast Cocoa Industry*, 1918-1919, by Mr. W. S. D. Tudhope. Its problems are felicitously discussed in Mr. E. J. Organ's paper on *The Gold Coast Cocoa Industry and its Recent Developments*, which was read at the International Tropical Exhibition, 1921.

CHAPTER VII

COLLECTION, TRANSPORT, AND MARKETING OF CACAO

Bagging. The planter weighs his cacao into good strong jute bags. This is now the universal method of packing: the "Socunusco" cacao from Guatemala used to be exported in buffalo-hide bags and cacao from Madagascar in cow-hide packages stitched with leather thongs, but these belong to the picturesque past. A suitable sack to hold $1\frac{1}{4}$ cwts. should be made of sufficiently stout material to weigh at least 3 lbs., as it has to bear rough handling. The bags are carefully sewn up and marked in a characteristic way which is generally indicative of the estate on which the cacao was grown.

One frequently sees in cacao statistics the amounts indicated as so many bags. This cannot signify a definite quantity unless the country of origin is known, as, unfortunately, the recognised weight varies from country to country. The following examples illustrate this—

APPROXIMATE WEIGHT OF BAGS OF CACAO

Country of Origin.	*Net Weight of Cacao in Bag.*
	lbs.
Trinidad	196
Grenada	196
Jamaica	196
San Domingo	196
Guayaquil	175
Surinam	168
San Thomé	140
Gold Coast	140
Brazil	140
Venezuela	112
Ceylon	112

Transport to the Shore. The conveying of cacao to the point of embarkation is a subject on which it is difficult to generalise, as will be seen by a brief consideration of the methods of the five principal producing countries, the Gold Coast, Brazil, Ecuador, Trinidad and San Thomé. In the more remote parts of the Gold Coast the primitive method of head loads is still used to convey the cacao to road or rail. The usual head load is 60 lbs., but the native easily carries a 140-lb. bag of cacao for many miles. The noisy and picturesque use of the palm-oil barrel for the transport of larger quantities, once so common, is now rapidly becoming a curiosity; occasionally, however, one may still see half a ton of cacao in a huge barrel being trundled by two or three men down the ways to the coast. In the last few years head-porterage and barrel-rolling have been largely displaced on the Gold Coast by the use of motor vehicles, which in 1922 numbered 2,000 in Coomassie and 4,000 in Accra.

In Brazil the problem of transport is complicated by the liability of the vast region round the Amazon to inundation when this mighty river is in flood, and much of the cacao is brought down the water-ways in canoes. In Ecuador, barges, motor launches and rafts are used for the same purpose. "One may see 60 rafts fastened together, three abreast, with a family hut built upon the central point and a couple of men poling down-stream, while a few others attend to the cacao beans drying on waterproof sheets in the sun."[1] In Trinidad one sees the more commonplace use of mules and vehicles for conveying the cacao to the nearest railway station. San Thomé is advanced in the matter of transport, light railways running right into the plantations. There are few countries which would not profit by the

[1] *The Confectioners' Union*, p. 2803 (1920).

THE OLD METHOD OF TRANSPORT BY HEAD LOADS, GOLD COAST

TRUNDLING BARRELS OF CACAO DOWN TO ACCRA

adoption of methods similar to those used in San Thomé.

Shipping Cacao. Preferably cacao should not be stored in the tropics but shipped as rapidly as possible. In a moist hot climate it is liable to become mouldy, especially if imperfectly fermented, and also to be attacked by such cosmopolitan pests of stored foodstuffs as the Mediterranean Flour Moth (*Ephestia kühniella*) and certain tiny beetles (*Araeocerus fasciculatus*, etc.).[1]

As affecting the quality of the cacao, the method of conveying it from the port to the ocean liner is more important than the transporting to the shore, because there is greater risk of getting the cacao wet. Good harbours in the tropics are few, and the cacao generally has to be taken out in lighters to the ocean liner which stands off from the shore. The Gold Coast has no deep sea harbour but there is a costly scheme in hand for building one at Takoradi. This harbour will be of special advantage to the Gold Coast because of the heavy surf which beats upon the shore, and because everything, including cacao, is taken out to the Elder Dempster steamships in surf boats. It is regrettable that carefully dried cacao should run the risk of being spoiled by the surf which at times rushes over the boats.

The leading shipping ports of the world for cacao are Accra and Secondee, both on the Gold Coast. The recent and rising importance of Secondee, which now ships 40 per cent of the Gold Coast cacao, is largely due to the increased output of Ashanti, which is now responsible for one-third of the total production of

[1] For full particulars, see a paper on "Insect Pests in the Cacao Store," by A. W. Knapp, in the *Bulletin of the Imperial Institute*, p. 189 (1921).

Gold Coast cacao. The principal shipping port for Brazil is Bahia, which exports nearly ten times the quantity shipped from the other leading port, Para. About 95 per cent of the cacao of Ecuador is exported from Guayaquil. Port-of-Spain is the chief port for Trinidad, Lagos for Nigeria, San Thomé for San Thomé, and Sanchez for the Dominican Republic; while Venezuela ships chiefly from La Guayra, Carupano and Puerto Cabello.

Several manufacturers, Menier, Suchard, Cadbury, and others, have estates of their own, but these estates produce only a small part of their requirements. Manufacturers seldom deal direct with the planter, although in some cases they have their buying agencies on the spot. Planters either sell locally or ship direct to European brokers. Most of the buying in England is done on cost and freight contracts. In this case the weight of the bags is deducted by the seller and the buyer takes all other charges, including shrinkage up to 2 per cent. More rarely the cacao is sold on London or Liverpool landed terms, in which case the planter, in calculating his returns, has to subtract from the gross weight not only the tare, but also the amounts allowed for sampling and for loss in weight. He then has to deduct from the market value of the remainder, the insurance, freight, dock and landing charges, and the agent's commission.

Valorisation schemes have often been proposed in connection with cacao, and in Ecuador in 1912 the *Asociacion de Agricultores del Ecuador* was formed in the interests of the planters and exporters, for the express purpose of storing and holding up cacao when prices were low. Such efforts tend to stabilise industry, but the fact mentioned above, namely, that cacao deteriorates if stored in the tropics, is a serious objection

from the manufacturers' and the consumers' points of view to the application of such schemes to cacao. And in this case it is by no means certain that the scheme has so far worked out profitably for the planters, for about 1920–1921, the *Asociacion*, presumably because it held up cacao on a falling market, was in financial difficulties, and during 1920 increased its tax on all cacao exported from 2s. 6d. to 7s. 6d. for each 100 lbs.

The Sale of Cacao. The principal cacao markets of the world are New York, Hamburg, London, Liverpool, and Hâvre. Other cacao markets are Bordeaux, Lisbon—to which the San Thomé cacao is shipped, and Amsterdam—where Java cacao is handled. During the war Hamburg lost its position as the largest cacao market and by 1923 had not regained it. A great part of the Gold Coast crop goes to Liverpool, and London and Liverpool together form a greater market than Hamburg. London has one advantage over all the other markets : it holds a public auction, and although sometimes only small quantities are sold, the prices at which the cacao changes hands are wired all over the world and form a basis for negotiation. This applies particularly to West Indian cacao. It used to be said that, what Greenwich observatory is to the users of clocks, the London sale is to the sellers of cacao, but the sale has lost much of its former importance and is no longer held regularly once a week. The auction is conducted in the Commercial Sale Rooms in Mincing Lane on Tuesday at 11 o'clock. The sale room is not very impressive ; it resembles a large lecture theatre. But commerce of this character has so long been associated with Mincing Lane that the place has for the visitor an atmosphere of romance. One is silent in awe, contemplating in thought the succession of experts in tropical produce who have bought and sold within

those walls. Peering down the corridors of time one hears the murmur of those who have made and lost fortunes through the rise and fall in the prices of strange raw products that half the world has never seen. How many drinkers of cocoa could describe a cacao bean? It is about the size of an almond, though plumper and less pointed. The skin or shell is brown. Under the shell at the broader end is the germ or radicle, which is hard, rod-shaped, and about one-fifth of an inch long. The inside (the cotyledons) of the bean may be milk-chocolate colour, brown, dark-brown, purple, or slate. The taste is fatty, more or less bitter and astringent, nutty and faintly aromatic. The odour of the raw bean is quite unlike chocolate; it is peculiar to raw cacao and contains a vinegary constituent. Not a single bean is to be seen at the auction. However learned the babble of the sale room may be, the auctioneer does no varnishing; he merely puts up the lots under a brief and accurate description. It is possible, however, to obtain samples before the day of sale, and these are always on show in trays at the various brokers' offices on the previous day. It is usual for prospective buyers to see these samples before going to the sale and to make notes on their lists against the various lots offered.

The cacao bought and sold may run into many thousands of bags, but it is only a small quantity compared with that which is sold by private contract for forward delivery, and an increasing amount of cacao is now bought, not according to sample, but according to type or specification. The public auction is of interest, not on account of the quantities sold, but because it gives periodically to the cacao world a definite indication of the trend of prices.

The Price of Cacao. Only for one brief year in its

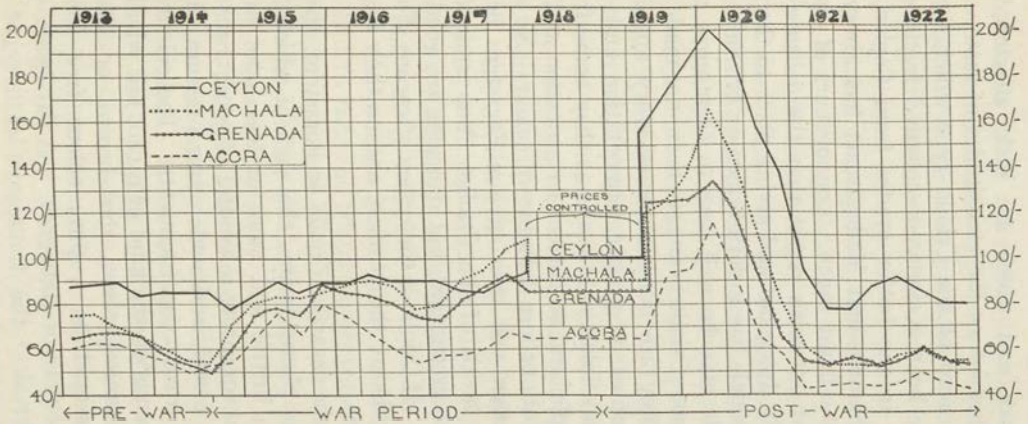
history has the price of cacao ever remained constant. This was during 1918 when the Food Controller fixed the price of the best qualities of the different varieties of raw cacao. The list below gives one an excellent general idea of the way cacaos are graded—

FIXED PRICE OF CACAO
APRIL, 1918, TO MAY, 1919

British West Africa (Accra)	65s. per cwt.
Bahia, Cameroons, San Thomé, Congo, Grenada	85s. ,, ,,
Trinidad, Demerara, Guayaquil, Surinam	90s. ,, ,,
Ceylon, Java, Samoa	100s. ,, ,,

On page 91 will be found a diagram showing the variation in price of four important varieties of cacao, one from each of the above sections, during the years 1913 to 1922. The most notable feature is the manner in which prices rose in 1919 like a rocket, when the Government control was taken off, and then fell like the stick in 1920. This fall in prices was a great loss to all holders of stock, and in one or two instances the losses were so great as to cause disaster.

Valuing Cacao. As far as country of origin is concerned, there is, to the uninitiated, something freakish in the great variation in price paid for beans which look so similar, and it is not possible, with the more expensive kinds, even for the expert entirely to account for it. However, apart from the effect of freight on price, one can call attention to certain qualities which



THE PRICE OF CACAO, 1913 TO 1922

influence price and which are little affected by the vagaries of fashion or the vicissitudes of taste. In the first place, cacao of the Criollo type which shows, on breaking the bean, a cinnamon-coloured fracture (such as one sees in the better grades from Ceylon, Java, Venezuela, Samoa, and Madagascar) has always been considered the finest cacao. Connoisseurs of chocolate have pointed out with regret that the delicate Criollo type is slowly dying out and giving place to the hardier Forastero, which has a dark-brown or brownish-purple "break." It may be well here to clear up a possible misconception. Criollo beans are born, not made. That is to say, they are born white as ivory and become cinnamon brown on proper fermentation and drying. Forastero and Calabacillo beans as they come from the pod are purple, and on correct fermentation and drying develop a more or less dark-brown colour. No amount of fermentation will ever give a Forastero bean the light-brown break of the Criollo. You cannot make damsons into greengages, but damsons are good to eat for all that. If Criollo is the queen of cacaos, Forastero and Calabacillo are the yeomen, and on their backs the industry rests.

Whether the cacao be Criollo or Forastero, the buyer prefers large, plump beans, the shell of which is crisp but not too brittle and more or less loose from the interior. On squeezing a handful of good beans a light crackling is heard, and under firm pressure the bean breaks into small crisp fragments. The colour of the fracture depends on the kind of cacao, but whether the tint is cinnamon-brown, dark-brown or brownish-purple, it should be a pure colour free from any suggestion of mud or slate-grey. A flat bean, a slate-coloured "break," the fragments leathery or cheesy in consistence, the shell soft and clinging closely to the

bean, are as so many red lights warning the buyer of imperfect fermentation. The buyer naturally prefers an even cacao to a mixture, and notes such gross imperfections as germinated beans, mouldy beans and grubby beans.

The method of procedure in judging a cacao is usually to glance first at its general external appearance, and make some such examination as is suggested above. The buyer then cuts a suitable number, say 100 beans, into halves and carefully examines these so as to get a percentage analysis. Their general character is noted and an estimation made of the good, unfermented and defectives. Some buyers are satisfied with this, but the more thorough proceed to roast the bean and test the aroma and other properties of the roasted product. The old proverb says, " The buyer has need of a hundred eyes." In the case of cacao he needs also at least one nose, and that a trained one. He pays great attention to the odour and the slightest alien tang, whether described as " hammy," mouldy, musty, smoky, or cheesy, is generally sufficient to condemn the sample. As far as the author knows it is exceptional to go further and to take the butter percentage and the shell percentage into account in valuing a particular sample, although a knowledge of the usual composition of the type may influence the buyer.

In fixing a price for a cacao one must also consider the demand, and this is definitely determined by the manufacturers' recipes. It is obvious that every cacao produces its own peculiar characteristics in the cocoa or chocolate prepared from it, but only the manufacturer knows exactly the qualities he is striving to produce in his finished goods, and what cacao, or blend of cacaos, will give the desired result. His aim is to please the public, and thus the taste of the public is the ultimate

arbiter of value. A writer in the *Times Trade Supplement* (July 15th, 1922) says, " As a rule it is customary to use a background of more than half of the mixture of some cacao of a not too pronounced variety. For this purpose the West African cacaos are used most extensively. A little higher up in the scale of strength come Bahia and San Thomé cacaos. Venezuelan cacaos vary from the cheapest to the best varieties ; Ceylon cacao is high grade and is favoured in this market, but the two types which are most in demand for ' lifting ' the chocolate mixture and determining its flavour are Trinidad and Grenada. Guayaquil has been used for making drinking cocoa, without blending, with considerable success."

CHAPTER VIII

THE COST OF CACAO PRODUCTION

THE cost of cacao production has been neglected in most modern works on cacao. The exceptions are Hart's book on *Cacao*, which gives a number of valuable figures, and Hamel-Smith's *Cocoa Planting in the West Indies*, which, though written over 20 years ago, contains advice to the would-be planter that is as good to-day as when it was written. There appears to be no book which gives detailed costs of creating and carrying on a plantation. The amount of care taken varies so greatly in different countries, that an average figure would have little significance. It appeared, therefore, that the best procedure would be to give the figures for one or two places where first-class cacao is produced, and Ceylon and Trinidad were chosen as illustrating costs in producing areas where sound methods of culture are practised. The author is indebted to Mr. E. W. Keith of the Kondesalle Estate, Kandy, Ceylon, for working out for inclusion in this book—

1. The costs of opening up and keeping up an estate in Ceylon for the first five years, that is, until the tree begins to bear.

