COFFEE

PLATE 1: *COFFEA ARABICA* L.

This species is the principal source of the commercial coffee-beans.
Illustration:—A branch, bearing flowers and fruits.

COFFEE

A Monograph of the Economic Species of the Genus *Coffea* L

BY

RALPH HOLT CHENEY

M.A., M.S., Sc.D. (Harvard), Assistant Professor of Biology, Washington Square College, New York University

THE NEW YORK UNIVERSITY PRESS

32 WAVERLY PLACE NEW YORK CITY

1925

THE NEW YORK UNIVERSITY PRESS
ARTHUR HUNTINGTON NASON, PH.D., DIRECTOR

Printed in the United States of America by
J. J. LITTLE AND IVES COMPANY, NEW YORK

TO

MY FATHER AND MOTHER

PREFACE

THE present work is a monographic presentation of the economic species of the genus *Coffea* L. The treatment of coffee presented here is an endeavor to include the systematic, economic, and cultural discussions which are indispensable to modern economic studies. Part I is a scientific discussion of the botany of coffee. Part II is an economic discussion of coffee including production and consumption data, types, preparation, facts concerning the chemistry, and the past and present adulteration of coffee. In concluding this part, a summary is given of the other caffeine-yielding plants,—their distribution and use. The cultural treatment of coffee is given in the form of two appendices presenting an ethnological and historical account of coffee and coffee-houses. The work includes eighty-four illustrations, a chronological chart for the use of coffee as a beverage throughout the countries of the world, and an extensive bibliography including economic and cultural references.

Research pertaining to the economic Rubiales, in the Department of Economic Botany of Harvard University, emphasized the fact that coffee, the best known and one of the most important plants of the group, had never been adequately investigated. Although there is abundant literature in regard to the use of the beverage and the systematic position of the coffee-plant, from the Pre-Linnæan period to the present time, the genus *Coffea* L. has not been treated monographically on an economic basis. Hiern discussed the African species of coffee in the Transactions of the Linnæan Society, series 2, 1 (1876) 173. K. Schumann published the results of his research on the African Rubiaceæ in Engler's Botanische Jahrbücher 25 (1898) 233. Lecomte in his book "Le Café," which was published in 1899, described numerous species and devoted the major part of the work to a discussion of coffee culture. Valeton's paper entitled "Die Arten der Gattungen *Coffea* L., etc.," which was published in the Bulletin de L'Institut Botanique de Buitenzorg 7 (1901) 1; and

De Wildemann's work, "Les Caféiers," which was published in 1901, were entirely systematic studies. These publications are limited to certain geographical areas or are lacking in economic consideration.

All discoverable bibliographical references have been studied carefully in connection with the macroscopic and microscopic examination of the species. Available evidence resulting from his research enabled the author to emend or amplify previous systematic descriptions and the nomenclatorial history of several species. The systematic treatment of the useful species is elaborated by a consideration of the other demands of an economic or applied botanical treatise. Thus the work enters a more original field of research than is characteristic of American methods of presentation. A section is devoted to coffee-adulteration and sophistication which involves a discussion of the past and present botanical sources of adulterants and substitutes and methods of detection, based on the microscopic, physical, and chemical examination of the commercial coffees and coffee-like beverages of the world. Such a discussion is inseparably connected with the commercial manipulation and the methods of preparation of coffee. Research in this department of the subject necessitated the determination of the caffeine-content of the seeds of the more common economic species. These caffeine-extractions from raw and roasted coffees, to ascertain any change due to seed-torrefication, required a study of the chemistry involved. The treatment presented here is the only complete compilation of the knowledge at hand. This investigation prompted the author to include a list, illustrations, and maps of the geographical distribution of the other caffeine-producing plants of the world.

Ethnological considerations necessitated the historical discussion of the development of coffee-houses, an interesting part of ethnobotany which shows the effect of the introduction of coffee on the political and social life of the metropolitan centers of Egypt, Arabia, Asia Minor, Europe, and America. Finally, the derivation of the term "coffee" presented here is a new theory which is based on original philological and botanical research which carried the author backward through the Arabic, Hindu, Sanskrit, and Dravidian languages of Southern India, and has resulted in the correction of an error which has existed since the tenth century.

Recognition of the source of each illustration, not original with

the author, has been carefully noted. The author wishes to express his thanks to Professor Oakes Ames, his former teacher and Head of the Department of Economic Botany of Harvard University, for the patience with which he has directed, counseled, and aided him, and made possible the completion of this work. The author alone, however, is responsible for any errors which may be embodied in the subject-matter. The author sincerely appreciates the constructive counsel of Mr. F. Tracy Hubbard in respect to bibliographical and systematic work; and of Dr. James Plummer Poole of Dartmouth College. The author is also indebted to Mr. Lally and to Mr. Butler of the wholesale coffee-house of Messrs. Chase & Sanborn of Boston, Massachusetts, for the photograph of a Brazilian Coffee Plantation and for numerous samples of the commercial coffees of the world; to the U. S. National Herbarium, Washington, D. C.; and to the Gray Herbarium of Harvard University, institutions which very kindly placed at his disposal their entire collection of the species of *Coffea* L.

The author recognizes with appreciation the care exercised by Professor Arthur H. Nason, Ph.D., Director of the New York University Press, and by Miss Hannah E. Steen, Secretary to the Director, in the details of editing and proof-reading. It is with pleasure that the author expresses his gratitude to his colleagues, Professor L. Alfred Mannhardt, of the department of biology in the Washington Square College of New York University, and to Professor James Buell Munn, Ph.D., acting dean, for the assistance and courtesies which have encouraged the publication of this work.

R. H. C.

Department of Biology
Washington Square College
New York University
1924.

K. R.

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PART I

THE BOTANY OF THE GENUS *COFFEA* L

CHAPTER I

Coffea L., Sp. Pl. ed. 1 (1753) 172

Calyx glandular on the inner surface or with glands between the lobes; tube short, campanulate, turbinate, or urceolate; limb small or obsolete, cleft or obscurely toothed, persistent, not accrescent. Flowers white, commonly fragrant, hermaphroditic, axillary, clustered, very rarely terminal and solitary; pedicels and peduncles sessile or short, usually with connate bracteoles forming a single or double cupule at the base of the calyx or on the short pedicels or peduncles. Corolla membranous or slightly coriaceous, salver- or funnel-shaped, contorted, glabrous, or villose on the throat; tube short or elongated; limb spreading, 4- to 8-partite; lobes contorted dextrorsely (as seen from the inside in aestivation). Stamens 4 to 8, inserted on the corolla-tube, usually near or at the mouth, exserted or included, glabrous, often twisted; filaments short, obsolete, or even two-thirds of the length of the anthers; anthers linear, attached at the back (dorsal surface) above the base. Style filiform, 2-cleft, glabrous, usually shortly exserted; lobes linear, spathulate, or tapering. Disk fleshy, glabrous. Ovary 2-celled; ovules solitary, subpeltately attached at about the middle of the ovary or rather lower, amphitropous. Berry ellipsoidal, oblong, or subglobose, dry or fleshy; pyrenes 2 (one sometimes abortive), papery or coriaceous, convex on the back, flat with a narrow but usually deep longitudinal furrow on the face (inner or ventral surface); embryo somewhat curved; cotyledons foliaceous; radicle subterete, inferior, longer than the cotyledons; albumen horny. Leaves opposite, usually glabrous, decussate, or rarely three-whorled; stipules interpetiolate, ovate, basally broad or lanceolate, apiculate, acuminate, persistent. Evergreen, seldom deciduous, small trees or shrubs.

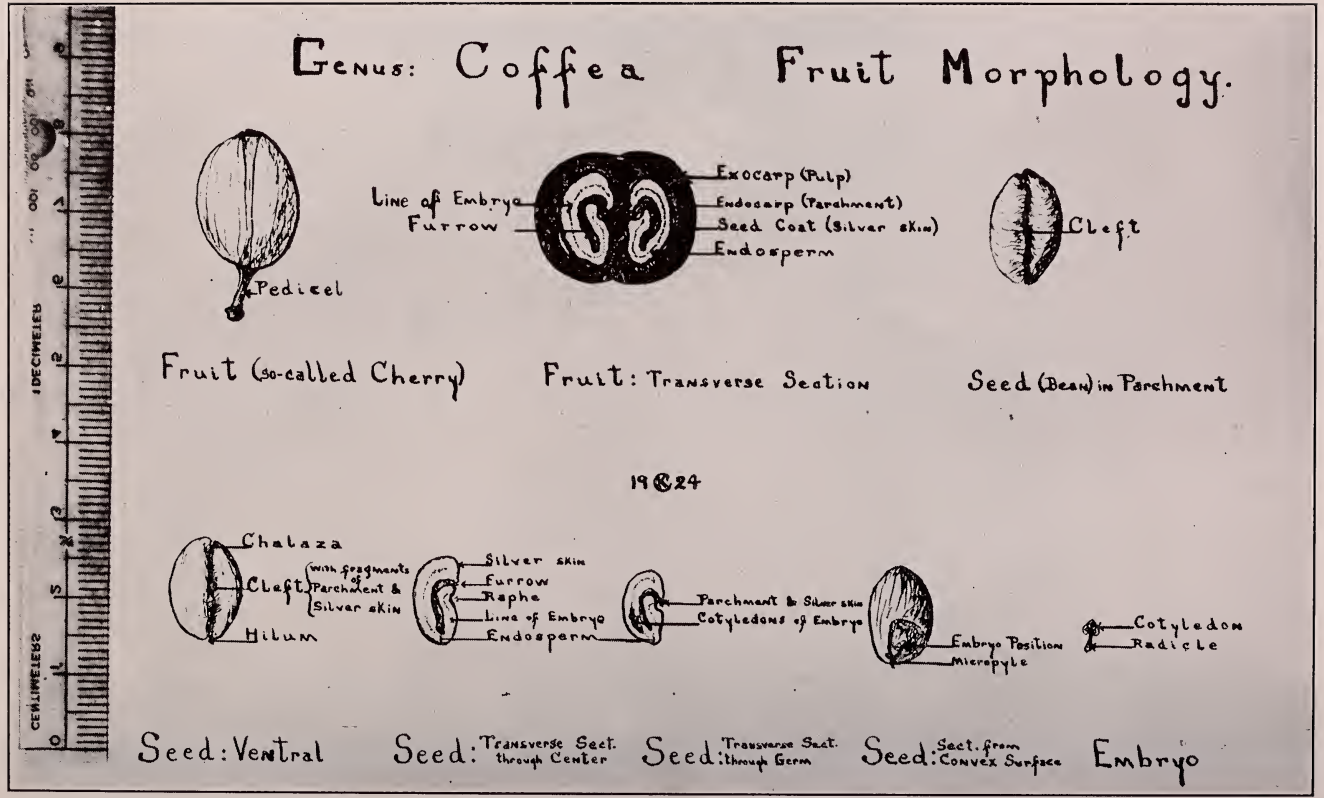

PLATE 2: GENUS *COFFEA* L., FRUIT MORPHOLOGY

Microscopic Characteristics of the Seed:—(1) The seed-coat is composed of several layers of collapsed, parenchymatous cells. Frequently the structure is not very distinct but the cell-walls can be seen here and there. The seed-coat includes numerous sclerenchymatous cells which are invariably present in this genus. These cells are about eight times as long as broad although there is some variation in proportionate width. Sclerenchymatous cells are arranged in approximation with their long axes parallel, and possess numerous large oblique pits. They vary from 150 μ to 350 μ in length, and taper bluntly, but are occasionally terminated by flat transverse walls. Their walls are lignified. (2) The endosperm epidermis and the one or two layers immediately beneath possess walls which are evenly thickened. The remaining endosperm cells are parenchymatous, thick-walled structures with large pits which may be as long as the width of the cell. In section, the cell-walls show a distinct knottiness which is very characteristic. The cell-contents consist chiefly of oil globules and proteid matter in addition to normal cytoplasm. (3) The embryo is composed entirely of minute, parenchymatous cells.

Synonymy:—Hexepta Raf. Sylva Tellur. (1838) 164.—Lachnostoma Korth. in Nederl. Kruidk. Arch. 2 (1851) 201.

Common Name:—Coffee.

Geographical Distribution:—Tropical Asia; tropical Africa; by introduction, throughout the tropics of the world.

Number of Species:—Forty.

Number of Economic Species:—Nineteen.

History of the Genus *Coffea*:—Botanists of to-day agree that the coffee-plant is indigenous to certain hilly regions of Abyssinia, of the Soudan, of Guinea, and of Mozambique. Coffee has been used in Ethiopia from the earliest times. Its use reached Abyssinia from Ethiopia, and became known in Arabia probably during the thirteenth century. Arabia became the stepping-stone to its universal consumption. It was Arabian coffee, shipped through the port of Mocha, that resulted in the esteem for and the general use of the term "Mocha" for millions of tons of foreign-grown coffee.

At that early period, Arabian traders were the most enterprising in the world. They added coffee to other luxuries from Africa. Since they were fortunately situated between Europe and Asia,

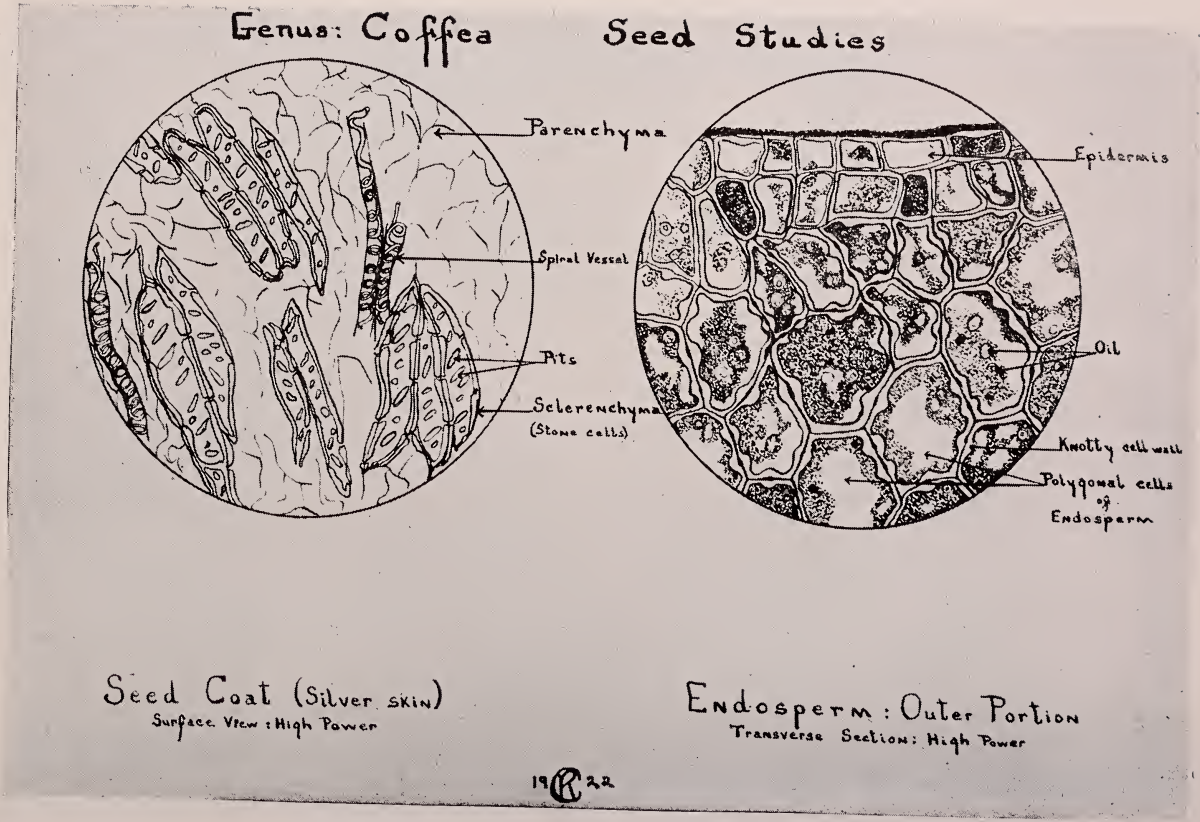

PLATE 3: GENUS *COFFEA* L., SEED STUDIES

they easily distributed it; and its use readily extended to Persia and Syria, then to Cairo and Venice; and it soon became the favorite drink at Constantinople. Coffee-houses appeared in the cities of all countries bordering on the eastern Mediterranean sea. The use of coffee was introduced into Europe about the middle of the seventeenth century; and, within a brief period, it became a favorite drink in London, in Paris, and throughout Europe. Coffee-houses became numerous, and served as gathering-places for literary men, politicians, and all other ranks of society.

Until about eighteen hundred, the world was dependent upon Africa for its coffee-supply. Louis XIV is credited with being the first to decree its introduction into the French West Indies at Martinique. Other European governments soon afterward introduced it successfully in the West Indies. The Dutch carried it into Java, Sumatra, and other islands of the Malay Archipelago. The coffee-plant was introduced into India about seventeen hundred and into Ceylon soon afterward. Spanish missionaries brought it to the Philippine Islands from Java in 1740. About this time, the first plant was grown in Brazil. Later it spread to Cuba, Porto Rico, and Mexico, and finally throughout Central and tropical South America.