2. A capital and revenue account showing the first five years of bearing.

3. The cost of producing 1 cwt. of cacao on an estate in full bearing, the yield of which is 5 cwts. per acre.

The whole drama of cacao production is brought into the lime-light by these figures, and, although they apply specifically to Ceylon, where the cacao bean is of a very fine kind, and the methods of cultivation the most

advanced and thorough, they illustrate the costs of the various items, a number of which must be borne wherever an attempt is made at cacao cultivation.

Many estates in Trinidad have been established by the contract system. By this method the land is let out to the contractor for four or five years, during which period he has the privilege of growing certain kinds of provisions on the land rent-free, and at the end of that time the young cacao trees are bought from him at 8d. to 1s. a tree. The costs below are for those cases in which the planter takes charge. The author owes the figures to the kindness of Mr. Stanhope Lovell. The cultivation is not quite so elaborate as in Ceylon, but any reduction due to this is compensated for by the very high cost of labour, the conditions of which, as in many other parts of the world, are not so settled as formerly.

Cost of Starting a Plantation. Mr. Stanhope Lovell gives the following figures for Trinidad in 1922. They would apply to a plantation of say 200 acres, where the ground was level and the soil calcareous. The costs do not include either the expenses of management or the costs of stock or buildings—

COST OF STARTING A PLANTATION

	Each Acre Costs : £ s. d.	£ s. d.
Felling and clearing	3 – –	
Drainage, roads, weeding, etc.	4 – –	
Planting	2 – –	
1st year		9 – –
2nd year		2 10 –
3rd year		2 10 –
4th year		2 10 –
5th year		2 – –
6th year		2 – –
Total cost to bring to bearing		£20 10 –

It is interesting to compare this with the figures given by Hart in pre-war days. He writes : " It is calculated that an estate can be established by the contract system at a cost of about £12 to £15 per acre, exclusive of buildings." On the Gold Coast, the Omanhene of Akwapim estimated (1919) that the cost of bringing an acre into bearing is £6 for the first year, and £2 5s. a year for four more years, making a total of £15 an acre.

While the above figures enable one to get an accurate outline of the costs, Mr. Keith's figures for Ceylon, in 1922, fill in the details. The costs were given in rupees, but that they may be more generally understood they have been converted into English money (100 rupees being equivalent to £6 13s. 4d.). *See* page 98.

The list of expenses does not allow for any buildings, the cost of which would depend on their size and the acreage planted, or for the manager's salary. The capital cost, including salary and buildings, of an estate of 300 acres, would be about £26 13s. 4d. an acre.

These figures speak for themselves and give one a good idea of the relative importance of the different operations during the first five years on the plantation. When the ground is cleared the weeds spring up with lightning-like rapidity, and to check this, as thoroughly as is usual in Ceylon, requires much labour, especially in the first few years. Both Mr. Lovell's and Mr. Keith's figures show a high initial outlay on roads and drains, an outlay which cannot safely be scamped, for the former greatly facilitates the work on the plantation and the latter are essential to its health. It will be noted that manuring is an expensive item, especially in the third and fifth years. Every year a little has to be spent on " supplying " new cacao and shade trees to take the place of those which die or prove unsatisfactory from other causes.

PLANTING—FIRST YEAR

Each Acre Costs :

	£	s.	d.
Felling and clearing	1	–	–
Lining, holing, filling-in, and planting		13	4
Seeds and nurseries	1	–	–
Survey		1	4
Roads and drains	1	13	4
Weeding	2	–	–
Manager's commission for opening		13	4
Contingencies, medical aid, tools, etc.		8	8
Shading and shade trees		8	–
Estimated total expenditure	£7	18	–

BRINGING THE TREES INTO BEARING

Each Acre Costs :

	2nd year.	*3rd year.*	*4th year.*	*5th year.*
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Roads and drains	1 4	1 4	1 4	1 4
Weeding	1 12 –	1 4 –	16 –	12 –
Manager's commission	6 8	6 8	6 8	6 8
Forking round plants	2 8	—	—	—
Forking with light application of manure	—	1 6 8	—	—
Forking whole ground	—	—	5 4	—
Manuring	—	—	—	2 – –
Contingencies, medical aid, tools, etc.	1 4	1 4	8	8
Shading and shade trees	1 4	1 4	8	8
Supplying	1 4	1 4	8	—
Terracing, boundaries, etc.	2 8	1 4	8	8
	£2 9 4	£3 4 –	£1 12 –	£3 2 –

Total expenditure for the five years, £18 5s. 4d. an acre.

The expenditure in the initial year is £9 an acre in Trinidad and £7 18s. an acre in Ceylon. The first five years cost £18 10s. an acre in Trinidad and £18 5s. 4d.

an acre in Ceylon. All this money has to be invested before one begins to gather a single pod. As pointed out above, in the case of Trinidad, this expenditure does not include anything whatever for management. During the five or six years of waiting for the trees to come into bearing, the young planter would have to live and he could hardly do this on less than £200 a year. At least £1,000 must be added to the initial outlay. The increase which this makes on the cost of an acre naturally depends on the size of the estate.

When the cacao tree is five years old in Ceylon and six years old in Trinidad, it bears as follows—

YIELD OF CACAO BEANS TO THE ACRE

Year of Bearing.	*Trinidad.*	*Ceylon.*[1]
	cwts.	cwts.
1st	1½	1½
2nd	2	2½
3rd	2½	3½
4th	3	4½
5th	3½	5
6th	4	5
7th	4½	5

If, as in Ceylon, the trees begin to bear after five years, the question now arises, how many years will the planter have to wait to get back the money he has invested. According to Mr. Keith's figures, which are given below, after five years' bearing, sufficient cacao has been produced to give a profit equal in value to the capital expenditure, so that, ten years after planting,

[1] These yields are for the Forastero variety; Criollo usually yields less.

one's outlay is reimbursed. On Mr. Keith's figures the investment of £26 13s. 4d. after five years begins to yield £9 per annum.

ESTIMATED CAPITAL AND ANNUAL REVENUE
ON ONE ACRE OF CACAO, FOR FIVE YEARS IN BEARING

Capital.	£ s. d.	*Revenue.*	£ s. d.
To capital expenditure— Opening and bringing 1 acre of cacao into bearing . . .	26 13 4	*6th Year—1st year in bearing* Yield 1½ cwts. an acre Cost of production at £2 2s. 8d. per cwt. Profit .	1 10 –
		7th Year—2nd year in bearing Yield 2½ cwts. an acre Cost of production at £1 16s. per cwt. Profit .	3 6 8
		8th Year—3rd year in bearing Yield 3½ cwts. an acre Cost of production at £1 12s. per cwt. Profit .	5 7 4
		9th Year—4th year in bearing Yield 4½ cwts. an acre Cost of production at £1 9s. 4d. per cwt. Profit .	7 9 4
		10th Year—5th year in bearing Yield 5 cwts. an acre Cost of production at £1 6s. 8d. per cwt. Profit .	9 – –
	£26 13 4		£26 13 4

In the above table the sale price of the cacao is taken as £3 2s. 8d. per cwt.

Cost of Producing one Cwt. of Cacao Beans (1922). Another interesting point is that, when the plantation is in full bearing, 1 cwt. costs about £1 7s. to produce and in 1922 sold for £3 2s. 8d. The table below shows in detail how the money is spent. In Ceylon, forking, pruning, and the lopping of shade trees are done every two years and manuring every three years, so the figures allow for forking, etc. over half the acreage, and manuring over one-third—

ESTIMATED COST OF PRODUCTION

Of each Cwt. of Cacao (Ceylon)

(On an estate of, say, 300 acres, in full bearing, giving a yield of about five cwts. an acre, and allowing for full programme of cultivation.)

	£	s.	d.	£	s.	d.
Salaries and General Expenses—						
Salaries		4	–			
Watchmen			5			
Contingencies			10			
Medical aid			6			
Labour recruiting			2½			
Allowances			2			
					6	1½
Cultivation—						
(*a*) *Cattle Establishment :*						
Cost and keep of stock		4	–			
Upkeep of grass fields (cutting grass)		1	4			
					5	4
(*b*) *Plantation :*						
Purchase of manure		3	4			
Application of manure			6½			
Cutlassing or weeding		1	2			
Diseases and pests (including rats, ants, squirrels, black cacao, etc.)		1	–			
Tools and carts			8			
Roads and drains			5			
Forking			4			
Pruning			3½			
Supplying cacao trees			2			
Shade trees and plants			2½			
Fences and boundaries			1			
					8	2½
Reaping and Preparation for the Market—						
Gathering and picking		1	2			
Curing, sorting and bagging			11			
Bags and matting (for drying)		1	–			
Transport (carting)			6			
Shipping			4			
Machinery and upkeep			2			
Export duty		2	3			
					6	4
Upkeep of Buildings, etc.—						
Barracks			6			
Cattle sheds			4			
Bungalows and furniture			2			
Factories			2			
					1	2
Total				£1	7	2

It will be noted that the most costly item is the practically indispensable cattle establishment. While some of the animals do useful work on the plantations, all provide manure of great value. In Trinidad, on an estate of 200 acres, one may find two horses, five mules, four cows, and two calves. All the items are self-explanatory with the exception of "Watchmen." Some planters regard watchmen as a necessary nuisance. Their chief duty is the prevention of theft, and other duties are sometimes added, such as the destruction of squirrels.

Costs vary with methods, and both alike are open to criticism. It may therefore be useful to give Mr. Stanhope Lovell's figures for comparison and contrast. These figures are for an estate of about 200 acres, yielding 4 cwts. to the acre, and the manager's salary is not included, neither is the cost of manure or barracks. It is well to note that overhead and superintendence charges are generally the heaviest items on the plantation's balance sheet and naturally reduce the profits. This explains why several large estates in a group are managed more profitably than a single small estate, the planter's salary and overhead charges being spread over a greater acreage. (*See* opposite page.)

These calculations were made in 1922, when labour was costly and prices for cacao were lower than they had been for some years. Thus in the rosy days of January, 1920, fine Trinidad cacao was fetching up to $27.50 in Trinidad and £6 10s. to £6 11s. the cwt. in London, while the average price in 1922 was $11.50 in Trinidad and £3 10s. 7d. in London.

One of the most striking figures is the amount spent on pruning and trimming, which, in Mr. Stanhope Lovell's opinion, is the most important work on the plantation.

ESTIMATED COST OF PRODUCTION
OF EACH CWT. OF CACAO IN TRINIDAD

	£ s. d.	£ s. d.
Salaries and General Expenses—		
Overlookers	1 6	
Watchmen	1 –	
Messenger	1	
		2 7
Cultivation—		
(*a*) *Cattle Establishment :*		
Cost and keep of stock	2 4	
Upkeep of grass fields (cutting grass)	1 –	
Shoeing and harness repairs	3	
		3 7
(*b*) *Plantation :*		
Application of manure	3	
Mulching	6	
Cutlassing, weeding and forking	2 6	
Diseases and pests (including rats, squirrels, ants, black cacao, etc.)	9	
Roads and drains	1 –	
Pruning	2 6	
Supplying cacao trees	2	
Shade trees and plants	3	
		7 11
Reaping and Preparation for the Market—		
Gathering and picking	2 7	
Heaping, cutting, extracting and conveying to the fermentary	2 8	
Curing, sorting and bagging	1 7	
Transport (carting)	6	
		7 4
Upkeep of Buildings, etc.—		
Repairs to buildings	7	
Miscellaneous	3	
		10
TOTAL		£1 2 3

Cost of Production and Sale Price. To judge from the figures published in the U.S.A. Consular Report on cacao in 1912, it would appear that, in pre-war days, on the average the planter received for his beans twice what it had cost him to produce them. Thus in San Thomé and Para the profit was 50 per cent of the value

of the crop ; in Ecuador it was much higher and in Grenada lower. Thus the cost of production in Grenada was 3½d. a lb. and the cacao sold for 6d. a lb.

According to Mr. Keith's figures for Ceylon in 1922, when the plantation is in full bearing each pound costs less than 3d. to produce and sells for over 6½d. Or to express it another way, each acre brings in a profit of £9 a year.

As cacao trees are usually planted 12 ft. by 12 ft., there are 300 to the acre. A yield of 5 cwts. an acre works out at 1·87 lbs. of cacao a tree, which in Ceylon, in 1922, was worth 12·5d. The cost of all work in connection with obtaining cacao from one tree in bearing, by calculation from Mr. Keith's figures, is 5·3d. a year, or on each bearing tree one makes a profit of 7·2d. (or on an acre growing 300 trees, £9).

The author promised in an earlier chapter to show how it was possible to cultivate profitably a tree which on the average gives less than 2 lbs. of product a year, and trusts that the above figures have explained the mystery.

Although the return on invested capital is high, it is not advisable for one to become a planter unless one has a strong liking for the open air and agricultural pursuits. Given this, it is a very enjoyable life, and with a plodding disposition, a receptive mind, and a buoyant faith to bridge the difficult times, one's ultimate success is assured. As a writer in *The Statist* (Aug., 1919) says, " The returns on a cacao plantation, once it has attained maturity and the plants are bearing to the full extent, very soon repay the planter for his outlay, and in a few years may, if he is fortunate, place him in such a position that he is able to retire with a handsome competence on a comparatively modest outlay of capital."

Valuing an Estate. The method of valuing an estate is based either on the number of trees or on the average

yield. The first is the simpler and more popular method. The actual value of the tree taken as the basis depends on the age and condition of the trees, the general character of the property, the number and state of the buildings, the productiveness of the soil, the degree of cultivation, as well as the ease of access to the plantation and its distance from the point of embarkation. In pre-war days in the West Indies it was usual to take the average value of a fully-bearing tree as one dollar.[1] This would mean that an estate planted 12 ft. by 12 ft., when the whole of the 300 trees were in full bearing, would be worth £62 10s. an acre.

Labour Required. The author remarked in an earlier chapter that, since 500,000,000 cacao trees are needed to produce the cacao crop of the world, a vast horde of people must be employed in its cultivation. The actual number is less than one might at first infer. Taking the country which is the third greatest producer in the world, Ecuador, where the amount of labour expended on cultivation is small, it is reckoned that, on a large estate there is only one labourer to every 7,000 trees, or one labourer to every 8,000 lbs. of cacao produced per annum. Using the number of trees as the basis of calculation, we find there are at least 70,000 labourers engaged in producing the world's cacao. This is a conservative estimate because it assumes that all plantations are managed, as in Ecuador, by Europeans and with a minimum of labour. In West Africa, which produces a third of the world's cacao supply, the natives own and manage the plantations, and these, in spite of the low standard of cultivation, maintain a greater number of people to the 100,000 trees than in Ecuador. Mr. E. J. Organ estimates that there are at least 25,000 growers on the Gold Coast.

[1] The average value in 1922 was more nearly 90 cents.

CHAPTER IX

THE MANUFACTURE OF COCOA AND CHOCOLATE

OPERATIONS COMMON TO BOTH COCOA AND CHOCOLATE

In the chapter on the history of cocoa and chocolate, it was described how the crushed cacao bean, which contains 54 to 55 per cent of butter, gave a somewhat too fatty drink, and how the early attempts to reduce this by adding corn-flour or arrowroot were followed, and largely superseded, by the method of pressing introduced by C. J. van Houten, of Weesp, the founder of the well-known firm. As the preparations containing starch or sugar cannot legally be described as pure cocoa, they will not be considered here.