Religious and state governments at various times attempted to check the popularity of the coffee-beverage by denouncing it as an insidiously pernicious drink and as occasioning gathering-places which gave birth to and nourished sedition and dangerous revolutionary ideas. Heavy taxation was levied as a source of governmental revenue. In spite, however, of attempted prohibition and the changes in the customs and habits of successive generations, the popularity of coffee has increased until the annual world consumption is now more than the enormous sum of 2,500,000,000 to 3,000,000,000 pounds.

Africa, the original and only important source for world consumption up to eighteen hundred, is to-day an unimportant factor in the bulk of coffee-production; while Brazil, where the coffee-plant is not native, has become the world's greatest coffee-growing country. Although the United States is the largest consumer of coffee with per capita consumption of twelve pounds per annum,

Holland ranks as the greatest consumer per capita with fifteen to fifteen and one half pounds.[1]

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CHAPTER II

Dichotomous Key to the Economic Species of the Genus *COFFEA*

Section I. Corolla 5 to 8 partite.....*Eucoffea* Hook. f.
Exception:—*Coffea canephora* Pierre is sometimes 4-partite.
Section II. Corolla 4-partite.....*Lachnostoma* Hook. f.

Section I:—*EUCOFFEA* Hook. f.

Trees or shrubs. Flowers fascicled or solitary. Corolla-lobes 5 to 8, large, obtuse; corolla-tube long and slender; anthers exserted or included, dorsifixed. Calyx-limb irregularly few or many-toothed. Style usually long; but commonly short in *Coffea Wightiana* Wall., *Coffea travancorensis* Wight & Arn., *Coffea fragrans* Wall. ex Hook. f., and *Coffea bengalensis* Heyne ex Roem. & Schult. Fruit didymous when 2-seeded. Endosperm, in transverse section, shows characteristic plications or, at least, wrinklings; knottiness of the cell-wall distinct.

I. Anthers included (hidden in the corolla-tube), see II.
1. Stigmas included in the corolla-tube.
A. Leaves rough (unglazed), hairy at least in the axils of the lateral veins.
a. Flowers 5-6-partite, calyculus extending beyond the calyx-margin.
x. Each calyculus surrounding one flower; fruit bicapitate by longitudinal furrows;—see y.
*. Calyx dentate;—see **.
+. Calyx-teeth fringed;—see + +; bracts chaffy, not herbaceous; flowers appear before the leaves; branches with whitish or grayish loose bark, thick.....
C. Wightiana Wall.
+ +. Calyx cup-shaped, many-toothed; synanthous; a glabrous bush; branches covered with fine, short,

almost imperceptible hairs; leaves elliptic-lanceolate, obtuse or obtusely caudate-acuminate, not very glossy, veins raised....*C. fragrans* Wall. ex Hook. f.

**. Calyx-margin nearly smooth; flowers appearing after the leaves; branches slender, covered with brownish cortex, rough in appearance...*C. travancorensis* Wight & Arn.

y. One calyculus commonly for several flowers; flowers frequently 6-merous; leaves herbaceous, both sides pale green, with about 7 first rank veins; hairs unicellular, woolly; fruit oval.....
C. bengalensis Heyne ex Roem. & Schult.

II. Anthers exserted (extending completely out of the corolla-tube).

1. Leaves deciduous, annual;—see 2.

A. Leaves hairy, at least in the axils of the lateral veins;—see B.

a. Secondary branches rise upward forming an acute angle with the stem.

x. Leaves ovate-lanceolate, scabrid.....*C. racemosa* Lour.

B. Leaves glabrous, broadly ovate, shortly acuminate; branches with grayish-white bark; flowers 6-partite, 2 to 6 in a spireme .....*C. Ibo* Froehner

2. Leaves evergreen, perennial.

A. Leaves up to 15 cm. long;—see B.

a. Leaves with distinctly elongated, narrow, and attenuated tip which provides for the rapid drainage of water;—see b.

x. Trees or shrubs, not climbing.

*. Flowers 1 to 3 together;—see **.

+. Flowers 6-7-partite.

1. Calyx-margin projecting beyond the calyculus.

=. Calyx-margin short, indistinctly dentate; corolla 12 mm. long; bracts of the primary calyculus linear; leaves narrow, cuneate at the base, caudate-acuminate, less then 15 cm. long, glossy on both surfaces, grayish-green, 5 to 6 veins of the first rank rather indistinct; a shrub or tree, slender, glabrous; bark light gray..*C. stenophylla* G. Don

**. Flowers 4 or more in axillary fascicle; lobe of the gamosepalous calyx short, dentate; tree or shrub.

+. Leaves ovate or elliptical, papery, 9 to 12 veins of the first rank;—see + +.....*C. arabica* L.

+ +. Leaves narrow-elliptical, thickly coriaceous, 5 to 7 veins of the first rank.....*C. congensis* Froehner

b. Leaves with shorter, obtuse terminations.

x. Leaves not differing macroscopically on the two surfaces; —see y.

*. Leaves remarkably glossy; both surfaces bear sharply prominent, graceful, reticulated venation; calyculus not extending the calyx-margin.

+. Flowers 1 to 4 in a cluster; leaves ovate.....

C. mauritiana Lam.

y. Leaves differing macroscopically on the two surfaces.

*. Leaves dull above, very glossy below, with 10 to 12 veins of the first rank, lower surface shows prominently reticulated venation, broadly ovate; sclerenchymatous tissue rather abundant; fruit oval, longitudinally striped; a glabrous, erect shrub;—see **.....

C. Zanguebariae Lour.

**. Leaves olive or brownish above when dry, paler beneath, small, oblong or oblong-lanceolate, obtuse...

C. Swynnertonii S. Moore

B. Leaves 18 to 30 cm. long, thinly coriaceous or chartaceous.

a. Flowers 4 or more in a fascicle; leaves ovate or obovate, sometimes cuneate toward the base, apex short; upper surface dark, glossy, lower surface lighter and bearing distinct first-rank veins; calyculus not projecting beyond the calyx-margin;—see b.

x. Flowers 5- (rarely 4-) partite; leaves with 12 to 14 paired lateral veins of the first rank;—see y.....

C. canephora Pierre

y. Flowers 6-8-merous; leaves with 8 to 12 paired lateral veins of the first rank.....*C. liberica* Bull

b. Flowers in dense axillary fascicles, about 4.4 cm. in diameter, often with a few small leaves intermixed; leaves large, chartaceous, oblong-elliptical, obtusely caudate-

acuminate, rounded at the base, up to 25 cm. long by 15 cm. wide, dull on both surfaces, glabrous, midrib flat above, prominent below; calyx minute, entire;—see c.

x. Flowers 5-merous, corolla-tube less than 1.25 cm. long; leaves with 9 to 12 lateral veins, looped and much branched within the margin, slightly arcuate, diverging by a 45-degree angle from the midrib, distinct above, prominent below, veins lax, petiole 1.25 cm. long, glabrous; berries about 1.25 cm. in diameter.....
C. robusta Linden

c. Flowers in axillary cymes, each of 1 to 5 fragrant, white flowers; total corolla-length 20 mm.; leaves 18-30 cm. long by 9-12 cm. wide, short petiole 1 cm. long, leaf-blade obovate-lanceolate, obovate-spathulate, terminating abruptly in an obtuse apex, 6 to 9 paired prominent veins below; calyx greatly reduced or nearly absent, shorter than the disk; calycules bear resinous surfaces, slightly fimbricated at the margin.....*C. excelsa* A. Chev.

Section II:—*LACHNOSTOMA* Hook. f.

Trees or shrubs. Flowers white, very small, in axillary cymes; bracts and bracteoles small, ovate, subconnate; corolla-tube short, throat dilated, bearded, lobes four, small, acute; æstivation contorted; anthers oblong, acute, dorsally attached near the base; filaments, if exserted, very shortly so. Calyx-limb quadridentate. Leaves petiolate, membranaceous, younger parts pubescent; stipules connate at the base, ovate, apex cuspidate, subpersistent. Fruit subglobose to oblong-ellipsoid, not didymous when 2-seeded; calyx crowns the fruit; pericarp fleshy; endocarp rather fibrous; seeds dorsally convex, ventrally plane or concave. Endosperm, in transverse section, devoid of plications; knottiness of the cell-walls very indistinct or lacking.

I. Leaves glabrous, oval or elliptical, acuminate; fruit long; seeds long, plano-convex;—see II.....*C. Jenkinsii* Hook. f.

II. Leaves oblong-lanceolate, obtuse, frequently cuspidate; fruit oblong; seeds oblong;—see III.....*C. ligustroides* S. Moore

III. Leaves at least somewhat hairy along the veins; fruit nearly round; seeds round, concavo-convex.....*C. khasiana* Hook. f.

CHAPTER III

Genus *COFFEA* L.: Section I: *EUCOFFEA* Hook. f.

Coffea Wightiana Wall.
Coffea fragrans Wall. ex Hook. f.
Coffea travancorensis Wight & Arn.
Coffea bengalensis Heyne ex Roem. & Schult.
Coffea racemosa Lour.
Coffea Ibo Froehner
Coffea stenophylla G. Don
Coffea arabica L.
Coffea congensis Froehner
Coffea mauritiana Lam.
Coffea Zanguebariæ Lour.
Coffea Swynnertonii S. Moore
Coffea canephora Pierre
Coffea liberica Bull
Coffea robusta Linden
Coffea excelsa Chev.

Coffea Wightiana Wall. Cat. (1832) No. 6246.

A small, copiously branched, almost spinescent bush with whitish bark. Branches rigid, stout, divaricate, often suppressed and very short, sometimes slender; young shoots puberulous. Leaves small, 1.25 cm. wide by 3.75 cm. long, subsessile or nearly sessile, oval, tapering toward the base, obtuse, glabrous or woolly in axils of veins beneath, subcoriaceous, pale when dry; stipules spinescent, short, sharply pointed, rigid, persistent, becoming small curved prickles, especially on the lateral branches. Flowers solitary, sessile, appear before the leaves, on short lateral branches, 5-merous, very sweetly scented, white; corolla-lobes much narrower than in *C. bengalensis* Heyne ex Roem. & Schult.; corolla-tube about 1.25 cm. long, lobes oblong-oval, obtuse, slightly over one-half the length

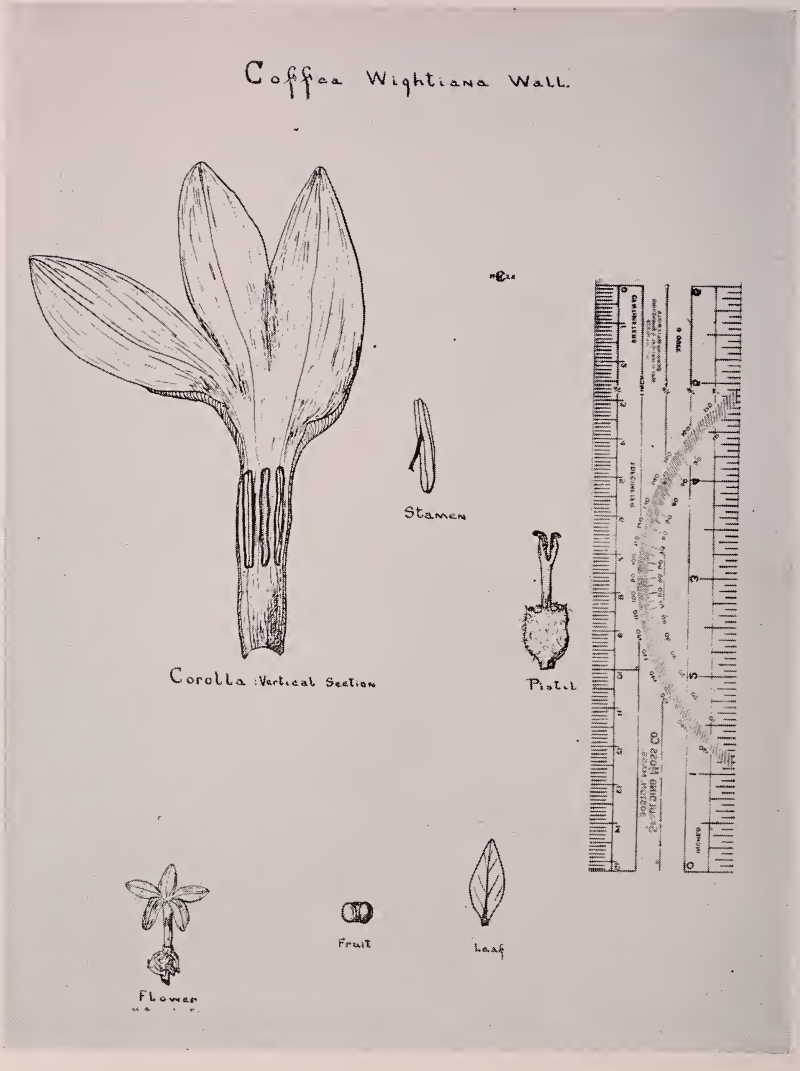

PLATE 4: *COFFEA WIGHTIANA* WALL.

of the corolla-tube; style short; calyx-limb 5-dentate, the margin with numerous shaggy hairs. Fruit not readily seen, about 0.83 cm. in diameter, much broader than long, didymous, with deep furrows between the lobes.

Diagnostic Characters of the Species:—Flowers in August and September. The calyx is enveloped by a resinous gum; shaggy and numerous hairs. Style short. Bark whitish or ash-like in color.

Common Name:—Kaddumallikai (Tamil Dialect).

Geographical Distribution:—Southern and Western India; in dry places from Coorg (or Kurg) to Travancore. Ceylon in the hot, drier parts of the island, rather rare; occurs in Jaffna, Mihintale, Uma-oya, Atakalen Korale. Grows up to 850 M. altitude.

History:—*C. Wightiana* Wall. was first noted about 1828. It occurs only in the drier regions of India and Ceylon up to an altitude of 850 M. It is the source of some local coffee-consumption in the above regions.

Uses:—Mainly as a substitute for the seeds of *C. arabica* L.

Bibliography:—Wall. Cat. (1832) No. 6246.—Wight & Arn. Prodr. 1 (1834) 436.—Wight Ic. Pl. Ind. Or. 4 (1850) t. 1598.—Thwaites Enum. Ceylon Pl. (1859) 154.—Hook. f. Fl. Brit. Ind. 3 (1882) 154.—Trimen Cat. Flow. Pl. & Ferns Ceylon (1885) 44; Handb. Fl. Ceylon 2 (1894) 352.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. IV, Abt. 4, Nachtr. (1897) 315.—Froehner in Notizbl. d. Kgl. Bot. Mus. (1897) 231; in Engl. Bot. Jahrb. 25 (1898) 252, 256.—Valeton in Bull. Inst. Bot. Buitenz. 8 (1901) 17, 23.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 21.

Economic and Cultural References:—Watt Dict. Econ. Prod. Ind. 2 (1889) 461.—Sebire Les Pl. Util. Sénégal (1899) 179.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

Coffea fragrans Wall. ex Hook. f. Fl. Brit. Ind. 3 (1882) 154.

A bush with glabrous or puberulous branches. Leaves elliptic-lanceolate, obtuse or obtusely caudate-acuminate, 1.2 cm. to 2.5 cm. wide, 4 cm. to 8 cm. long, glossy. Flowers solitary, synanthous, 5-merous; corolla-tube 1.6 cm. to 2.5 cm. long; calyx many-toothed. Fruit 0.83 cm. in diameter, broadly didymous.

Diagnostic Characters of the Species:—Leaves more brilliant (shining) than the allied species *C. travancorensis* Wight & Arn.; veins raised to a greater degree. Calyx-limb deeply cupped, many-toothed.