When a roasted cacao bean is crushed between the thumb and forefinger, it breaks into a large number of angular fragments which are generally termed " nibs," and one can obtain a rough analysis of the cacao-bean by picking out the flakes of husk or shell and the rod-like " germ " or radicle. Such an analysis would give approximately the following result—

COMPOSITION OF THE CACAO BEAN

	Per cent.
Nibs	86·7
Shell	12·5
Germ	0·8
	100·0

If one blows on to the crushed bean resting on the palm of one's hand, the shell is carried away. Turning

over the nibs one notices a characteristic fragment which looks like a very minute rusty nail. This is the germ ; it will be found to be hard and flinty. While the shell and germ contain very little cacao butter, about three and five per cent respectively, the nib is more than half butter, and if the finger-nail is gently pressed into it, its fatty nature becomes evident. Cocoa consists simply of the finely ground nib from which part of the butter has been pressed. Though essentially simple in outline, in factory production a dozen operations are necessary to obtain from a bag of cacao beans so many tins of cocoa. Engineers have given much attention to the various processes, and the manufacture of cocoa powder has now become one of mass production involving comparatively little manual labour.

If one examines the piles of bulging sacks in the European manufacturer's store, one finds distinctive cacaos from places all round the equator—from widely sundered isles like Java and Grenada—rubbing shoulders.

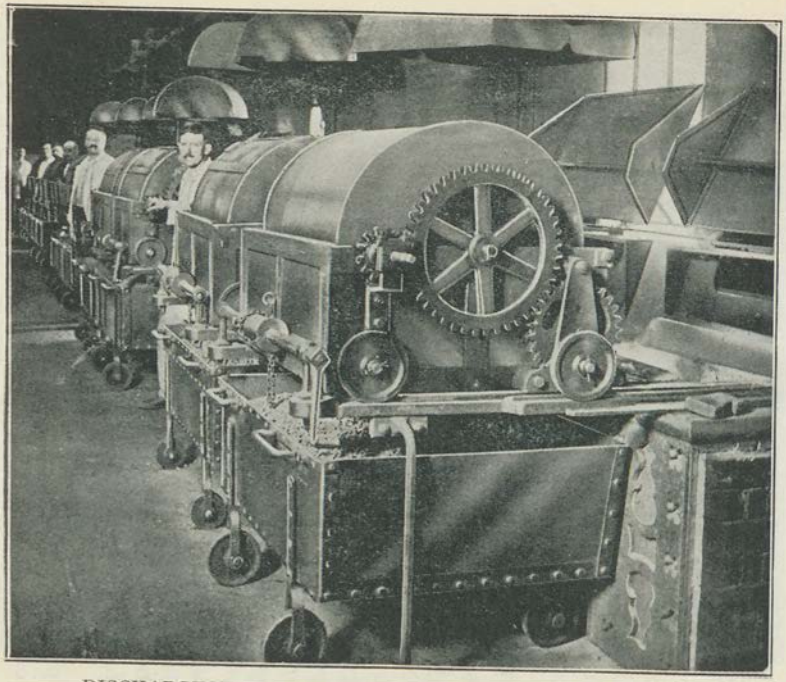
Factory Operations. 1. *Cleaning and Sorting.* Although the cacao beans of commerce are reasonably free from foreign matter, they are liable to contain string from the bag, small twigs of dried placenta from the pod, stones, dust, etc. To remove these the beans are run over a series of rocking sieves, the separation of the lighter particles being assisted by a strong current of air. The beans, at the end of the cleaning, have lost up to 0·5 per cent by weight. The same machine also roughly sorts the beans to size, a necessary precaution if one is to obtain an even roasting.

2. *Roasting.* In spite of the advance of science the roasting of cacao remains a romantic occupation. For him who " rules the roast " no cut and dried rules are laid down ; he is expected continuously to use his

judgment, and this is necessary because cacao beans, like all natural products, show appreciable variations in size, dryness, and so forth.

The apparatus in which the roasting is conducted is very similar to a coffee-roaster. It consists essentially of a heated rotating cylinder. The heat may be supplied by a coke fire, gas jets, or by superheated steam. The period of roasting and the heat supplied depend on the results desired. Some roasting amounts to little more than drying, while in other cases it is carried to within an ace of burning. The time varies from thirty minutes to two hours, and the temperature attained is comparatively low, being from 100° C. to 140° C. The roasters are fitted with a neat sampling device which enables small quantities of the beans to be removed from time to time without stopping the operation. The supervisor breaks the beans, applies his highly-trained nose to the crisp and fragrant fragments, and passes judgment. If the roast is satisfactory, the beans are immediately discharged from the roaster and rapidly cooled by a blast of cold air to stop any further changes due to heat. The roasting of cacao not only first creates, and then develops, the chocolate aroma, but also changes the colour of the kernel, even though it be slate or purple, to a chocolate brown. Further, it loosens the husk or shell, so that the removal of this in the next operation is greatly facilitated. The moisture falls from 6 or 7 per cent in the raw to 1 or 2 per cent in the roasted bean. Besides water, acetic acid and other bodies are driven off during roasting, so that the total loss averages about 7 per cent.

With regard to the chocolate aroma, Messrs. Bainbridge and Davies have made an investigation of the aroma and flavour of cocoa and chocolate. They distilled over 4,000 lbs. of cacao beans and obtained less



DISCHARGING ROASTING CYLINDERS AFTER HEATING
OVER A COKE FIRE
(Messrs. J. S. Fry & Sons, Ltd., Bristol)

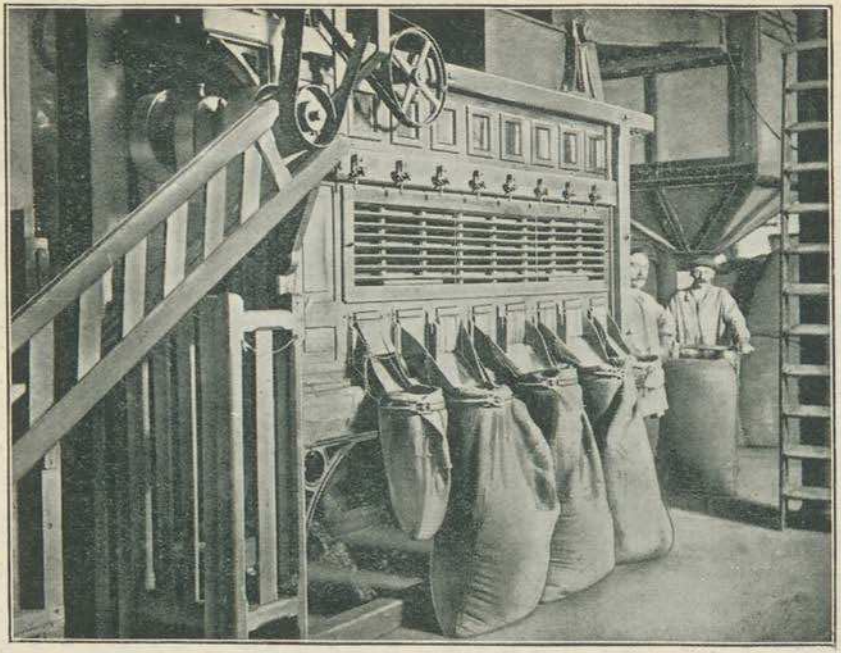
than 1 oz. of *essential oil of cocoa*. This had an intense flavour, 1 part being detectable in 50,000,000 parts of syrup. It contained a number of esters, but the chief constituent was *d*-linalool.[1]

3. *Obtaining Pure Nib*. All manufacturers of high grade cocoa and chocolate do their utmost to remove the shell. The problem appears simple, one has merely to break the bean and blow away the shell. Were it possible in breaking to produce large fragments only, the separation would be easy, but the smaller the fragments, the more similarly they behave in a current of air.

The usual method of cracking the beans is to run them through rolls. The size of aperture between the rolls is very nicely adjusted, but, as the beans vary slightly in size, while the majority are cracked into conveniently large pieces, a minority are smashed to atoms. Special machines are required to separate the germ, and usually the cracked beans pass through the germ sieve or separator *before* going into the winnowing machine which separates the shell. All methods of withdrawing germs depend upon taking advantage of their definite size and distinctive shape ; as occurring in roasted beans they are 0·25 in. long and 0·08 in. wide. They are separated from the mixture either by being caught up in germ-shaped depressions, or by falling through suitable perforations, in a metal cylinder.

Practically all shell-separating machines apply the principles of grading and winnowing. Generally they consist of an inclined cylinder made up of sections of metal gauze, each with a different sized mesh. As the

[1] Esters are generally volatile liquids and occur as the odoriferous principles of fruits, etc. Linalool, or linalol, is an alcohol which contributes to the fragrance of bergamot and lavender.



SHELL SEPARATING MACHINE
(Messrs. J. S. Fry & Sons, Ltd., Bristol)

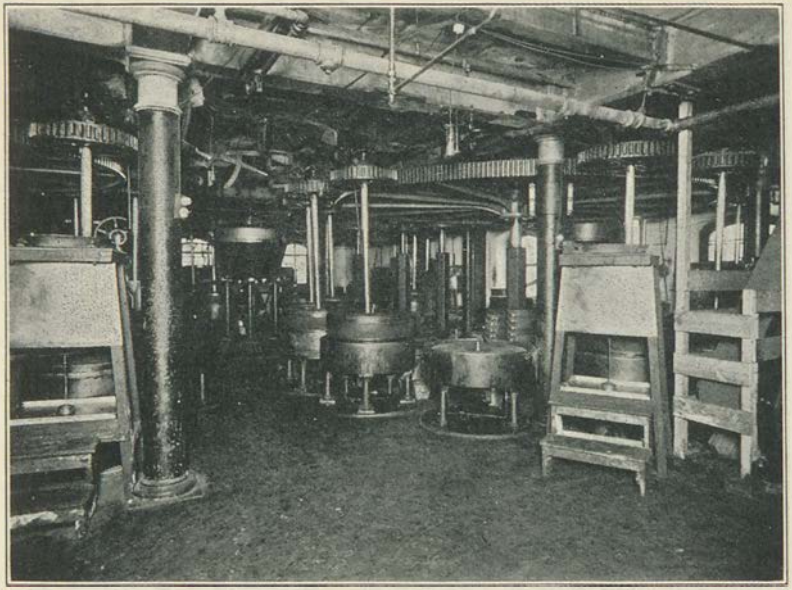
mixture passes down, it is sieved into the various sizes. Each of the grades meets a current of air, which carries away the shell and allows the nib to pass on. By such processes are obtained (a) shell almost free from nib, (b) large fragments of perfectly clean glossy nib, and (c) a mixture of fine material which requires a further special separation. The shell is bagged up and sold to cattle food manufacturers. The shell-free nib is the material from which cocoa and chocolate are made.

(*a*) *Cacao Shell.* This is the principal by-product of the cocoa and chocolate industry, about 5,000 tons being produced annually in Great Britain. This skin or husk is a crisp material, rich brown in colour, with a pleasant characteristic odour resembling that of chocolate. It keeps uncommonly well and in a dry place will remain unchanged for years, showing no signs of rancidity or mouldiness. It is bulky, the ordinary sack in which it is sold holding, according to the size of the pieces of shell, from 56 lbs. to 84 lbs.

A small amount of cacao shell is used in Ireland to prepare a drink called "Cocoa tea," and during the war a preparation of cacao shell for the same purpose was widely advertised in England under the name of "Celesco." The bulk of cacao shell, however, is used in the manufacture of compound cattle cakes.[1] In the standard exposition of "The Valuation of Feeding Stuffs," by Mr. A. Smetham (*Royal Lancashire Agricultural Society's Journal*, 1921), two analyses of cacao shell are recorded. (*See* page 114.)

Considering its food value the cost of cacao shell is low. The average price is about £5 a ton, or roughly about 1s. the food unit. Cacao shell is distinguished

[1] For a discussion of other commercial uses, see "The Separation and uses of Cacao Shell," by A. W. Knapp, *Journal of the Society of Chemical Industry* (1918), p. 240.



GRINDING CACAO BETWEEN STONES
(Messrs. J. S. Fry & Sons, Ltd., Bristol)

CACAO SHELL

ANALYSIS AND FOOD UNITS

Water.	*Oil.*	*Albuminoids.*	*Digestible carbohydrates.*	*Woody fibre.*	*Mineral matters.*	*Sand and silica.*	FOOD UNITS.
9·30	3·83	18·81	46·01	13·85	8·20	0·85	102
9·50	8·97	17·13	39·35	16·60	8·45	1·00	104

from all other feeding stuffs by the presence of 0·2 to 3·0 per cent of theobromine. The theobromine is a valuable stimulant, but its presence makes it advisable to avoid an excessive proportion of cacao shell in a diet. Cacao shell should therefore be used chiefly as an appetiser, and the best results will be obtained if the daily quantity fed is small; thus for a cow it should not exceed 3 lbs.

(*b*) *Cacao Nibs.* While the complete removal of the shell is well-nigh impossible, in good factory practice not more than 1 per cent is left in the nib.

The nibs were once an important article of commerce, and to this day doctors sometimes recommend their patients to prepare a drink by making a water infusion of the nibs, a costly and wasteful method of preparing a thin beverage.

The losses on cleaning (0·5 per cent) and roasting (7 per cent) have already been noted. In obtaining the nib a further loss occurs due to the removal of the shell, about 10·5 per cent of which is readily separated as coarse shell. When all the fractions have been sorted, about 80 parts of usable nib are obtained from every 100 parts of raw beans.

4. *Grinding the Nib.* This is accomplished by means of a grinding mill consisting of several pairs of French burr stones. One stone is revolved on the top of another which is stationary, the nib being automatically fed into the plane of contact down a central hole in the

upper stone. The nib contains over half its weight of fat, and as the nib is crushed, the cells are broken and the fat liberated. The grinding process generates heat, and at 90° F. the fat melts to an oil. This explains why the crisp, nutty cacao nib, after passing between the stones, emerges as a thick brown liquid. According to the fineness of particles required, the nib is passed through one, two, or three pairs of stones. The material obtained is liquid cacao nib, which on cooling sets to a hard brown block. This is known as cacao mass or unsweetened chocolate, and can be used to prepare either cocoa or chocolate. The illustration of grinding shows a circle of grinding stones driven in an unusual manner by a huge spur-wheel, which is 18 ft. in diameter and weighs $3\frac{3}{4}$ tons. So far cocoa and chocolate have been considered together, but from this point their methods of manufacture are totally different.

CHAPTER X

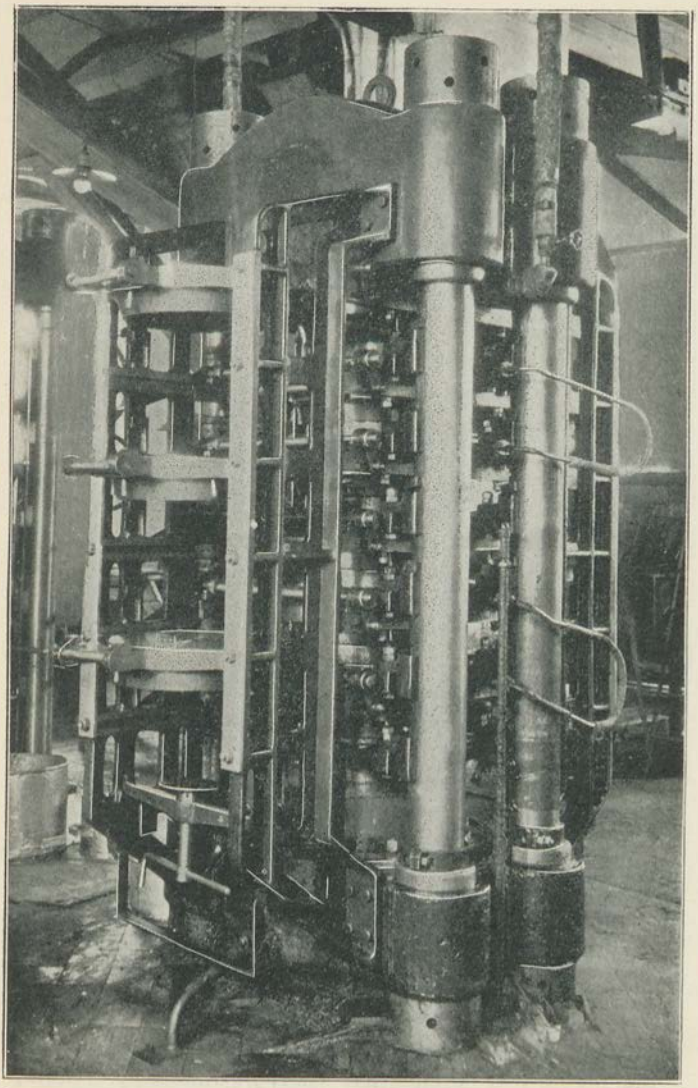
MANUFACTURE OF COCOA AND CHOCOLATE (CONT.)