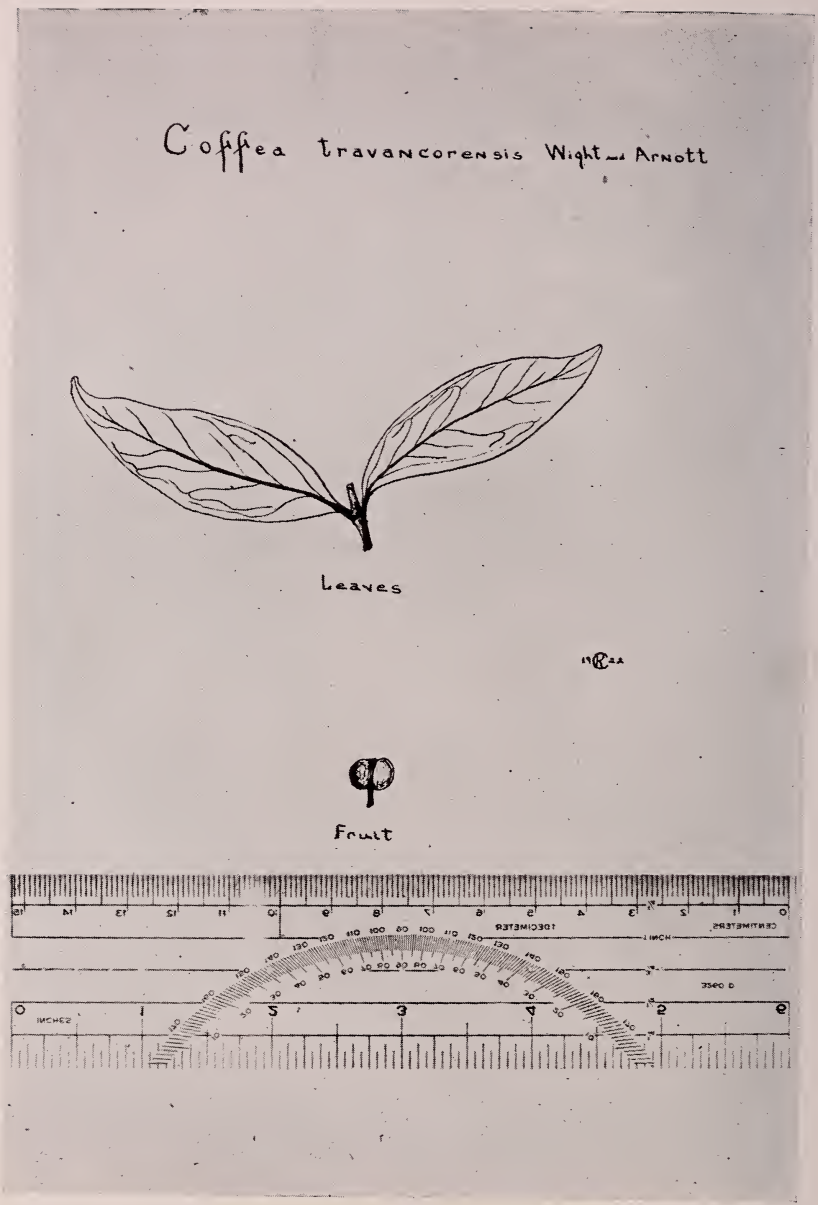

PLATE 5: *COFFEA TRAVANCORENSIS*
WIGHT & ARNOTT

Synonymy:—*Coffea triflora* var. *fragrans* (Wall). Froehner in Notizbl. d. Kgl. Bot. Gard. 1 (1897) 231; in Engl. Bot. Jahrb. 25 (1898) 256.

Geographical Distribution:—Eastern India; Sylhet, Tenasserim, Burma, Mergui.

History:—*C. fragrans* Wall. ex Hook. f. was collected in the Sylhet region of India by Gomez; in Tenasserim by Helfer; and in Mergul (Mergui) by Griffith. It is very similar to *C. travancorensis* Wight & Arn. and has been treated as a variety of that species by some authors.

Uses:—Mainly as a substitute for the seeds of *C. arabica* L.

Bibliography:—Hook. f. Fl. Brit. Ind. 3 (1882) 154.—Froehner in Engl. Bot. Jahrb. 25 (1898) 256.—Lecomte Le Café (1899) 15.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 7, 17, 20.

Economic and Cultural References:—Sebire Pl. Util. Sénégal (1899) 179.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

Coffea travancorensis Wight and Arn. Prodr. 1 (1834) 435.

A small shrub. Branches stiff, slightly pubescent, slender, thickened at the nodes; twigs flattened; bark of the younger twigs brownish. Leaves small, 2.5 cm. to 3.75 cm. wide by 7.5 cm. to 10.0 cm. long, oval, lanceolate or elliptic-lanceolate, acute at the base, acuminate, shortly acute or obtuse at the apex, quite glabrous, rather thin; petiole very short; stipules small, short, rounded, with cuspidate point, soon dehiscent. Flowers solitary or in threes, occasionally in fours, usually 5-merous, white, very sweet-scented, synanthous; pedicel very short, each bearing 2 minute, linear bracts at the base; corolla-tube 1.66 cm. to 2.5 cm. long, glabrous within, lobes ovate-oblong, acute, rather shorter than the tube; ovary bears thick disk surrounding the style; stigma large, erect; calyx small, pubescent, limb quite absent or 2- to 3-toothed. Fruit black, broadly didymous, 0.83 cm. in diameter. Slightly pubescent when young; deep vertical furrow divides the fruit into 2 parts causing it to appear bicapitate; pedicel short.

Diagnostic Characters of the Species:—This plant blossoms from April until June. The flowers resemble those of jasmine and are similar to, but smaller than, *C. bengalensis* Heyne ex Roem. & Schult. The leaves are dark above, lighter green below, somewhat shorter than *C. bengalensis* Heyne ex Roem. & Schult. The leaves

PLATE 6: *COFFEA TRAVANCORENSIS* WIGHT & ARNOTT

From Trimen Plates Handb. Fl. Ceylon (1893) t. 53.

PLATE 7: *COFFEA TRAVANCORENSIS* WIGHT & ARNOTT

are pale and rather yellowish when dry, broadly orbicular-elliptical in Ceylon specimens. In general, the leaves are intermediate in size between *C. Wightiana* Wall. and *C. bengalensis* Heyne ex Roem. & Schult. The form of the stipules distinguishes this species from *C. bengalensis* Heyne ex Roem. & Schult.

Synonymy:—*Coffea triflora* Moon Cat. (1824) 15 (Non Forst).

Common Name:—Moon's Sinhalese name for this plant is "Gaspichcha."

Geographical Distribution:—Southern and Western India, Negombo, Deltota, Doluwe Kande, Travancore; Ceylon, in the warm, moist, and intermediate regions up to 3000 feet; rather rare. Unauthentic reports from Java.

History:—*C. travancorensis* Wight and Arn. was first described in 1834 by Wight as an indigenous plant in western India in the Travancore region. It was also collected in Kalutara by Moon and in Kurunegala by Gardner. It is rather rare and not as yet of any commercial importance.

Uses:—Mainly as a local substitute for the seeds of *C. arabica* L.

Bibliography:—Wall. Cat. (1832) No. 6245.—Wight and Arn. Prodr. 1 (1834) 435.—Thwaites Enum. Ceylon Pl. (1859) 154.—Hook. f. Fl. Brit. Ind. 3 (1882) 154.—Trimen Cat. Flow. Pl. and Ferns Ceylon (1885) 44; Plates Handb. Fl. Ceylon (1893) t. 53; Handb. Fl. Ceylon 2 (1894) 353.—Froehner in Notizbl. d. Kgl. Bot. Mus. (1897) 231.—K. Schum. in Engl. and Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Froehner in Engl. Bot. Jahrb. (1898) 252, 256.—Lecomte Le Café (1899) 4.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 7, 17-20.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 20.

Economic and Cultural References:—Sebire Pl. Util. Sénégal (1899) 179.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

Coffea bengalensis Heyne ex Roem. and Schult. Syst. Veg. 5 (1819) 200.

A glabrous shrub bearing horizontal, dichotomous, slender branches. Leaves deciduous, 12.5 cm. long by 7.5 cm. wide as a maximum but usually much smaller, not glossy, opposite, broadly ovate or elliptic, obtusely acuminate, entire, spreading, remote, submembranaceous; veins (especially in the young leaves) hairy beneath, base rounded or acute, always contracted into a very short petiole with persistent subulate (awl-shaped) stipules. Flowers axillary, or more commonly at the terminus of short shoots with leaf-like bracts.

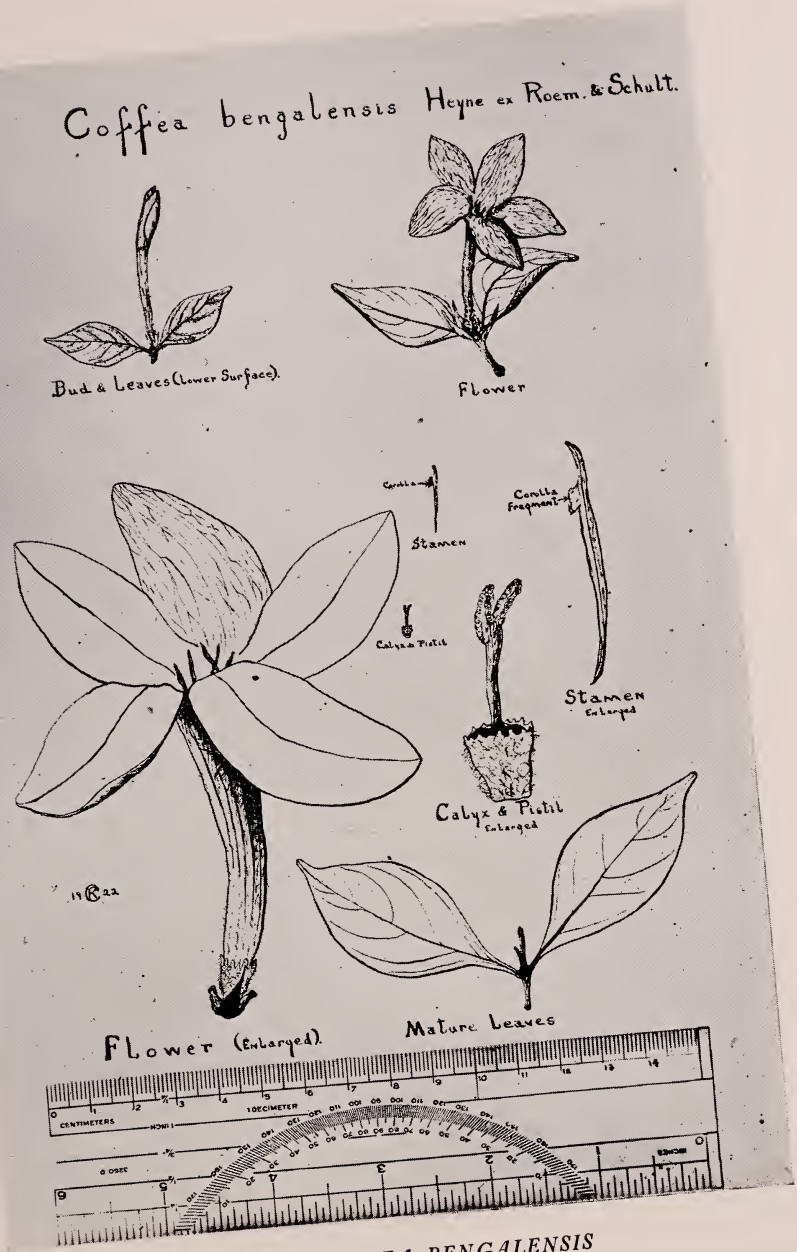

PLATE 8: *COFFEA BENGALENSIS* HEYNE EX ROEM. & SCHULT.

PLATE 9: *COFFEA BENGALENSIS*
HEYNE EX ROEM. & SCHULT.

Young branch.

Flowers 1 to 3 together, 5-6-merous, and appear before the leaves; flowers fragrant, pure white, large 2.5 cm. to 3.75 cm. in diameter; corolla hypocrateriform; corolla-tube 1'.25 cm. to 3.75 cm. long; lobes obovate-oblong; calyx-tube turbinate, downy, limb short, of 5 to many laciniated lobes, with their segments clavated, unequal. Anthers linear, sessile, extrorsely attached a little below the acuminate apex, to the mouth of corolla; only the points visible above the tube. Ovary fleshy, 2-celled; style included; stigma large, bipartite. Fruit black, size of a small cherry, ovoid-oblong, 1.25 cm. in diameter, not broader than long, didymous when 2-seeded; pedicel short.

Diagnostic Characters of the Species:—Twigs brown or whitish. Leaves usually broadly-elliptic with very greatly narrowed obtuse point, green when dry; petiole very short. Two subulate leaf-like bracts at the base of each flower. Calyx-limb with many, commonly ten, glandular teeth. Fruit not broader than long.

Synonymy:—*Coffea Horsfieldiana* Miq. Fl. Ind. Bat. 2 (1856-1859) 308.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 17.

Common Name:—Kath-jahi (Hindu).

Geographical Distribution:—Central and Southern India; Burma; Tropical Himalaya, from Kumaon to Mishmi up to 900 M.; Bengal; Assam; Silhet; Chittagong; Tenasserim (lower half); Siam; Java; Samarang (Miquel).

History:—*Coffea bengalensis* Heyne ex Roem. and Schult. of the eastern tropics is much more widely distributed than its close allies *Coffea Wightiana* Wall., *Coffea fragrans* Wall. ex Hook. f., and *Coffea travancorensis* Wight and Arn. This species was cultivated on a large scale prior to the introduction of *Coffea arabica* L. It produces small beans of an inferior value and is no longer cultivated extensively, although used by the natives wherever it is found locally.

Use:—As a substitute for *Coffea arabica* L.

Bibliography:—Roxb. Hort. Bengal. (1814) 15.—Heyne ex Roem. and Schult. Syst. Veg. 5 (1819) 200.—Roth Nov. Spec. (1821) 148.—Moon Cat. Pl. Ceylon (1824) 15.—Roxb. Fl. Ind. 2 (1824) 194.—Spreng. Syst. Veg. 1 (1825) 755.—DC. Prodr. 4 (1830) 499.—Wall. Cat. (1832) no. 6244.—Roxb. Fl. Ind. ed. 2, 1 (1832) 540.—Don G. Gen. Hist. Dichlam. Pl. 3 (1834) 581.—Wight and Arn. Prodr. 1 (1834) 435.—Bot. Mag. 82 (1856) t. 4917.—Miq. Ann. Mus. Lugd.

PLATE 10: *COFFEA BENGALENSIS* HEYNE EX ROEM. & SCHULT.

Mature branch.

Bat. 4 (1868-1869) 258.—Brandis For. Fl. (1874) 277.—Kurz For. Fl. Brit. Burma 2 (1877) 28.—Hook. f. Fl. Brit. Ind. 3 (1882) 153.—Burck in Ann. Jard. Bot. Buitenz. 4 (1884) 57 t. 6, f. 53.—Reprint from Gardener's Chronicle in Trop. Agric. 8 (1889) 860.—Burck's Mss. transl. by Herzsohn in Ann. Jard. Bot. Buitenz. 8 (1890) 149 t. 23, f. 1.—Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 231.—Schum. K. in Engl. and Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul and Sagot pt. 1, 2 (1897) 241.—Froehner in Engl. Bot. Jahrb. 25 (1898) 255.—Lecomte Le Café (1899) 14.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 10, 16, 20-25.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 17.—Brandis Ind. Trees ed. 1 (Third Impression) (1911) 390.—Bailey Stand. Cycl. Hort. 2 (1914) 823.

Economic and Cultural References:—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul and Sagot pt. 1, 2 (1897) 241-242.—Sebire Les Pl. Util. Sénégal (1899) 179.—Hartwich Die Menschlich. Genuszm. (1911) 274.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

Coffea racemosa Lour. Fl. Cochinch. (1790) 145.

A small, greatly branched tree about 1.2 metres high. Branches diffused, terete. Leaves opposite, ovate-lanceolate, scabrous; petiole short. Flowers subterminal, in erect racemes, brachiate; common peduncle long, 4-sided, the individual pedicels shorter, terete. Fruit subglobose, small, red, watery, 2-seeded; seeds hemispherical.

Diagnostic Characters of the Species:—This species is in young fruit from July to September. Mature fruits are watery. The leaves are scattered with numerous tubercles.

Synonymy:—*Coffea ramosa* Roem. and Schult. Syst. Veg. 1 (1819) 198.—*Rudgea racemosa* Spreng. Syst. Veg. 1 (1825) 755.—*Coffea mozambicana* DC. Prodr. 4 (1830) 500.—*Hexepta racemosa* Raf. Sylva Tellur. (1838) 164.

Geographical Distribution:—Mozambique Island, Loureiro.

History:—*C. racemosa* Lour. has been known since 1790. It is narrowly localized in distribution.

Use:—Mainly as a local substitute for the seeds of *C. arabica* L.

Bibliography:—Lour. Fl. Cochinch. (1790) 145 (not C. racemosa Ruiz and Pavon (1799)).—Spreng. Syst. Veg. 1 (1825) 756.—DC. Prodr. 4 (1830) 500.—Hiern in Trans. Linn. Soc. ser. 2, 1 (1876) 175; in Oliver Fl. Trop. Afr. 3 (1877) 185.—Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 231; K. Schum. in Engl. and Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Froehner in Engl. Bot. Jahrb. 25 (1898) 253, 272.—Lecomte Le Café (1899) 39.—Raoul,

Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 229, 237.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 35.
Economic and Cultural Reference:—Sebire Pl. Util. Sénégal (1899) 179.

Coffea Ibo Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 231-234.

A thickly branched shrub bearing gray-white, longitudinally fissured bark. Branches numerous; short lateral branches bear, at moderately enlarged nodes, 2-6-flowered fascicles which appear prior to the leaves or before the leaves reach maturity. Leaves 4 to 4.7 cm. wide by 8 to 9.5 cm. long, develop only weakly up to flowering-time, obovate or ovate, with a short obtuse tip; leaf-lamina dull, darker above than below, glabrous, attenuated at the base into the petiole; 5-7 veins of first rank are distinct, other venation only faintly visible. Flowers and fruit occur on the same branches at the same time; flowers 6-partite, subtended at the base of the short pedicel by an indistinctly quadridentate, villose, circular bract; corolla 2.4 cm. long, tube 0.9 cm. long; lobes flat, broadened, obtusely-lanceolate, 1.5 cm. long. Anthers 1.0 cm. long. Style 1.7 cm. long, and extends beyond the corolla-tube; calyx 7-8-toothed, extending well above the calyculus. Fruit 1 cm. long by 0.6 cm. wide; fruit, when dry, is light brown, with 5 longitudinal fissures on each half; pedicel short; fruit crowned with a scanty but clearly toothed calyx-margin; seed small 0.3 to 0.4 cm. wide by 0.6 cm. long, flat or narrowly bead-like in form, light yellowish-green, narrows at each extremity. Stone-cells very numerous in the testa. Caffeine-content of seed is 0.795%.