OPERATIONS PECULIAR TO COCOA AND CACAO BUTTER

1. *Pressing out the Cacao Butter.* In the preceding chapter, the processes for the production of ground cacao nib or unsweetened chocolate were briefly described. The next process in the production of cocoa is the removal of part of the cacao butter. The machines used are similar in principle to those generally used for pressing the oil out of seeds and nuts, but, whereas most of these are pressed in a whole or mealy condition, in this instance the material to be pressed is a liquid, carrying only very fine particles in suspension.

The modern cacao press consists of a number of circular pots arranged vertically one above the other. A filter cloth having been placed on the perforated plate which forms the bottom of the pot, about 20 lbs. of liquefied cacao bean is run into the pot and the top covered with a filter cloth and perforated plate. Hydraulic pressure up to 6,000 lbs. to the square inch is applied to the pile of full pots. The butter which escapes through the perforations is carefully collected. It is coloured brown by a trace of ground cacao bean. After pressing, the material left in the pot is no longer a liquid but a hard brown disc, weighing about 12 lbs., and looking for all the world like a gigantic pine lozenge. The cake may contain anything between 20 and 30 per cent of cacao butter, and has only to be ground up and sieved to become cocoa.

2. *Obtaining the Powder.* The press-cakes are



HYDRAULIC COCOA PRESS

(Messrs. Rowntree & Co., Ltd , York)

crushed between toothed rollers, and passed through other grinding or disintegrating machines which reduce them to a fine powder. As it is important that the cocoa should be a very fine and even powder, great care is taken in sieving it. In some factories a vast space is devoted to an elaborate system of sifting by means of wind, only those cocoa particles which settle in almost still air being used. The more usual process is to sieve the powder in a revolving, inclined, hexagonal drum, the sides of which are made of fine silk gauze.

3. *Packing.* The modern automatic weighing, packing and labelling machines are marvels of ingenuity. The empty, open packets stand like a waiting procession, and one by one are brought under a stream of cocoa which is cut off automatically when the correct weight has been supplied. The machine gently bumps the packet to shake down the powder, inserts a check coupon, puts a dab of gum on the paper and closes the packet. Later, one sees the filled circular tins rolling merrily along, one after the other, over a pile of gummed labels. A label adheres to each tin, and they roll out of the machine in a condition suitable for dispatch to the grocer's shop.

4. *"Soluble" Cocoa.* Besides the cocoas prepared in the simple manner described above, there is an important class which is called "Soluble" cocoa. These cocoas are obtained by treating the cacao with an alkali or salt of the alkalies. The originator of this process was C. J. van Houten, and it is generally known as the "Dutch method." Similar methods are now followed very widely, and, with notable exceptions, the majority of the cocoa powders on the market are prepared in this way. Both the alkaline substance and the method of application vary. Potassium, sodium, ammonium or magnesium carbonates or bicarbonates

AUTOMATIC WEIGHING MACHINE FOR COCOA POWDER
(Messrs. Cadbury Bros., Ltd., Bournville)

are used in quantities of 2 to 3 per cent. Either the roasted nib, or the ground paste, or the cocoa powder itself is treated. Everyone is familiar with the use of a bicarbonate in baking. In ordinary baking powder the sodium bicarbonate is neutralised by tartaric acid. In the process under consideration, the alkali neutralises, and is neutralised by, the natural acidity of the cacao bean. The effects are to destroy partially the characteristic bouquet of cacao, to give a darker colour, and, in the opinion of many, to improve the flavour. One of the objects of using alkalies is to increase the buoyancy of the particles, and hence to produce a cup of cocoa which is homogeneous and which takes a long time to settle out. Strictly speaking, the product cannot be described as " soluble." The effect of the treatment is not to make the cocoa soluble, but more suspendable ; certain changes, such as the loosening of the component parts and the effect of a neutral solution on the colloids, tending to this end.

The word " alkali " has an objectionable " chemical " sound. The writer, however, does not propose to thrust up this discarded bogy before an astonished public. It may be well to state that the use of this word in connection with the finished cocoa powder, as made by reputable makers, is incorrect. After treatment the cocoa contains no alkali in the free state or as carbonate ; it apparently becomes converted into salts similar to those found in foods of purely animal and vegetable origin. Where alkaline salts are used with understanding and discretion, their employment becomes entirely a question of taste.

Judging Cocoa. Cocoa should be absolutely pure and possess a fine flavour. It may be said that compared with other foodstuffs, it is rarely adulterated. The commonest adulterant is cacao shell. In the Annual

Report of the Ministry of Health, 1921–22, it states that in 1921, of 1,382 samples of cocoa submitted to public analysts, only seven were reported against: four being deficient in cacao butter, two containing sugar, and one both sugar and arrowroot.

Apart from the question of adulteration, the value of cocoa is related to its composition, in particular to the amount of cacao butter present. In 1921 Dr. Plimmer published his authoritative series of analyses for use by His Majesty's Services. Below are quoted his figures for the mean of six cocoas. For comparison, the average composition of the two types of high-class cocoas of British manufacture is given—

ANALYTICAL DATA FOR COCOA

	Dr. Plimmer's Figures.	*Cocoa Essence.*	*"Soluble" Cocoa.*
	Per cent	Per cent	Per cent
Cacao butter	26·8	28·0	28·0
Cacao starch	40·3	10·2	10·0
Other digestible carbohydrates		27·2	25·3
Protein	18·1	18·1	17·7
Crude fibre	3·7	4·2	4·2
Water	4·9	5·0	5·0
Mineral constituents	6·3	5·0	7·5
Theobromine	—	2·2	2·2
Caffeine	—	0·1	0·1
	100·1	100·0	100·0

Dr. Plimmer calculates the average energy value per lb. as 2,214·5 calories. Apart from its high food value, cocoa has worth as a stimulant, which might be inferred from the amount of the theobromine present. This is rather less than the amount of active principle (caffeine) contained in tea, but is twice the amount of caffeine contained in coffee.

In choice of bean and care in preparation, the proprietary brands are generally superior to the cocoa sold loose. The professional cocoa-taster is influenced by the colour and aroma of the powder, but the determining factor naturally is how it makes up with water. He notes the flavour, aroma, body and strength. In judging the flavour of the liquor, he usually tastes it without sugar or milk. He also carefully observes the amount of sediment left in the cup.

It may be well to describe how cocoa should be prepared in the household to obtain the beverage at its best. The operation which is most neglected is the use of the whisk. For each cup of cocoa required put one piled teaspoonful of cocoa into a jug, add an equal number of teaspoonsful of sugar, and mix dry. Raise a mixture of equal parts of water and milk to the boil in an aluminium or enamelled saucepan, pour the boiling milk over the cocoa and stir briskly. Put the whole back into the saucepan and boil for one minute. Transfer back to the jug, whisk vigorously, and serve whilst steaming hot.

Cacao Butter. (Oleum Theobromatis. French—*Beurre de cacao*, German—*Kakaobutter*, Spanish—*Manteca de coco*, Italian—*Burro di cacao*.)

Cacao butter as it flows from the press is brown. When it has been passed through cloth in a filter press, it becomes a crystal-clear amber coloured oil, which sets to a brittle, pale yellow solid with a characteristic fragrance. Though brittle at ordinary temperatures it melts readily in the mouth (at 90° F.).

As far as elementary composition is concerned, cocoa is the ground cacao bean from which some of the cacao butter has been pressed, and chocolate is ground cacao bean and sugar with or without the addition of cacao butter. Owing to the growing demand for

chocolates rich in cacao butter, and also for milk chocolate, cacao butter, the by-product of the cocoa industry, has become the life fluid of the chocolate industry. The surplus of the one is a necessity of the other, so that while the manufacturer sets out to make cocoa, the demand for cacao butter is such that the accessory product may obtain the higher price. Cacao butter is the most expensive of the vegetable fats that are of commercial importance. Below will be found the wholesale price for the last five years, together with the quantities imported into England. Holland, with its important cocoa factories, is the principal exporting country.

CACAO BUTTER

Year.	*Exported from Holland.*	*Imported into United Kingdom*	*Wholesale Price per lb. Prime English. Duty paid. Delivered.*
	Tons.	Tons.	*s. d.*
1918	268	188	1 $5\frac{3}{4}$
1919	2,177	1,445	2 $2\frac{3}{8}$
1920	5,260	909	2 3
1921	5,824	286	1 $7\frac{1}{4}$
1922	8,747	1,216	1 $7\frac{3}{16}$

An important cacao butter auction is held at Amsterdam. There were no sales in 1918 or 1919. The following table shows the average wholesale prices, 1920 to 1922.

AVERAGE PRICE OF DUTCH CACAO BUTTER
Net f.o.b. Amsterdam.

Year.	*Van Houten " A."*	*Van Houten " B."*
	Per lb.	Per lb.
	s. d.	*s. d.*
1920	2 $2\frac{3}{4}$	2 1
1921	1 $5\frac{5}{8}$	1 $3\frac{7}{8}$
1922	1 $3\frac{1}{2}$	1 $2\frac{7}{8}$

A little cacao butter is used in pharmaceutical preparations, but its main use is in the manufacture of chocolate. No other fat is quite as good for this purpose, although a fair substitute, illipé butter, and a clever imitation, a hardened oil, are now on the market. Cacao butter is an example of an important article of commerce, like agar-agar, ambergris, copra and cacao beans, which the public, under normal conditions, never sees. When in 1918 the world was pining for cooking fats, and beautiful blocks of cacao butter, weighing a quarter of a hundredweight, were exhibited in grocers' windows, the general public had not the faintest idea what it was or where it came from. The housewife found it so hard that it had to be grated to use in cakes, and the flavour which makes it so delightful in chocolate, did not by any means improve fried fish or chip potatoes. The newspapers, ever anxious to help, explained that the flavour could be driven off by heating the cacao butter to 320° F. In spite of the interest shown, as soon as the price of butter, lard, and margarine dropped to more reasonable figures, the public demand for cacao butter ceased and it returned to its normal use.

CHAPTER XI

THE MANUFACTURE OF COCOA AND CHOCOLATE (CONCLUDED)

OPERATIONS PECULIAR TO CHOCOLATE

CHOCOLATE is made for eating and drinking. It will be remembered that the author uses the word cocoa solely for cocoa powder (*Cacao en poudre*, French ; *Kakaopulver*, German ; *Cacao en polvo*, Sp. ; *Cacau em po*, Port. ; *Cacaopoeder*, Dutch). As there is no legal standard for, or definition of, chocolate, it may be well to explain how the word is used here. In general, chocolate is any preparation of roasted cacao beans without the abstraction of butter. High class chocolate contains no other ingredients than cacao nibs, sugar and cacao butter, save the small quantity of substances added as flavouring. Whereas chocolate for eating generally contains 50 to 55 per cent of sugar, chocolate powders for preparing the beverage may contain up to 75 per cent. Since the introduction of cocoa, drinking-chocolate has declined, and eating-chocolate has risen in importance. The latter will be mainly considered here.

Since " nature's confectioner, the bee," set the pace by making honey, human creatures have striven to produce things both sweet and delectable, and chocolate is one of man's masterpieces. The manufacturer in seeking to establish a brand aims at producing an unchanging product of marked individuality. To do this he uses a particular blend of beans, and prepares them in a definite way to develop a characteristic flavour. He may intensify the individuality of the flavour by adding a small quantity of coffee or roasted

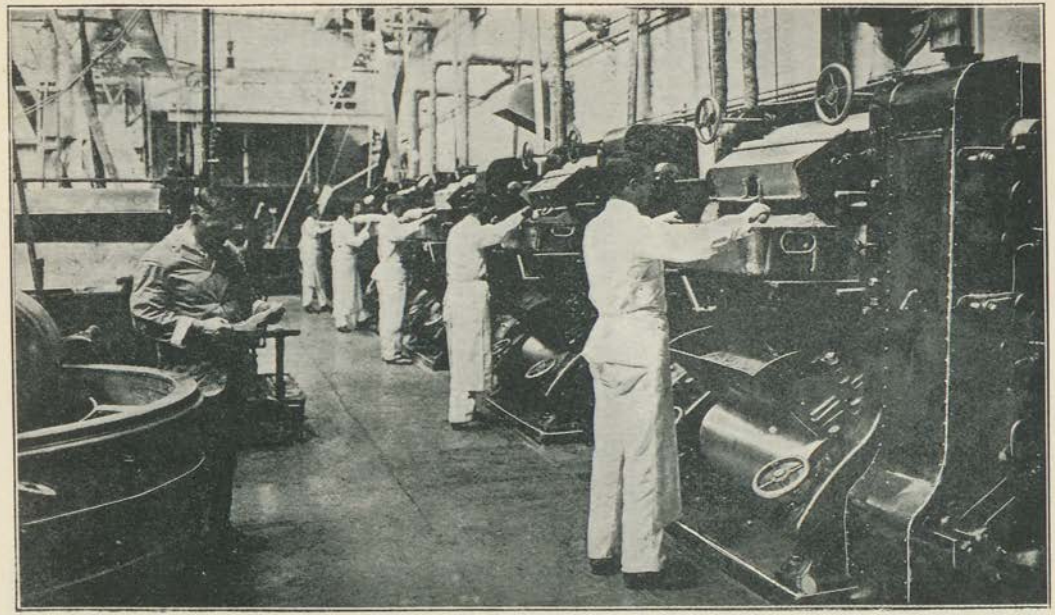
almonds. And as aroma is a part of flavour he will probably add a minute quantity of vanilla or vanillin, coumarin or heliotropin ; or odoriferous spices like aniseed, cinnamon or nutmeg ; or aromatic bodies like balsam of Peru, gum benzoin or attar of roses.