Diagnostic Characters of the Species:—Fruit with 10 longitudinal fissures; seed small. *Coffea Ibo* Froehner distinguishes itself from other species in the Mozambique such as *Coffea racemosa* of Lour. by the barren, not warty, leaves and the short lateral branches bearing flower-clusters. It is differentiated from *Coffea Zanquebariæ* Lour., which it resembles in the long veined fruit, by the thin consistency and indistinct venation of the leaves and the large number of flowers in a fascicle. The supposition that it is derived from *Coffea Zanquebariæ* Lour., which has slender and pointed seeds, has not been confirmed by study.

Common Name:—Ibo Coffee.

Geographical Distribution:—East African Tropics; Mozambique.

History:—The seeds of this species first appeared on the German southeast African market in 1893 and on a small island, belonging to Portugal, called Ibo which is about 12° South Latitude and from which it derives its name "Ibo Coffee." Specimens of the plant were sent by Prof. Henriques and Inspector Moller to the Botanical Museum in Berlin. It is mentioned in the Notizbl. d. Kgl. Bot. Mus. 5 (1895) but was not described until 1897. The beans appear to be immature because of their inferior size and the slightly thickened endosperm.

Use:—It has been recently taken in cultivation in its native localities as a substitute for *C. arabica* L.

Bibliography:—Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 231-234.—K. Schum. in Engl. and Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Froehner in Engler Bot. Jahrb. 25 (1898) 272. —Lecomte Le Café (1899) 36.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 34.—Engler-Gilg Syllab. Pflanzenf. ed. 8 (1919) 339.

Economic and Cultural Reference:—Hartwich Die Menschlichen Genuszm. (1911) 273, 825.

Coffea stenophylla G. Don Gen. Syst. 3 (1834) 581.

An evergreen shrub or small tree from 1.2 to 6.0 M., glabrous, glossy; stem about 3 M. in tree-like specimens, and 32.5 cm. in diameter at the base. Bark grey, smooth. Branches slender, terete, compressed toward the extremities, the lower ones irregularly scattered, the upper ones opposite, leafy. Leaves 3.75 cm. to 15 cm. long by 0.5 cm. to 3.75 cm. wide, 6 to 10 pairs of lateral veins of the first rank inconspicuous above, marked on the lower surface with small, white, perforated glands in the axils; leaf-lamina bright green and glossy above, paler beneath; leaves of youngest shoots are pinkish; mature leaves elliptic-oblong or obovate, caudate-acuminate, cuneate at the base, subcoriaceous, somewhat undulated on the margin; petiole 0.2 cm. to 0.41 cm. long; stipules apiculate from a broadly ovate or subtruncate, connate base; stipules rather exceeding the small, pale green, subentire calyx-limb which barely exceeds the disk. Flowers white, large, 1.5 cm. to 2.2 cm. long before expansion, 0.83 cm. to 0.93 cm. after expansion, 2.5 cm. to 3.75 cm. across expanded corolla-lobes; corolla 6-8-partite; lobes oblong or

oval, obtuse, 0.75 cm. wide by 1.5 cm. long, spreading; corolla-tube 0.62 cm. long. Anthers wholly exserted, fixed at one third their length above their base, 3 times the length of the filaments which are 0.62 cm. to 0.93 cm. long. Style nearly equal to the unexpanded flower, bifid; lobes narrowly linear. Berry prolate-spheroidal or globose, 1.25 cm. in diameter, black when ripe; pedicel short; seeds 0.83 cm. long, hemispherical, with narrow ventral furrow.

Diagnostic Characters of the Species:—The leaves are marked on the lower surface by small, white, punctured glands in the axils of the veins. The youngest leaf-shoots are pink.

Synonymy:—*Coffea arabica* Benth. (non Linn.) in Hook. Niger Fl. (1849) 413.

Common Names:—Highland Coffee; Native Coffee; Sierra Leone Coffee; Bush Coffee; Wild Coffee; Upland Coffee; Rio-Nuñez Coffee.

Geographical Distribution:—Upper Guinea, Angola, Abyssinia; West Africa, Sierra Leone. Introduced into the English colonies in 1895-1896.

History:—*Coffea stenophylla* G. Don was discovered by Afzelius a century and a quarter ago. It was described and published in 1834 by G. Don who collected specimens in Sierra Leone. It is an interesting economic species since it is the only indigenous West African species excepting *C. liberica* Bull which may rival *C. arabica* L. commercially. The beans are said, by both the natives and the French merchants, to be superior to those of all other species. At Freetown, it is preferred to the seeds of *C. liberica* Bull. It has been shipped to France and sold as best Mocha. The plant thrives on gneissose or granitic soil and grows best from 500 to 2000 feet elevation, but may grow well from sea level to 5000 feet elevation. Higher elevations seem to tend to improve the quality of the berry and reduce the vigor of the plant. Seeds were sent to the Royal Botanic Gardens at Kew, England, in May, 1894, by Sir Wm. H. Quayle Jones, late Chief Justice of the West African Settlements and Deputy Governor of Sierra Leone. These plants flowered in one of the tropical houses in September, 1895. Seeds and plants were distributed to Indian Botanic Institutions and to the other English colonies, where it is now cultivated. It produces excellent coffee-beans although it has not thriven as well as could be desired

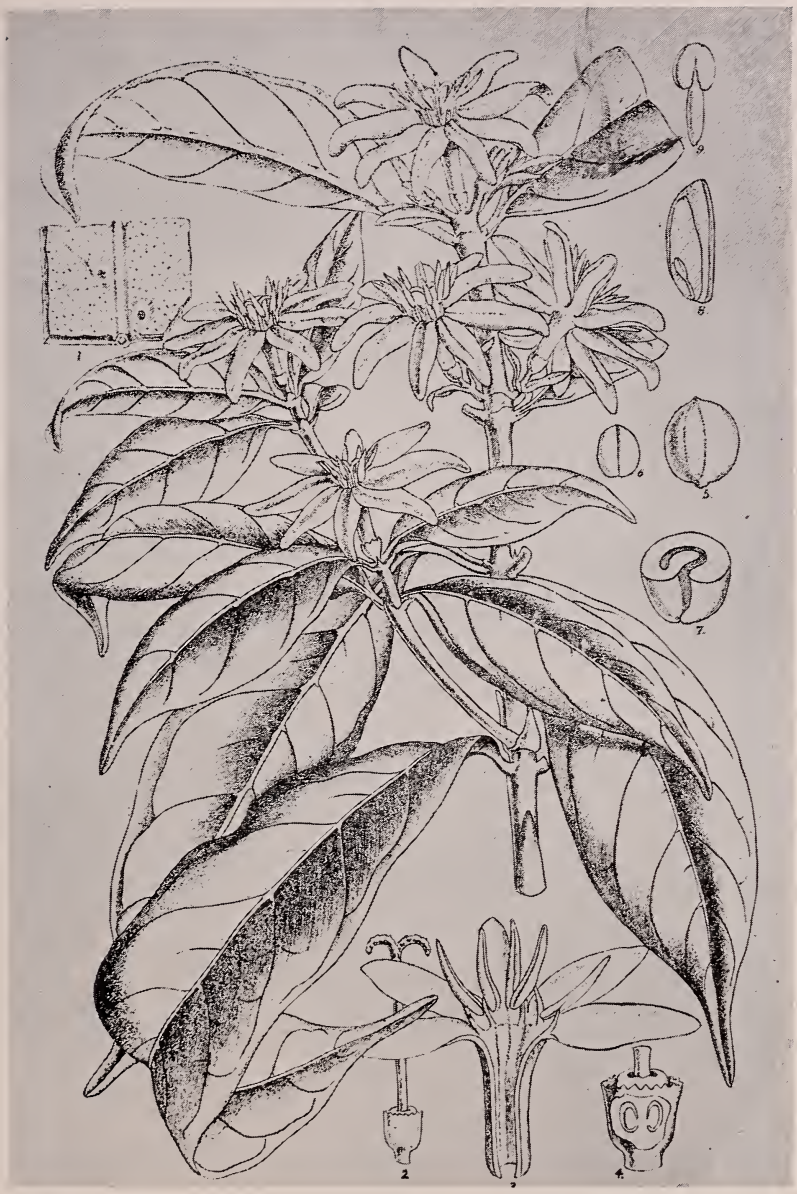

PLATE 11: *COFFEA STENOPHYLLA* G. DON

From Kew. Bull. (1896) 190.