The variations on the fundamental processes are too many to be described here, and only the essentials will be briefly mentioned. The original method of making chocolate with a mortar and pestle has been expanded in the factory into a number of operations known as grinding, melangeuring, refining and conching. The nib is finely ground either as described for cocoa or between revolving steel discs. The sugar is ground to an almost impalpable snow-white powder either in a mill resembling a mortar mill or else in a disintegrator. The nib and sugar are then mixed in suitable proportions. Whymper cites the following recipe as giving an eating chocolate possessing a very good flavour—

RECIPE FOR PLAIN EATING CHOCOLATE

	lbs.
Caracas nib	16¼
Para nib	9¼
Trinidad nib	18½
Sugar	55¾
Vanilla	¼
	100

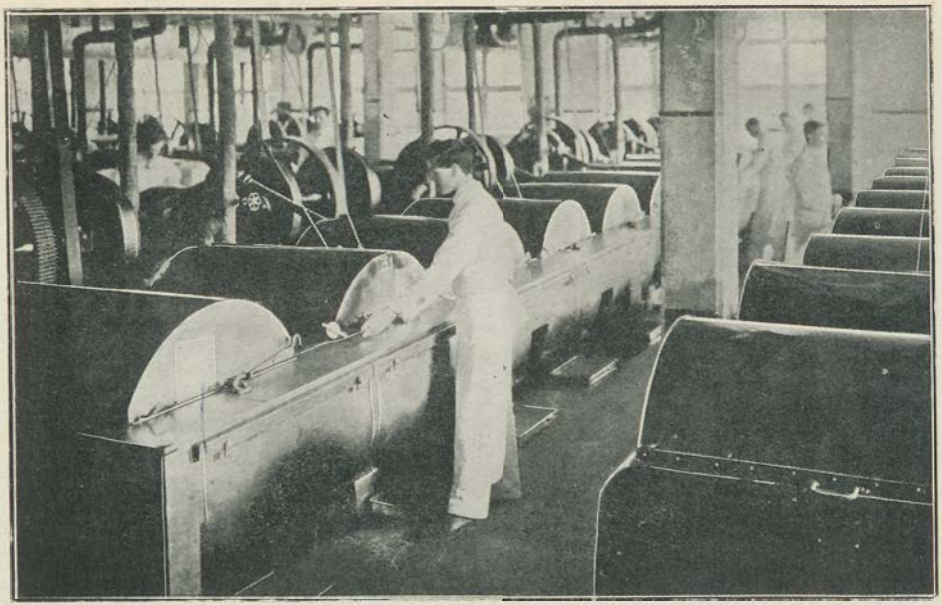
The mixing is done in a machine called a *melangeur*, a refined kind of edge-runner, which consists of two heavy granite rollers resting on, and revolved by, a rotating granite bed. The melangeur is kept warm and the mixture is obtained in a soft and plastic condition. This is chocolate in the rough and, though gritty to the teeth, would have satisfied consumers fifty years ago. This chocolate dough is now put through a refiner, a



GRINDING CACAO NIB AND SUGAR FOR CHOCOLATE
(Messrs. Cadbury Bros., Ltd., Bournville)

kind of "mangle *de luxe*," that is to say, it is given a number of grinds between granite, porcelain or steel rolls. The chocolate goes into the nip of two rolls revolving at different speeds, so that the particles are torn apart as well as crushed. As overheating would be detrimental to the chocolate, the steel rolls are water-cooled. One effect of the refining is to make the dough stiffer or to convert it into dry flakes. It is now put into a hot cupboard to recover its plasticity, or to obtain the same effect, mixed in a melangeur with a little cacao butter. Grinding and melangeuring are repeated three, four, or five times, until the chocolate is fine enough to satisfy the public taste. The crunchy chocolates which sold in quantity only five to ten years ago have gone, the public now demanding a chocolate with a smooth velvet feel. This is most effectively obtained by means of a machine peculiar to chocolate, called a *conche*, in which the chocolate is worked continuously for three or four days. Along the concave bottom of the conch a heavy roller is thrust backwards and forwards under the chocolate. Many clever attempts have been made to supersede this tedious and costly process, but, in spite of local secessions, it still holds the field.

The remaining processes are concerned with making the chocolate look pleasing to the eye. The chocolate dough is moulded into bars, cakes, discs (croquettes) or small rectangular tablets (Neapolitans). The temperature of the chocolate going into the moulds has to be very carefully controlled by tempering machines, and the temperature of the cooling chambers, through which the chocolate is automatically conveyed, kept within narrow limits, to ensure the glossy appearance, the fine brown colour, and the crisp snap of good chocolate.



CONCHES

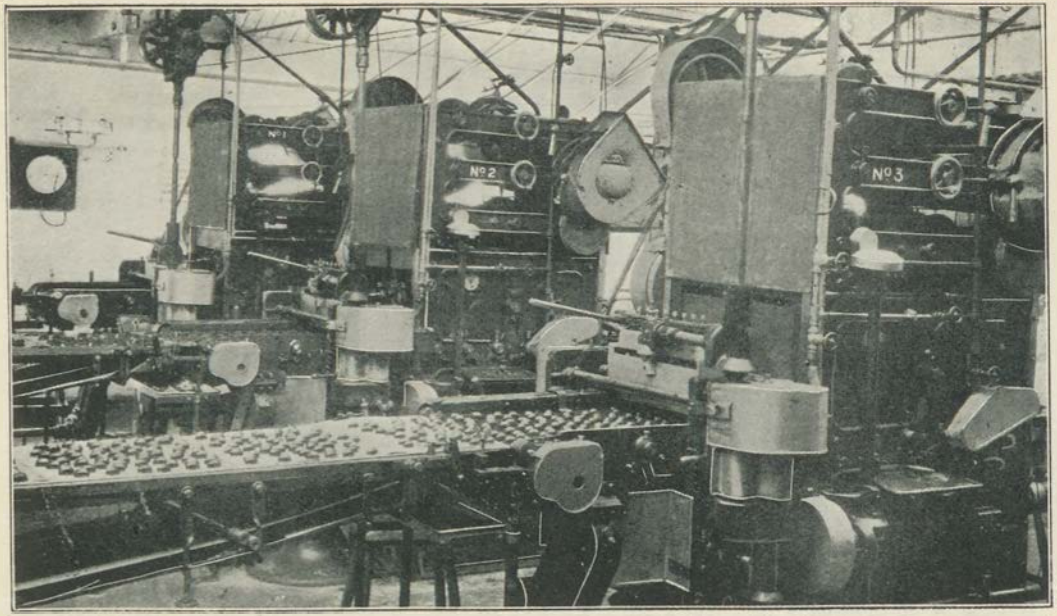
(Messrs. Cadbury Bros., Ltd., Bournville)

The wrapping is done by machinery, and much attention is given to the appearance of the package. Old Gorgon Graham says, " The package doesn't count after the eye has been attracted to it, and in the end it finds its way to the scrap heap. It's the quality of the goods inside which tells." This is no doubt true in the long run, but to please the eye is the first step towards pleasing the palate.

Covering Chocolate. While plain chocolate deserves its popularity not only on account of its flavour but also because it is a convenient and compact form of nourishment, the property that chocolate has of blending with most flavours and, in the form of an " overcoat," of protecting and preserving the confection inside, has led to a huge development of the industry. Crêmes, soft caramels, and liqueurs are covered in this way, as well as biscuits, roasted nuts, Turkish delight, nougat, and indeed almost everything that contains or harmonises with sugar. In 1922 some ingenious American created a boom in chocolate-covered ices, which were sold under the quaint name of " Eskimo pie."

Covering chocolate may be prepared in the same way as plain chocolate, save that more cacao butter must be added to give the necessary fluidity. The best covering is done by hand, the " centre " being dipped on a fork into a little bowl of chocolate, but there are two wonderful machines, the *Enrober* and the *Enpholda*, which do good work. An army of crêmes are marched on a wire band straight through a miniature cascade of chocolate and come out enrobed, or enfolded, in a covering of chocolate.

The production and boxing of chocolate-covered goods in all their variety of substance, form and decoration entail much hand work, and are the greatest labour-absorbing items in the cocoa and chocolate industry.



ENROBER MACHINES

(Messrs. Rowntree & Co., Ltd., York)

They explain also the high percentage of feminine labour employed therein.

Milk Chocolate. The incentive of competition is a poor thing beside the stimulus of creation. Few things have resulted in more solid delight for children than the invention of milk chocolate. It is one of those little inventions which matter to a million people. Some of these pass unnoticed—no song was ever made about the man who put the hump on the hairpin—but the name of M. D. Peter, of Vevey, Switzerland, will not be forgotten. He first produced milk chocolate in 1876. It is now manufactured in a variety of ways direct from fresh milk, from condensed milk and from milk powder. Save for the method of incorporating the milk, the mixing, grinding, conching and moulding are similar to plain chocolate. Good milk chocolate is an ideal food, each pound of a well-known British make containing roughly one and a half pints of milk from which the water has been evaporated, five ounces of cacao bean products and seven ounces of sugar.

CHAPTER XII

SOME STATISTICS OF CACAO PRODUCTION AND CONSUMPTION

A GENERAL idea of the way in which the world's production is made up can be obtained from the chart on page 135.

WORLD'S HARVEST OF CACAO BEANS
(In tons of 1,000 kilos)

Producing Country.	1902	1912	1921	1922[1]
	Tons.	Tons.	Tons.	Tons.
Gold Coast (B.)	2,710	39,260	133,909	159,000
Brazil	20,642	31,415	44,280	51,000
Ecuador	24,398	37,078	40,066	42,000
Trinidad (B.)	17,612	18,878	34,843	23,000
Nigeria (B.)	—	3,463	18,473	28,000
San Thomé	17,619	36,012	28,276	18,000
San Domingo	8,975	20,833	26,574	19,000
Venezuela	9,925	10,985	22,000	24,000
Grenada (B.)	6,043	5,519	4,471	4,000
Fernando Po	1,198	2,229	5,199	6,000
Jamaica (B)	—	3,374	3,677	3,700
Ceylon (B.)	2,673	3,720	3,170	2,000
French Colonies	1,706	1,706	4,200	7,000
German Colonies	658	5,689	3,500	—
Costa Rica	—	309	2,000	2,000
Surinam	2,355	962	1,636	1,800
Haiti	1,990	3,043	2,000	2,000
Java	—	2,024	1,057	1,500
Belgian Congo, St. Lucia, Cuba, Dominica, etc.	4,776	5,558	7,580	9,000
TOTAL	123,480	232,057	386,917	403,000

B. denotes British Empire. [1] Estimated.

The above figures are compiled from the *Gordian*, the most reliable source of cacao statistics. From a study of these one realises that the cultivation of cacao has

not been neglected. Looking back over the last twenty years one sees the continuous increase in cacao production, and that during this period the world's harvest has grown to three or four times what it was in 1902. This increase is largely due to the Gold Coast. The poet has written somewhere of mournful numbers—those concerning the Gold Coast cacao crop make cheerful reading, and the history of Accra cacao may be epitomised thus—

GOLD COAST CACAO PRODUCTION

Year.	*Tons of Cacao.*	*Value.*
		£
1892	0·1	4
1902	540·0	27,280
1912	38,624·0	1,642,733
1922	156,271·0	5,753,478

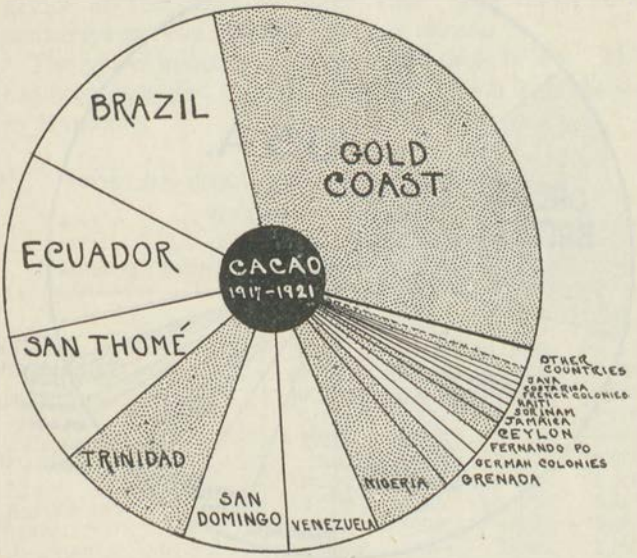
Briefly noting the other producing areas in order of quantity, one observes that Brazil, with its Bahia and Para cacao, has now established its position as the second largest producer in the world. It has overtaken Ecuador in a neck and neck race. The Ilheos district supplies the major part of the Bahia cacao.

Ecuador, third on the list, is famous for its Arriba cacao. It contains several very large estates, the greatest being the Caamano Tengel estate on which grow about two and a half million cacao trees.

Trinidad and San Thomé have for many years been competitors for fourth place. Trinidad, the second largest producer in our Empire, has long been known for its fine and well-prepared cacao. In San Thomé is the famous Agua Isé estate, probably the largest and most efficiently organised estate in the world, which produces some 4,000 tons of cacao per annum.

Nigeria, with its Lagos cacao, has made great stride

during the last few years. It promises to advance in front of Trinidad and San Thomé and take fourth place. Not only is the output rapidly increasing, but there are definite signs that care is beginning to be taken in its preparation for the market. Its quality, however, as a



CACAO PRODUCTION OF THE WORLD

Mean World Production for five years, 1917–1921, 368,000 tons per annum.

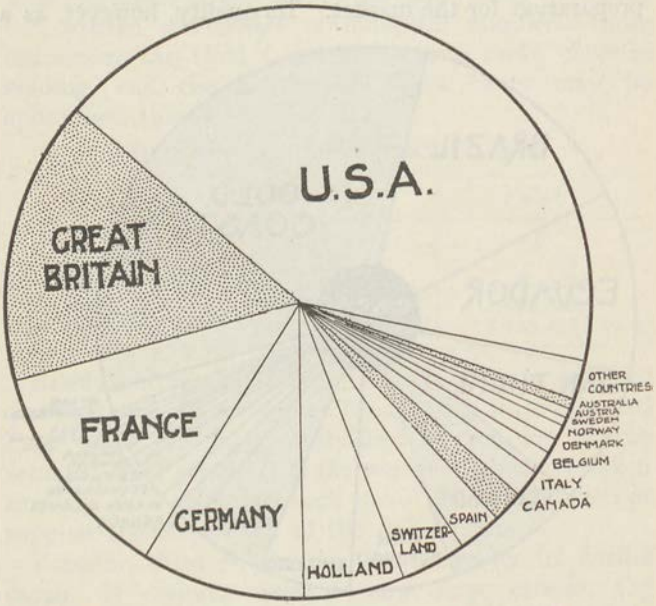
This diagram shows the relative amounts produced by the chief producing countries during 1917–1921. The shaded parts show production in the British Empire.

whole is still decidedly below the standard of the Gold Coast cacao.

The Dominican Republic (Santo Domingo) is rising in importance. A large portion of the Sanchez cacao goes to the United States. It is one of the common kinds

and on the New York market fetches about the same price as Accra cacao.

A large quantity of the fine kinds of Venezuelan cacao



CONSUMPTION OF CACAO BEANS, 1917–1921

The diagram shows the relative amounts consumed by the chief consuming countries during 1917–1921.

still go to France. Since the war, America is taking an increasing quantity of Caracas and Columbian.

Grenada produces a small bean of very constant quality.

Ceylon cacao has a very beautiful external appearance, and the fine varieties have a pale interior.

The export of cacao from Costa Rica has risen sufficiently in the last ten years to deserve separate mention.

It will be noted that the British Empire produces about half the world's cacao.

A sound impression of the consumption of cacao during the five years 1917 to 1921 can be obtained by a glance at the chart on page 136. The mean total consumption was 360,000 tons per annum.

The figures in detail are given in the table below. This has been compiled from the *Gordian*, which is published in Hamburg.

WORLD'S CONSUMPTION OF CACAO BEANS

(In tons of 1,000 kilos)

Consuming Country.	1902	1912	1921	1922[1]
	Tons.	Tons.	Tons.	Tons.
U.S.A.	23,120	66,553	124,416	143,000
Germany	20,687	55,085	102,000	84,000
Great Britain	20,386	28,044	47,164	51,000
France	19,343	26,891	33,215	39,000
Holland	9,172	24,921	28,785	36,000
Belgium	2,277	6,992	9,220	9,000
Canada	312	3,039	8,417	8,000
Spain	6,002	5,250	7,953	10,000
Switzerland	5,707	10,342	6,389	3,000
Italy	466	2,432	4,216	5,000
Austria	1,820	7,734	3,200	2,000
Norway	410	1,136	3,601	3,000
Sweden	591	1,449	1,917	3,000
Denmark	826	1,727	3,063	2,000
Australia	554	747	9,000	8,000
Other Countries	2,480	9,147	4,064	5,000
TOTAL	114,153	251,589	396,620	411,000

[1] Estimated.

It is thought that Germany will have difficulty in maintaining its rapid and uncertain rise in consumption

to about 100,000 tons, and it is certainly remarkable that (according to the *Confectioners' Journal*) in 1921, Germany consumed 127,000 tons of chocolate, an amount over double its consumption in pre-war days.

The United States now consume about one-third of the world's cacao production. It is said that, when the States "went dry," many of the breweries were converted into chocolate factories. This may partly account for America's amazing appetite for cacao products. To satisfy this appetite, New York imports every year about 2,000,000 bags of cacao. Of these, about half come from the Gold Coast, although in pre-war days Accra cacao was practically unknown in the United States. The consumption of cacao has shown a rapid increase : in 1916 it was 1·6 lbs. for each person, and in 1920 was 3·2 lbs. In Great Britain, the consumption was nearly 2 lbs. for each person in 1915, and had increased to 2·4 lbs. in 1920, which figure was maintained in 1921 and 1922. There has been a very steady rise in the amount of cacao consumed in Great Britain during the last hundred years, as is well shown by the table in the chapter on history (see p. 26). The home consumption in recent years is given in English tons in the table below, which is taken from the Board of Trade returns—

CACAO IN THE UNITED KINGDOM

Year.	*Imported.*	*Exported.*	*Home Consumption.*
	Tons.	Tons.	Tons.
1920	103,065	43,734	50,651
1921	60,487	28,326	45,865
1922	64,084	18,419	50,530

The total stock of raw cacao in the world (apart from that in the manufacturers' stores) taken on the last

day of the year, generally amounts to round about 40 per cent of the year's harvest or consumption. The stock held in London at the end of 1920 was 35,900 tons ; 1921, 34,350 tons ; and 1922, 29,200 tons.

The cacao imported into the United Kingdom came from various producing centres as follows—

CACAO BEANS IMPORTED INTO THE UNITED KINGDOM

	1921	1922
	Tons.	Tons.
British West Africa . . .	48,103	50,930
British West Indies . . .	7,746	6,692
Ceylon	785	1,130
Others	2,710	3,266
Ecuador	865	1,365
Brazil	278	701
Total imported . . .	60,487	64,084
Value	£2,860,156	£2,931,675

In pre-war days about 50 per cent of the cacao imported into the United Kingdom was grown in British Possessions. By 1919 this had increased to 75 per cent. In that year a preferential duty was introduced, and partly as a result, in 1921, as much as 94½ per cent of cacao imported into the United Kingdom was Empire-produced.

The duty, at the time of writing, on raw cacao-beans is 3d. per lb. on foreign, and 2½d. per lb. on British. It is high compared with the duty in other countries. It may be of interest to tabulate the changes in the duty over the last seventy years. (*See* page 140.)

DUTY ON CACAO, CACAO BUTTER, AND CACAO SHELL
(1853–1923)

Year.	On Raw Cacao.	On Cacao Butter.	On Cacao Shell.
	Per cwt.	Per cwt.	Per cwt.
	s. d.	s. d.	s. d.
1853–1915 . . .	9 4	9 4	2 –
1915	14 –	14 –	3 –
1916 (5th Apr.–22nd June)	56 –	56 –	12 –
1916–1919 . . .	42 –	42 –	6 –
1919–1922 (Foreign) . .	42 –	42 –	6 –
(British) . .	35 –	35 –	5 –
May, 1922 (Foreign) . .	28 –	28 –	4 –
(British) . .	23 4	23 4	3 4

Industry is being more and more considered as an organic whole, the life of which depends on the healthy growth of every part. The industry considered in this book has all the signs of vitality. On the scientific side the facilities for the study of cacao cultivation are being slowly but continuously improved—an important step in this direction being the opening of the West Indian Agricultural College in Trinidad in 1922—and the annual output of research on matters related to cocoa and chocolate is being greatly increased by the Research Association founded in 1918. On the purely industrial side there are similar signs of healthy progress. On the one hand, we have the rapid increase in the production of the raw material, an increase which will continue unless Nigeria and the Gold Coast suffer a set-back. On the other hand, we have the enterprise of the manufacturers who, aided by the charms and virtues of cacao products and in spite of high duties, have made consumption keep pace with production. The author hopes this little book has enabled the reader to take a comprehensive glance at the whole industry, and that it will incite him to study the current literature and larger works dealing with its various branches,

BIBLIOGRAPHY

SELECTED BOOKS ON COCOA AND CHOCOLATE

CULTIVATION—
Cocoa, by C. J. J. van Hall ; 512 pp. (Macmillan, 1914.)

FERMENTATION AND DRYING—
The Fermentation of Cacao, edited by H. Hamel Smith ; 318 pp. (Bale, Son, & Danielsson, 1913.)

THE GOLD COAST—
The Gold Coast Handbook. Official Publication, 1923.

COCOA AND CHOCOLATE MANUFACTURE—
Cocoa and Chocolate, their Chemistry and Manufacture, by R. Whymper ; 568 pp. (J. & A. Churchill, 1921.)

PERIODICALS

The following periodicals deal with cacao production :

Bulletin of the Imperial Institute. For authoritative articles on cacao cultivation, *see* pp. 40–95, 1919 ; pp. 36–73, 1920 ; p. 189, 1921, etc.

Tropical Life. Gives prominence to cacao. It is edited by H. Hamel Smith, who writes the statistical Market Reports on Cacao.

The West India Committee Circular. Contains articles on cacao of special interest to West Indians.

West Africa. Contains reliable articles on all that concerns West African prosperity.

The Gordian. A German periodical, published in Hamburg. Its cacao statistics are the most complete published.

There is no British periodical which deals scientifically with cocoa and chocolate manufacture save *Research*, which is issued by the Cocoa and Chocolate, etc., Research Association, 9 Queen Street Place, E.C.4, for the private use of its members. On the commercial side one should consult *The Confectioners' Union*.

INDEX

NAMES of places are in heavy type.
An asterisk indicates an illustration.

PRINTED IN GREAT BRITAIN AT THE PITMAN PRESS, BATH
Y—(1463E)

A SELECTION FROM THE LIST OF

COMMERCIAL HANDBOOKS

Published by

SIR ISAAC PITMAN & SONS, LTD.

Complete Catalogue sent post free on application.

LONDON: PARKER STREET, KINGSWAY, W.C.2.

BATH: Phonetic Institute. MELBOURNE: The Rialto, Collins St.
NEW YORK: 2 West 45th St. TORONTO: 70 Bond Street.

The Prices contained in this List apply only to the British Isles, and are subject to alteration without notice.

TERMS

Cash MUST *be sent with the order,* AND MUST INCLUDE AN APPROXIMATE AMOUNT FOR THE POSTAGE. *When a remittance is in excess of the sum required, the surplus will be returned.*

Sums under 6d. can be sent in stamps. For sums of 6d. and upwards Postal Orders or Money Orders are preferred to stamps, and should be crossed and made payable to SIR ISAAC PITMAN & SONS, LTD.

Remittances from abroad should be by means of International Money Orders in Foreign Countries, and by British Postal Orders within the British Overseas Dominions. Colonial Postal Orders are not negotiable in England. Foreign stamps CANNOT BE ACCEPTED.

ARITHMETIC

PRICE

Arithmetic and Book-keeping.
By THOS. BROWN, F.S.S., and VINCENT E. COLLINGE, A.C.I.S. In two parts.
Part I . . . . . Net 2/6
Part II . . . . . Net 1/3

Arithmetic of Commerce.
By P. W. NORRIS, M.A., B.Sc. (Hons.) . . Net 4/-

Complete Commercial Arithmetic. 3/-
Answers . . . . . Net 1/6

Complete Mercantile Arithmetic.
With Elementary Mensuration.
By H. P. GREEN, F.C.Sp.T. (With Key) . Net 6/-

Arithmetic—contd.

		PRICE
Counting-House Mathematics. By H. W. Porritt and W. Nicklin, A.S.A.A..	Net	2/–
Elements of Commercial Arithmetic. By Thomas Brown	Net	2/–
Metric and British System of Weights, Measures, and Coinage. By Dr. F. Mollwo Perkin	Net	3/6
Principles and Practice of Commercial Arithmetic. By P. W. Norris, M.A., B.Sc. . . .	Net	7/6
Rapid Methods in Arithmetic. By John Johnston. Revised and Edited by G. K. Bucknall, A.C.I.S.	Net	1/–
Slide Rule Applied to Commercial Calculations, The By R. M. Shireby	Net	2/6
Smaller Commercial Arithmetic. By C. W. Crook, B.A., B.Sc. . . .	Net	2/–

BOOK-KEEPING AND ACCOUNTANCY

Accountancy. By F. W. Pixley, F.C.A., *Barrister-at-Law* .	Net	7/6
Accountants' Dictionary. Edited by F. W. Pixley, F.C.A. In 2 Vols. .	Net	63/–
Accounting. By S. S. Dawson, M.Com., F.C.A., and R. C. de Zouche, F.C.A.	Net	10/6
Accounts of Executors, Administrators, and Trustees. By William B. Phillips, A.C.A., A.C.I.S. .	Net	5/–
Advanced Accounts. Edited by Roger N. Carter, M.Com., F.C.A. .	Net	7/6
Advanced Book-keeping.	Net	3/6
Apportionment in Relation to Trust Accounts. By A. F. Chick, *Incorporated Accountant* . .	Net	6/–
Auditing, Accounting, and Banking. By F. Dowler, A.C.A., and E. M. Harris, A.I.B.	Net	7/6

Book-keeping and Accountancy—contd.

	PRICE
Auditors : Their Duties and Responsibilities. By F. W. PIXLEY, F.C.A. . . . . Net	21/-
Balance Sheets, How to Read and Understand. By PHILIP TOVEY, F.C.I.S. . . . . Net	2/6
Book-keeping and Commercial Practice. By H. H. SMITH, F.C.T., F.Inc.S.T.	1/9
Book-keeping for Beginners. By W. E. HOOPER, A.C.I.S. . . . . Net	2/-
Book-keeping for Bootmakers, Retailers, etc. By F. W. WHITFIELD . . . . . Net	3/6
Book-keeping for Commercial and Secondary Schools. By C. H. KIRTON, A.C.I.S. . . . . Net	6/-
Book-keeping for Retailers. By H. W. PORRITT and W. NICKLIN, A.S.A.A. . Net	2/-
Book-keeping Simplified. By W. O. BUXTON, A.C.A. (Hons.) . . .	3/6
Answers . . . . . Net	3/-
Book-keeping Teachers' Manual. By C. H. KIRTON, A.C.I.S., F.Inc.S.T. . . Net	7/6
Branch Accounts. By P. TAGGART, A.S.A.A. . . . . Net	3/-
Business Book-keeping. By J. ROUTLEY . . . . . Net	3/6
Commercial Goodwill. By P. D. LEAKE, F.C.A. . . . . Net	21/-
Company Accounts. By ARTHUR COLES, F.C.I.S. . . . . Net	7/6
Complete Book-keeping. Net	6/6
Cost Accounts in Principle and Practice. By A. CLIFFORD RIDGWAY, F.C.A. . . . Net	5/-
Cost Accounts for the Metal Industry. By H. E. PARKES, M.Com., A.C.W.A. . . Net	10/6
Costing and Price Fixing. By J. M. SCOTT-MAXWELL, B.Sc. . . . Net	6/-
Depreciation and Wasting Assets. By P. D. LEAKE, F.C.A. . . . Net	15/-

Book-keeping and Accountancy—contd.

		PRICE
Dictionary of Book-keeping. By R. J. Porters	Net	7/6
Elements of Book-keeping. By W. O. Buxton, A.C.A. (Hons.)	Net	2/–
Full Course in Book-keeping. By H. W. Porritt and W. Nicklin, A.S.A.A.	Net	5/–
Higher Book-keeping and Accounts. By H. W. Porritt and W. Nicklin, A.S.A.A.	Net	5/–
Hotel Book-keeping.	Net	2/6
How to Become a Qualified Accountant. By R. A. Witty, A.S.A.A.	Net	3/6
Manual of Book-keeping and Accounting. By A. Nixon, F.C.A., and H. E. Evans, A.C.A.	Net	10/6
Manual of Cost Accounts. By H. Julius Lunt	Net	7/6
Manufacturing Book-keeping and Costs. By G. Johnson, F.C.I.S.	Net	3/6
Municipal Audit Programmes. By S. Whitehead, A.S.A.A.	Net	3/6
Municipal Book-keeping. By J. H. McCall	Net	7/6
Notes of Lessons on Book-keeping. By J. Routley	Net	3/6
Practical Book-keeping. By G. Johnson, F.C.I.S.	Net	6/–
Principles of Auditing. By F. R. M. De Paula, O.B.E., F.C.A.	Net	7/6
Principles of Book-keeping Explained. By I. H. Humphrys	Net	2/6
Questions and Answers in Book-keeping and Accounting. By F. F. Sharles, F.S.A.A., A.C.I.S.	Net	10/6
Railway Accounts and Finance. By Allen E. Newhook, A.K.C.	Net	5/–
Shopkeepers' Accounts Simplified. By C. D. Cornell	Net	2/–
Sinking Funds, Reserve Funds, and Depreciation. By J. H. Burton, A.S.A.A.	Net	3/6
Theory and Practice of Costing. By E. W. Newman, A.C.A.	Net	8/6

BUSINESS TRAINING

		PRICE
Business Handwriting.	Net	1/6
Business Methods and Secretarial Work for Girls and Women. By HELEN REYNARD, M.A.	Net	2/6
Commercial Handwriting and Correspondence.	Net	2/6
Commercial Practice. By ALFRED SCHOFIELD	Net	3/6
Counting-House Routine. 1st Year's Course. By VINCENT E. COLLINGE, A.C.I.S.	Net	1/9
Counting-House Routine. 2nd Year's Course. By VINCENT E. COLLINGE, A.C.I.S.	Net	3/6
Course in Business Training. By G. K. BUCKNALL, A.C.I.S.		2/6
Elements of Commerce. By F. HEYWOOD, A.C.I.S.	Net	4/–
Handbook for Commercial Teachers. By FRED HALL, M.A., B.Com., F.C.I.S.	Net	2/6
How to Become a Private Secretary. By J. E. MCLACHLAN, F.I.P.S.	Net	3/6
How to Enter the Mercantile Marine. By R. A. FLETCHER	Net	3/6
How to Teach Business Training. By F. HEELIS, F.C.I.S.	Net	2/6
How to Write a Good Hand. By B. T. B. HOLLINGS	Net	1/6
Junior Woman Secretary. By ANNIE E. DAVIS, F.Inc.S.T.	Net	2/–
Manual of Business Training.	Net	4/–
Modern Business and Its Methods. By W. CAMPBELL, Chartered Secretary.	Net	7/6
Popular Guide to Journalism. By A. KINGSTON	Net	2/6
Practical Journalism and Newspaper Law. By A. BAKER, M.J.I., and E. A. COPE	Net	3/6

		PRICE
Principles and Practice of Commerce. By JAMES STEPHENSON, M.A., M.Com., D.Sc.	Net	8/6
Principles of Business. By JAMES STEPHENSON, M.A., M.Com., D.Sc.		
Part I	Net	2/6
Part II	Net	3/6
Routine of Commerce. By ALFRED SCHOFIELD, B.Sc. (Econ).	Net	4/–
Theory and Practice of Commerce. Edited by F. HEELIS, F.C.I.S. Assisted by Specialist Contributors	Net	7/6
Traders and Trading. By W. J. WESTON, M.A., B.Sc.	Net	2/6

CIVIL SERVICE

Civil Service Arithmetic Tests. By P. J. VARLEY-TIPTON	Net	2/6
Civil Service Essay Writing. By W. J. ADDIS, M.A.	Net	2/6
Civil Service Guide. By A. J. LAWFORD JONES	Net	2/6
Civil Service Practice in Précis Writing. Edited by ARTHUR REYNOLDS, M.A. (Oxon)	Net	2/6
Civil Servant and His Profession, The	Net	3/6
Copying Manuscript, Orthography, Handwriting, Etc. By A. J. LAWFORD JONES.	Net	3/6
Digesting Returns into Summaries. By A. J. LAWFORD JONES	Net	2/6
Elementary Précis Writing. By WALTER SHAWCROSS, B.A.	Net	2/–
Guide to Indexing and Précis Writing. By W. J. WESTON, M.A., B.Sc.	Net	2/–
Indexing and Précis Writing. By A. J. LAWFORD JONES	Net	2/6

ENGLISH AND COMMERCIAL CORRESPONDENCE

		PRICE
Commercial Correspondence and Commercial English.	Net	3/6
Commercial Dictionary.	Net	1/6
Correspondence of Commerce, The. By A. Risdon Palmer, B.Sc., B.A.	Net	4/-
English Composition and Correspondence. By J. F. Davis, D.Lit., M.A., LL.B. (Lond.)	Net	2/-
English for Commercial Students. By H. W. Houghton	Net	2/6
English for Technical Students. By F. F. Potter, M.A.		2/-
English Grammar. By C. D. Punchard, B.A. (Lond.)	Net	2/-
English Grammar and Composition. By W. J. Weston, M.A., B.Sc. (Lond.)	Net	5/-
English Mercantile Correspondence.	Net	3/6
English Prose Composition. By W. J. Weston, M.A., B.Sc. (Lond.)	Net	3/6
Guide to Commercial Correspondence and Business Composition. By W. J. Weston, M.A., B.Sc. (Lond.)		2/6
Guide to English Composition. By the Rev. J. H. Bacon	Net	2/-
How to Teach Commercial English. By Walter Shawcross, B.A.	Net	3/6
Manual of Commercial English. By Walter Shawcross, B.A.	Net	3/6
Pocket Dictionary.	Net	1/6
Practice in English. By P. H. Reaney, M.A.		2/6
Principles and Practice of Commercial Correspondence. By J. Stephenson, M.A., M.Com., D.Sc.	Net	7/6
Punctuation as a Means of Expression. By A. E. Lovell, M.A.	Net	1/-

COMMERCIAL GEOGRAPHY AND HISTORY

		PRICE
Commercial Geography of the British Empire Abroad and Foreign Countries.	Net	3/–
Commercial Geography of the British Isles.	Net	2/6
Commercial Geography of the World.	Net	4/6
Commercial History. By J. R. V. MARCHANT, M.A.	Net	5/6
Elements of Commercial Geography. By C. H. GRANT, M.Sc., F.R.Met. Soc.	Net	2/–
Elements of Commercial History. By FRED HALL, M.A., B.Com., F.C.I.S.	Net	2/–
Examination Notes on Commercial Geography. By W. P. RUTTER, M.Com.	Net	2/–
Principles of Commercial History. By J. STEPHENSON, M.A., M.Com., D.Sc.	Net	7/6
World and Its Commerce, The.	Net	2/6

ECONOMICS

British Finance (1914-1921). Edited by A. W. KIRKALDY, M.A., B.Litt., M.Com.	Net	15/–
British Labour (1914-1921). Edited by A. W. KIRKALDY, M.A., B.Litt., M.Com.	Net	10/6
Dictionary of Economic and Banking Terms. By W. J. WESTON, M.A., B.Sc., and A. CREW	Net	5/–
Economic Geography. By JOHN MCFARLANE, M.A., M.Com.	Net	10/6
Economic Geography, The Principles of. By R. N. RUDMOSE BROWN	Net	7/6
Economics for Business Men By W. J. WESTON, M.A., B.Sc.	Net	3/6
Elements of Political Economy. By H. HALL, B.A.	Net	2/–
Guide to Political Economy. By F. H. SPENCER, D.Sc., LL.B.	Net	3/6

Economics—contd.

	PRICE
History and Economics of Transport. By A. W. KIRKALDY, M.A., B.Litt. (Oxford), M.Com. (Birm.), and A. DUDLEY EVANS . . . Net	15/-
Housing Problem, The. By JOHN J. CLARKE, M.A., F.S.S. . . . Net	21/-
Labour, Capital and Finance. By "SPECTATOR" (W. W. WALL, F.J.I., F.S.S.) . Net	3/6
Local Government of the United Kingdom. By JOHN J. CLARKE, M.A., F.S.S. . . . Net	7/6
Outlines of Central Government. By JOHN J. CLARKE, M.A., F.S.S. . . . Net	1/6
Outlines of Industrial and Social Economics. By JOHN J. CLARKE, M.A., F.S.S., and JAMES E. PRATT, A.C.I.S. . . . . Net	1/6
Outlines of Local Government. By JOHN J. CLARKE, M.A., F.S.S. . . . Net	2/6
Outlines of the Economic History of England. By H. O. MEREDITH, M.A., M.Com. . . Net	7/6
Plain Economics. By JOHN LEE, M.A., M.Com.Sc. . . . Net	3/6
Social Administration. By JOHN J. CLARKE, M.A., F.S.S. . . . Net	7/6
Substance of Economics, The. By H. A. SILVERMAN, B.A. . . . . Net	6/-
Value for Money. By SIR WM. SCHOOLING, K.B.E. . . . Net	2/6

BANKING AND FINANCE

Bankers' Advances. By F. R. STEAD. Edited by SIR JOHN PAGET, K.C. Net	6/-
Bankers' Advances Against Produce. By A. WILLIAMS, A.I.B. . . . . Net	6/-
Bankers' Credits. By W. F. SPALDING . . . . . Net	10/6
Bankers' Securities Against Advances. By LAWRENCE A. FOGG, Cert. A.I.B. . . Net	6/-

Banking and Finance—contd.

	PRICE
Bankers' Clearing House, The. By P. W. MATTHEWS . . . . . Net	7/6
Bank Organization, Management, and Accounts. By J. F. DAVIS, M.A., D.Lit., LL.B. (Lond.) . Net	6/–
Cheques. By C. F. HANNAFORD . . . . . Net	6/–
Dictionary of Banking. By W. THOMSON and LLOYD CHRISTIAN . . Net	30/–
Eastern Exchange. By W. F. SPALDING . . . . . Net	15/–
Elements of Banking. By J. P. GANDY . . . . . Net	2/–
English Public Finance. By HARVEY E. FISK . . . . . Net	7/6
Foreign Exchange and Foreign Bills in Theory and in Practice. By W. F. SPALDING, Cert. A.I.B. . . . Net	7/6
Foreign Exchange, A Primer of. By W. F. SPALDING . . . . . Net	3/6
Functions of Money, The. By W. F. SPALDING . . . . . Net	7/6
London Money Market, The. By W. F. SPALDING . . . . . Net	10/6
Money and the Stock and Share Markets. By EMIL DAVIES . . . . . Net	2/–
Money, Exchange, and Banking. By H. T. EASTON, A.I.B. . . . . Net	6/–
Notes on Banking and Commercial Law. By T. LLOYD DAVIES . . . . . Net	3/–
Practical Banking. By J. F. G. BAGSHAW, Cert. A.I.B. . . . Net	7/6
Simple Interest Tables. By SIR WILLIAM SCHOOLING, K.B.E. . . Net	21/–
Talks on Banking to Bank Clerks. By H. E. EVANS . . . . . Net	2/6
Title Deeds and the Rudiments of Real Property Law. By F. R. STEAD . . . . . Net	6/–

INSURANCE

PRICE

Actuarial Science, The Elements of.
By R. E. Underwood, M.B.E., F.I.A. . . Net 5/-

Common Hazards of Fire Insurance.
By W. G. Kubler Ridley, F.C.I.I. . . Net 5/-

Guide to Life Assurance.
By S. G. Leigh, F.I.A. . . . . Net 5/-

Guide to Marine Insurance.
By Henry Keate . . . . . Net 3/6

Insurance.
By T. E. Young, B.A., F.R.A.S., W. R. Strong, F.I.A., and Vyvyan Marr, F.F.A., F.I.A. . . . Net 10/6

Insurance Office Organization, Management, and Accounts.
By T. E. Young, B.A., F.R.A.S., and Richard Masters, A.C.A. . . . . Net 6/-

Law and Practice as to Fidelity Guarantees.
By C. Evans and F. H. Jones . . . Net 6/-

Motor Insurance.
By W. F. Todd . . . . . Net 6/-

Pension, Endowment, Life Assurance, and Other Schemes for Commercial Companies.
By H. Dougharty, F.C.I.S. . . . . Net 6/-

Principles of Insurance.
By J. Alfred Eke . . . . . Net 3/6

Principles of Marine Law. (See page 20.)

Successful Insurance Agent, The.
By J. J. Bisgood, B.A., F.C.I.S., J.P. . . Net 2/6

Talks on Insurance Law.
By J. A. Watson, B.Sc., LL.B. . . . Net 3/6

Workmen's Compensation Insurance.
By C. E. Golding, LL.B., F.C.I.I. . . . Net 5/-

SHIPPING

Case and Freight Costs.
By A. W. E. Crosfield . . . . Net 2/-

Consular Requirements for Exporters and Shippers to all Parts of the World.
By J. S. Nowery . . . . . Net 7/6

PRICE

Exporters' Handbook and Glossary, The.
By F. M. DUDENEY . . . . . Net 7/6

Exporting to the World.
By A. A. PRECIADO . . . . . Net 21/–

How to Export Goods.
By F. M. DUDENEY . . . . . Net 2/–

How to Import Goods.
By J. A. DUNNAGE . . . . . Net 2/–

Import and Export Trade.
By A. S. HARVEY . . . . . Net 21/–

Shipbroking.
By C. D. MACMURRAY and M. M. CREE . . Net 3/6

Shipping.
By A. HALL and F. HEYWOOD . . . Net 2/–

Shipping Business Methods.
By R. B. PAUL . . . . . Net 3/6

Shipping Finance and Accounts.
By R. B. PAUL . . . . . Net 2/6

Shipping Office Organization, Management, and Accounts.
By ALFRED CALVERT . . . . . Net 6/–

SECRETARIAL WORK

Chairman's Manual.
By GURDON PALIN, *of Gray's Inn, Barrister-at-Law,* and ERNEST MARTIN, F.C.I.S. . . . . Net 5/–

Company Secretarial Work.
By E. MARTIN, F.C.I.S. . . . . Net 2/–

Company Secretary's Vade Mecum.
Edited by P. TOVEY, F.C.I.S. . . . . Net 3/6

Debentures.
A Handbook for Limited Company Officials, Investors, and Business Men.
By F. SHEWELL COOPER, M.A., *Barrister-at-Law* Net 6/–

Dictionary of Secretarial Law and Practice.
Edited by PHILIP TOVEY, F.C.I.S. With contributions by nearly 40 eminent authorities . . . Net 42/–

Secretarial Work—contd.

		PRICE
Guide for the Company Secretary. By ARTHUR COLES, F.C.I.S.	Net	6/–
Guide to Company Secretarial Work. By O. OLDHAM, A.C.I.S.	Net	3/6
How to Become a Company Secretary. By E. J. HAMMOND, A.C.I.S.	Net	3/6
How to Become a Private Secretary. By J. E. MCLACHLAN	Net	3/6
How to Take Minutes. Edited by E. MARTIN, F.C.I.S.	Net	2/6
Outlines of Transfer Procedure in Connection with Stocks, Shares, and Debentures of Joint Stock Companies. By F. D. HEAD, B.A. (Oxon), *Barrister-at-Law*	Net	3/6
Practical Share Transfer Work. By F. W. LIDDINGTON	Net	3/6
Prospectuses : How to Read and Understand Them. By PHILIP TOVEY, F.C.I.S.	Net	5/–
Questions and Answers on Secretarial Practice. By E. J. HAMMOND, A.C.I.S.	Net	7/6
Secretary's Handbook. Edited by H. E. BLAIN, C.B.E.	Net	5/–
Transfer of Stocks, Shares, and Other Marketable Securities. By F. D. HEAD, B.A.	Net	10/6
What is the Value of a Share ? By D. W. ROSSITER	Net	2/6

INCOME TAX

Corporation Profits Tax. By P. D. LEAKE	Net	1/–
Dictionary of Income Tax and Super Tax Practice. By W. E. SNELLING	Net	25/–
Practical Income Tax. By W. E. SNELLING	Net	3/6

INDUSTRIAL ADMINISTRATION

	PRICE
Common Sense and Labour. By S. Crowther . . . . . Net	8/6
Current Social and Industrial Forces. Edited by L. D. Edie . . . . . Net	12/6
Employment Management. Compiled and Edited by Daniel Bloomfield . Net	8/6
Factory Administration in Practice. By W. J. Hiscox . . . . . Net	8/6
Fair Wage, A. By E. Batten . . . . . Net	2/6
Industrial Control (Applied to Manufacture). By F. M. Lawson, A.M.I.C.E., A.M.I.Mech.E. . Net	8/6
Industrial Organization. By John Lee, M.A., M.Com.Sc. . . . Net	5/–
Lectures on Industrial Administration. Edited by B. Muscio, M.A. . . . . Net	6/–
Management. By J. Lee . . . . . Net	5/–
Modern Industrial Movements. Edited by D. Bloomfield . . . . Net	10/6
Outlines of Industrial Administration. By R. O. Herford, H. T. Hildage, and H. G. Jenkins Net	6/–
Patents for Inventions. By J. Ewart Walker, B.A., and R. Bruce Foster, B.Sc. Net	21/–
Philosophy of Management, The. By Oliver Sheldon, B.A. . . . . Net	10/6
Principles of Industrial Administration, An Introduction to. By A. P. M. Fleming, C.B.E., M.Sc., M.I.E.E., and H. J. Brocklehurst, M.Eng., A.M.I.E.E. . Net	3/6
Problems of Labour. Compiled and Edited by Daniel Bloomfield . Net	8/6
Psychology of Management, The. By L. M. Gilbreth . . . . . Net	7/6
Research in Industry. By A. P. M. Fleming, C.B.E., M.Sc., M.I.E.E., and F. G. Pearce, B.Sc., A.M.I.E.E. . . . Net	10/6

PRICE

Sharing Profits With Employees.
By J. A. Bowie, M.A. . . . . Net 10/6

Workshop Committees.
By C. G. Renould . . . . . Net 1/–

BUSINESS ORGANIZATION AND MANAGEMENT

Business Management for Small Retailers.
By H. W. Theedam . . . . . Net 3/6

Card Index System. Net 2/–

Clubs and Their Management.
By Francis W. Pixley, F.C.A. . . . Net 7/6

Colliery Office Organization and Accounts.
By J. W. Innes, F.C.A., and T. Colin Campbell, F.C.I. . . . . Net 7/6

Counting-House and Factory Organization.
By J. Gilmour Williamson . . . . Net 7/6

Drapery Business Organization, Management, and Accounts.
By J. Ernest Bayley . . . . . Net 7/6

Filing Systems.
By E. A. Cope . . . . . Net 3/6

Grocery Business Organization and Management.
By C. L. T. Beeching and J. Arthur Smart . Net 6/–

Manual of Duplicating Methods.
By W. Desborough . . . . . Net 3 –

Municipal Organization.
By Montagu H. Cox, LL.B. . . . . Net 5 –

Office Machines, Appliances, and Methods.
By W. Desborough, F.C.I. . . . . Net 6/–

Office Organization and Management, Including Secretarial Work.
By Lawrence R. Dicksee, M.Com., F.C.A., and H. E. Blain, C.B.E. . . . . Net 7/6

PRICE

Organization of a Small Business, The.
By W. A. SMITH . . . . . Net 2/6

Solicitors' Office Organization, Management, and Accounts.
By E. A. COPE and H. W. H. ROBINS . . Net 6/–

Stockbroker's Office Organization, Management, and Accounts.
By J. E. DAY . . . . . Net 7/6

ADVERTISING AND SALESMANSHIP

Ads. and Sales.
By HERBERT N. CASSON . . . . Net 8/6

Advertising
By HOWARD BRIDGEWATER . . . . Net 2/–

Advertising as a Business Force.
By P. T. CHERINGTON . . . . . Net 10/6

A Short Course in Advertising.
By A. F. OSBORN . . . . . Net 12/6

Business Man's Guide to Advertising.
By A. E. BULL . . . . . Net 3/6

Buying Goods.
By A. E. BULL . . . . . Net 2/–

Commercial Travelling.
By ALBERT E. BULL . . . . . Net 3/6

Craft of Silent Salesmanship.
By C. MAXWELL TREGURTHA and J. W. FRINGS Net 5/–

Effective Postal Publicity.
By MAX RITTENBERG . . . . . Net 7/6

Efficient Salesmanship.
By F. W. SHRUBSALL . . . . . Net 2/–

Mail Order Business, Conducting a.
By A. E. BULL . . . . . Net 2/–

Mail Order Organization.
By P. E. WILSON . . . . . Net 3/6

Making Advertisements and Making Them Pay.
By ROY S. DURSTINE . . . . . Net 12/6

Modern Methods of Selling.
By L. J HOENIG . . . . . Net 10/6

PRICE

Modern Publicity.
By A. W. Dean . . . . . Net 2/6

New Business, The.
By Harry Tipper . . . . . Net 8/6

Practical Press Publicity.
By A. L. Culyer . . . . . Net 3/6

Practical Salesmanship.
By N. C. Fowler, assisted by 29 expert salesmen, etc. Net 7/6

Principles of Practical Publicity.
By Truman A. de Weese . . . . Net 10/6

Psychology of Advertising in Theory and Practice, The.
By W. Dill Scott, Ph.D. . . . . Net 12/6

Salesmanship.
By W. A. Corbion and G. E. Grimsdale . Net 3/6

Ticket and Showcard Designing.
By F. A. Pearson . . . . . Net 3/6

Window Dressing.
By G. L. Timmins . . . . . Net 2/–

BUSINESS HANDBOOKS AND WORKS OF REFERENCE

Business Man's Encyclopaedia and Dictionary of Commerce.
Edited by J. A. Slater, B.A., LL.B. (Lond.). Assisted by about 50 specialists as contributors. Four vols. Net £4/4/–

Business Man's Guide.
Edited by J. A. Slater, B.A., LL.B. . . Net 6/–

Business Statistics.
By R. W. Holland, O.B.E., M.A., M.Sc., LL.D. Net 3/6

Business Terms, Phrases, and Abbreviations.
Net 3/6

Commercial Arbitrations.
By E. J. Parry, B.Sc., F.I.C., F.C.S. . . Net 3/6

Commercial Commodities.
By F. Matthews, B.Sc., A.I.C., F.C.S. . . Net 12/6

Business Handbooks and Works of Reference–contd.

PRICE

Commercial Contracts.
By E. J. PARRY . . . . . Net 5/–

Commercial Self-Educator.
Edited by R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D.
Two Vols. . . . . Net 30/–

Commodities of Commerce.
By J. A. SLATER, B.A., LL.B. . . . Net 6/–

Complete Guide to the Improvement of the Memory.
By the late REV. J. H. BACON . . . Net 1/6

Dictionary of the World's Commercial Products.
By J. A. SLATER, B.A., LL.B. (Lond.) . . Net 3/6

Discount, Commission, and Brokerage Tables.
By ERNEST HEAVINGHAM . . . . Net 1/6

Drapery and Drapers' Accounts.
By RICHARD BEYNON . . . . . Net 3/6

History, Law, and Practice of the Stock Exchange, The.
By A. P. POLEY, B.A., *Barrister-at-Law*, and F. H. CARRUTHERS GOULD . . . . . Net 7/6

Ironmongery and Ironmongers' Accounts.
By S. W. FRANCIS . . . . . Net 3/6

Investor's Manual, The.
By W. W. WALL, F.S.S., F.J.I. . . . Net 3/6

Mercantile Terms and Abbreviations.
Net 1/6

Money and the Stock and Share Markets, The.
By EMIL DAVIES . . . . . Net 2/6

Shareholder's Manual, The.
By H. H. BASSETT . . . . . Net 3/6

LAW

Bankruptcy, Deeds of Arrangement, and Bills of Sale.
By W. VALENTINE BALL, M.A., *Barrister-at-Law* Net 12/6

Bills, Cheques, and Notes.
By J. A. SLATER, B.A., LL.B. . . . Net 6/–

PRICE

Commercial Law of England, The.
By J. A. SLATER, B.A., LL.B. (Lond.) . . Net 3/6

Companies and Company Law.
By A. C. CONNELL, LL.B. (Lond.) . . . Net 6/-

Company Case Law.
By F. D. HEAD, B.A. (Oxon) . . . Net 7/6

Elements of Commercial Law, The.
By A. H. DOUGLAS, LL.B. (Lond.) . . . Net 2/-

Elementary Law.
By E. A. COPE . . . . . Net 4/-

Examination Notes on Commercial Law.
By R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D. Net 2/6

Examination Notes on Company Law.
By R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D. Net 2/6

Guide to Company Law.
By R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D. Net 3/6

Guide to Railway Law.
By ARTHUR E. CHAPMAN, M.A., LL.D. (Camb.) Net 7/6

Guide to Bankruptcy Law and Winding-up of Companies.
By F. PORTER FAUSSET, B.A., LL.B., *Barrister-at-Law* Net 3/6

Guide to the Law of Licensing.
By J. WELLS THATCHER . . . . Net 5/-

Inhabited House Duty.
By W. E. SNELLING . . . . . Net 12/6

Law of Contract, The.
By R. W. HOLLAND, M.A., M.Sc., LL.D., *of the Middle Temple, Barrister-at-Law* . . . . . Net 5/-

Law of Repairs and Dilapidations.
By T. CATO WORSFOLD, M.A., LL.D. . . Net 3/6

Law Relating to Secret Commissions and Bribes (Christmas Boxes, Gratuities, Tips, etc.), The.
By ALBERT CREW, *Barrister-at-Law.* With American Notes by MORTEN Q. MACDONALD, LL.B. . Net 10/6

Law Relating to the Carriage by Land of Passengers, Animals, and Goods, The.
By S. W. CLARKE, *of the Middle Temple, Barrister-at-Law* . . . . . Net 7/6

PRICE

Law Relating to the Child.
By R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D. Net 5/-

Law Relating to Trade Customs, Marks, Secrets, Restraints, Agencies, Etc., Etc.
By LAWRENCE DUCKWORTH, *Barrister-at-Law* . Net 1/3

Legal Aspect of Commerce, The.
By A. SCHOLFIELD, M.Com., A.C.I.S. . . Net 7/6

Legal Terms, Phrases, and Abbreviations.
By E. A. COPE . . . . . Net 3/-

Mercantile Law.
By J. A. SLATER, B.A., LL.B. (Lond.) . . Net 7/6

Municipal and Local Government Law.
By H. EMERSON SMITH, LL.B. (Lond.) . . Net 7/6

Outlines of Company Law.
By F. D. HEAD, B.A. (Oxon) . . . Net 2/6

Partnership Law and Accounts.
By R. W. HOLLAND, O.B.E., M.A., M.Sc., LL.D. Net 6/-

Principles of Marine Law.
By LAWRENCE DUCKWORTH . . . . Net 7/6

Questions and Answers in Commercial Law.
By R. W. HOLLAND . . . . . Net 5/-

Railway (Rebates) Case Law.
By GEO. B. LISSENDEN . . . . . Net 10/6

Solicitor's Clerk's Guide.
By E. A. COPE . . . . . Net 4/-

Wills, Executors and Trustees.
By J. A. SLATER, B.A., LL.B. (Lond.) . . Net 2/6

TRANSPORT

Industrial Traffic Management.
By G. B. LISSENDEN . . . . . Net 21/-

History and Economics of Transport, The.
By A. W. KIRKALDY, M.A., B.Litt., M.Com., and A. D. EVANS . . . . . Net 15/-

How to Send Goods by Road, Rail, and Sea.
By G. B. LISSENDEN . . . . . Net 2/-

Motor Road Transport for Commercial Purposes.
By J. PHILLIMORE . . . . . Net 12/6

PITMAN'S

COMMON COMMODITIES AND INDUSTRIES

SERIES

In each volume of this series a particular product or industry is treated by an expert writer and practical man of business in an interesting non-technical style.

In crown 8vo, about 150 pp., including many illustrations, and, where necessary, a map and diagrams. **3s.** net.

Acids, Alkalis, and Salts.
By G. H. J. Adlam, M.A., B.Sc.

Alcohol.
By C. Simmonds.

Aluminium.
By G. Mortimer, M.Inst.Met.

Anthracite.
By A. L. Summers.

Asbestos.
By A. L. Summers.

Boot and Shoe Industry, The.
By J. S. Harding.

Bread and Bread Baking.
By J. Stewart.

Brushmaker, The.
By Wm. Kiddier.

Butter and Cheese.
By C. W. Walker Tisdale and Jean Jones

Button Industry, The.
By W. U. Jones.

Carpets.
By R. S. Brinton.

Clays and Clay Products.
By Alfred B. Searle.

Clocks and Watches.
By G. L. Overton.

Clothing Industry, The.
By B. W. Poole, M.U.K.A.

Coal.
By Francis H. Wilson, M.Inst. M.E.

Coal Tar.
By A. R. Warnes, F.C.S.

Cocoa and Chocolate.
By A. W. Knapp.

Coffee.
By B. B. Keable.

Cold Storage and Ice Making.
By B. H. Springett.

Concrete.
By W. Noble Twelvetrees.

Copper.
By H. K. Picard.

Cordage and Cordage Hemp.
By T. Woodhouse and P. Kilgour.

Corn Trade, The British.
By A. Barker.

Cotton.
By R. J. Peake.

Cotton Spinning.
By A. S. Wade.

Cycle Industry, The.
By W. F. Grew.

Drugs in Commerce.
By J. Humphrey, Ph.C.

Dyes.
By A. J. Hall.

Electric Lamp Industry, The.
By G. Arncliffe Percival

Electricity.
By R. E. Neale, B.Sc. (Hons.).

Engraving.
By T. W. Lascelles.

Explosives, Modern.
By S. I. Levy, B.A., B.Sc.

Film Industry, The.
By Davidson Boughey.

Fishing Industry, The.
By Dr. W. E. Gibbs.

Furniture.
By H. E. Binstead.

Furs and the Fur Trade.
By J. C. Sachs.

Gas and Gas Making.
By W. H. Y. Webber, C.E.

Glass and Glass Making.
By P. Marson.

Gloves and the Glove Trade.
By B. E. Ellis.

Gold.
By B. White.

Common Commodities Series—contd.

Gums and Resins.
By Ernest J. Parry, B.Sc., F.I.C., F.C.S.

Incandescent Lighting.
By S. I. Levy, B.A., B.Sc.

Ink.
By C. Ainsworth Mitchell.

Internal Combustion Engines.
By J. Okill, M.I.A.E.

Iron and Steel.
By C. Hood.

Ironfounding.
By B. Whiteley.

Jute Industry, The.
By T. Woodhouse and P. Kilgour.

Knitted Fabrics.
By John Chamberlain and James H. Quilter.

Lead.
By J. A. Smythe, Ph.D., D.Sc.

Leather.
By K. J. Adcock.

Linen.
By Alfred S. Moore.

Meat Industry, The.
By W. Wood.

Motor Boats.
By F. Strickland.

Motor Industry, The.
By Horace Wyatt, B.A.

Nickel.
By B. H. White.

Oil Power.
By Sidney H. North.

Oils.
By C. Ainsworth Mitchell.

Paints and Varnishes.
By A. S. Jennings, F.I.B.D.

Paper.
By Harry A. Maddox.

Patent Fuels.
By J. A. Greene and Dr. Mollwo Perkin.

Perfumery, The Raw Materials of.
By Ernest J. Parry, B.Sc.

Petroleum.
By A. Lidgett.

Photography.
By W. Gamble, F.R.P.S.

Player Piano, The.
By D. M. Wilson.

Rubber.
By C. Beadle and H. P. Stevens, M.A., Ph.D., F.I.C.

Salt.
By A. F. Calvert, F.C.S.

Silk.
By Luther Hooper.

Silver.
By B. White.

Soap.
By William H. Simmons, B.Sc.

Sponges. (Lond.), F.C.S.
By E. J. J. Cresswell.

Starch and Starch Products.
By H. A. Auden, D.Sc., F.C.S.

Stones and Quarries.
By J. Allen Howe, B.Sc.

Straw Hats.
By H. Inwards.

Sugar.
By Geo. Martineau, C.B.

Sulphur.
By H. A. Auden, D.Sc.

Talking Machines.
By Ogilvie Mitchell.

Tea.
By A. Ibbetson.

Telegraphy, Telephony, and Wireless.
By Joseph Poole, A.M.I.E.E.

Textile Bleaching.
By Alec. B. Steven.

Timber.
By W. Bullock.

Tobacco.
By A. E. Tanner.

Velvet and Corduroy.
By J. H. Cooke.

Wall Paper.
By G. Whiteley Ward.

Weaving.
By W. P. Crankshaw.

Wheat and Its Products.
By Andrew Miller.

Wine and the Wine Trade.
By André L. Simon.

Wool.
By J. A. Hunter.

Worsted.
By J. Dumville & S. Kershaw.

Zinc and Its Alloys.
By T. E. Lones, M.A., LL.D.

FOREIGN LANGUAGES

FRENCH

PRICE

Progressive French Grammar.
By Dr. F. A. Hedgcock, M.A., D.ès.L. Part I, 3/6 Net. Part II, 3/- Net . . Complete Net 5/6

Commercial French Grammar.
By F. W. M. Draper, M.A., B.ès.L. . . . Net 2/6

French-English and English-French Commercial Dictionary.
By F. W. Smith . . . . . Net 10/6

Commercial Correspondence in French. Net 3/6

GERMAN

A New German Grammar.
By J. Keegan, M.A. . . . . Net 5/6

Commercial German-Grammar.
By J. Bithell, M.A. . . . . Net 3/6

German-English and English-German Commercial Dictionary.
By J. Bithell, M.A. . . . . Net 10/6

Commercial Correspondence in German. Net 3/6

SPANISH

Spanish Commercial Grammar.
By C. A. Toledano . . . . . Net 4/6

Spanish-English and English-Spanish Commercial Dictionary.
By G. R. Macdonald . . . . . Net 15/-

Manual of Spanish Commercial Correspondence.
By G. R. Macdonald . . . . . Net 4/6

ITALIAN

Italian Commercial Grammar.
By Luigi Ricci . . . . . Net 4/-

Mercantile Correspondence, English-Italian.
Net 5/-

PORTUGUESE

		PRICE
Practical Portuguese Grammar.	Net	7/6
Mercantile Correspondence, English-Portuguese.	Net	3/6

PITMAN'S SHORTHAND

Pitman's Shorthand holds the world's record for speed and accuracy

For Complete List of Text-books, Phrase Books, Dictation Books, Reading Books, etc., see Pitman's "SHORTHAND AND TYPEWRITING CATALOGUE."

Pitman's Shorthand Instructor.		4/6
Pitman's Shorthand Commercial Course.		4/6
Pitman's Shorthand Rapid Course.		4/6
English and Shorthand Dictionary.		10/–
Shorthand Dictionary.		7/6
Shorthand Clerk's Guide. By V. E. COLLINGE, A.C.I.S.	Net	2/6
Progressive Dictator.		2/6
Phonographic Phrase Book.	Paper	1/6, Cloth 2/–

TYPEWRITING

Pitman's Commercial Typewriting. By W. and E. WALMSLEY		5/–
Pitman's Typewriter Manual.		5/–
A New Course in Typewriting. By MRS. SMITH CLOUGH, F.Inc.S.T.	Net	2/–
Practical Course in Touch Typewriting. By C. E. SMITH		2/–
Dictionary of Typewriting. By H. ETHERIDGE	Net	7/6
Mechanical Devices of the Typewriter. By R. T. NICHOLSON, M.A.	Net	6/–
Work and Management of a Copying Office, The.	Net	10/6

Complete List post free on application.

Sir Isaac Pitman & Sons, Ltd., Parker St., Kingsway, London, W.C.2

PRINTED IN GREAT BRITAIN AT THE PITMAN PRESS, BATH
(4627W)

The Approval of Generations.

FOUR generations ago, in 1828, C. J. Van Houten discovered and introduced Cocoa Powder as we now know it; a discovery which has largely been responsible for the present enormous consumption of Cacao

Since then VAN HOUTEN'S COCOA has met with the continuous and unqualified approval of Medical & Scientific authorities. It has always been recognised as **the most perfect of all cocoas.**

Prepared from the world's choicest Cocoa Beans by a House of great experience and with traditional care, VAN HOUTEN'S COCOA remains a distinctive beverage of unexampled purity and high quality.

VAN HOUTEN'S COCOA

is a light, easily digested and most nutritious food-beverage. It is unquestionably the most reliable of all Cocoas—Doctors recommend it because of its uniform superiority.

Prepared by
C. J. van Houten & Zoon.
Royal Cocoa Factories.
Weesp, Holland.

London Office:
Van Houten Ltd.,
Cocoa House,
15-17, City Road, London,
E.C. 1.

(1463E)