1. Portion of Leaf—showing lower surface and glands. 2. Pistil. 3. Portion of Corolla with Stamens, laid open. 4. Vertical section of Ovary showing Ovules. 5. Fruit. 6. Seed. 7. Transverse section of Seed. 8. Vertical section of Seed. 9. Embryo.

at Dominica and Ceylon. Many plants appear to be out of their proper environment; and their irregular growth suggests that the climate is not advantageous. It seems, however, to have a greater resistance to the coffee-leaf disease than *C. arabica* L. It has also been introduced into the West Indies. The chief vernacular name "Highland Coffee of Sierra Leone" is due to Dr. Daniell. The caffeine-content of the seeds varies from 1.52% to 1.7%. *C. stenophylla* G. Don gives a rather poor yield which has diminished its cultivation considerably. When young it is susceptible to the disease known as *Cercospora coffeicola* nearly as readily as varieties of *C. arabica* L.; but, when well grown, the plants are not seriously affected.

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Coffea arabica L. Sp. Pl. ed. 1 (1753) 172.

A beautiful, glabrous, glossy shrub or small tree attaining 4.5 to 5.5 metres. Bark thin, grey. Wood white, moderately hard and

PLATE 12: *COFFEA STENOPHYLLA* G. DON

From DeWild. & Miss. Ém. Laur. 3 (1906) 340 t. 63.

1. Flowering Branch. 2. Fruiting Branch. 3. Fruit. 4. Portion of Leaf: Lower Surface with Glands.

closely grained. Pores very fine. Wood rays very fine, numerous, short. Branches terete or at the extremities rather compressed. Leaves borne in pairs, usually papery in texture, 7.5 cm. to 20 cm. long by 3.2 cm. to 7.5 cm. wide, oval or elliptical, acuminate, cuneate at the base, subcoriaceous, evergreen and usually persisting for three years, somewhat undulated at the margin; 7-12 paired lateral veins of first rank; petiole 0.41 cm. to 1.25 cm. long; stipules broadly ovate, apiculate, connate at the base, 0.41 cm. to 0.62 cm. long. Flowers fragrant, 1.25 cm. to 1.87 cm. long just prior to expansion, about half as long after expansion, subsessile or very shortly pedicellate, 2 to 9 or more together in very short, axillary or lateral bracteolate clusters; bracteoles ovate, the inner ones connate at the base of the pedicels, falling short of the shallow subtruncate or obtusely 5-denticulate calyx-limb; corolla white; lobes oval, obtuse or mucronulate, equalling or exceeding the corolla-tube, spreading. Anthers rather shorter than the corolla-lobes, wholly exserted, fixed rather below the middle to the filaments which are about half as long as the anther. Disk glabrous. Style about equalling the unexpanded flower, bifid; lobes linear, narrower toward the tip. Berry ellipsoidal, 0.93 cm. to 1.25 cm. long at first green, then red, and at length blue-black; chartaceous integument ("parchment skin") usually thin; seeds 0.83 cm. long. Caffeine-content of seeds varies from 0.69 to 1.6%.

Diagnostic Characters of the Species:—At least four flowers in a fascicle. Leaves evergreen or perennial, ovate or elliptical, with pointed apex, and 9 to 12 first-rank veins in the leaf lamina. Gamosepalous calyx with a short 5-denticulate margin.

Synonymy:—*Coffea vulgaris* Moench Meth. Pl. (1794) 504.—*Coffea laurifolis* Salisb. Prodr. (1796) 62.—*Coffea moka* Hort. ex Heynh. Nom. 2 (1846) 153.

Common names:—Arabian Coffee; Maragogype Coffee; Moka or Mocha Coffee; Blue Mountain Coffee; Chato Coffee; Common Coffee; Nalknad Coffee; Peaberry Coffee.

Dialect names of the East:—See in Appendix A, 'Eastern Dialect Terms Synonymous with Coffee,' page 220 *et seq.*

Geographical Distribution:—Abyssinia, Nile Land, Angola, Upper Guinea, Lower Guinea, Mozambique Coast; Sierra Leone; Arabia. Now widely cultivated following its introduction into the Celebes

(Prov. Menado), Sumatra, Java, Queensland, Philippines, West Indies, and throughout tropical India and South America.

History:—*Coffea arabica* L. has always been the source of the great bulk of the coffee utilized in world consumption. It is indigenous to Abyssinia, Soudan, Guinea, and Mozambique. A survey of Arabic literature reveals the fact that coffee was not mentioned in the Koran; nor do the Hebrew Scriptures contain any allusion to it. It would seem that the plant and its use was known only to the African natives until it was carried into Arabia, probably during the fourteenth century, A.D.; for travellers of the thirteenth century make no mention of it.

The pericarp of the coffee-fruit contains sugar. The preparation obtained from the succulent pulp of the coffee fruit or so-called cherry was called *Kahwah* which was the common term for wine. If the preparation is allowed to stand, it becomes alcoholic. The theory is held by some authors that the original Arabian coffee-beverage was distinctly an intoxicating drink. The art of roasting the beans and preparing a decoction from them was discovered soon after their introduction into the countries bordering on Arabia. This discovery was possibly made in Persia. Although non-alcoholic, this bitter beverage was called *Kahwah*.

The use of coffee-seeds was known, although not generally practised, in Europe some time previous to 1554; for in that year Ramusio, in his "Raccolta delle Navigationi e Viaggi," speaks of coffee as if it were well known at that period. Clusius [1] was the first botanist to describe coffee-berries. Prosper Alpino [2] mentions a drink made from a fruit which was called *Buna* and sold in the taverns of Cairo and throughout the Turkish Dominions in the place of wine, and was called *Caova*. Alpino saw living coffee-shrubs in Egypt. Rauwolff [3] saw the seeds and the beverage in Syria, where it was referred to as *Chaube*. It was a decoction from the seeds of an Arabian tree.

The use of the coffee-beverage was well established throughout the Eastern Mediterranean countries for two centuries prior to its general use in Europe about the middle of the seventeenth century.

[1] Clusius Arom. Hist. Garcia de Orta (1574) 214-215.
[2] Alpino De Plant. Aegypti ed. 1 (1592) 36.
[3] Rauwolff Reise in die Morgenländer (1582) 102.

According to Parkinson, who refers to it as the 'Turkes berry drinke' in his book entitled "Theatrum Botanicum" which was published in 1640, "This drinke hath many good Physicall properties therein: for it strengtheneth a weake stomache, helping digestion and the tumours and obstructions of the liver and spleene, being drunke fasting for some time together. The Egiptian and Arabian women use it familiarly while their courses hold, to cause them to passe away with the more ease, as also to cause those to flow that are stayed, their bodies being prepared and purged aforehand." The 1735 edition of Alpino by Vesling speaks of the coffee-berries sold in Egypt as crystallized coffee cherries. The "Kräuter-Buch" (1678) 788, by Verzascha, states that the husks of the berries make a stronger infusion than the seeds. One finds that the name of *coffe* was used synonymously with *coho* in ancient literature. *Coho,* which is merely a variant of *kahwah,* was applied originally to the drink prepared from *C. arabica* L. pulp instead of an infusion of the seeds. The Arabs of Yemen abstained from the use of coffee as prepared from the roasted and ground seeds in the present European and American fashion; but they powdered the sun-dried pericarp and prepared a favorite beverage called *kischer*, *gischr*, or *qischr*, which was aromatized with ginger or other spices. The resulting drink was stimulative and as popular as *quât,* the favorite stimulant of Yemen Arabs, which was prepared from the leaves of *Catha edulis* Forsk. (*Celastrus edulis* Vahl.)

Coffee was known as a drug prior to its general use as a beverage. Records compiled by La Roque [4] and Ellis [5] state that Abu Abdallah Muhammad Dhabbani Ibn Said visited Persia, Africa, and Abyssinia during the fifteenth century, and found the people using coffee as a beverage; and upon his return to Aden, Arabia, he continued to drink coffee and recommended his followers to substitute it for their common beverage *kât*. From Aden, the use of *C. arabica* L. seeds spread to Mecca, Medina, Cairo, Damascus, Aleppo, and finally to Constantinople in 1554. The use of coffee was introduced into Syria a few years previous to its use in Constantinople. Dr. Russell in his book entitled "The Natural History of Aleppo," which was published in 1794, informs us that, in Constantinople and less com-

[4] La Roque Voy. L'Arab. Heureuse (1716) 323.
[5] Ellis Monogr. Coffee (1774) 5.

monly at Aleppo, coffee was used to wash down opium when taken in pill form or in broken bits. During the sixteenth, seventeenth, and eighteenth centuries, the ladies of Aleppo and Constantinople frequented the public baths which were referred to as the Bagnio or Hummann. Coffee was served there, as the women remained for some time in the Bagnio, where they enjoyed drinking coffee, chatting, and bathing. Dashing water upon one another was a common frolic, and the Fouta or wrapper was easily dropped by accident or drawn aside in sport, and, should the girl happen to be carrying a cup of coffee at the time, she often continued and served it without stooping to recover her Fouta. This is the explanation of the fact that the women were sometimes seen in the Bagnio, walking about in the nude state as they carried coffee. In Aleppo, as throughout the East, coffee was always served without sugar. It was served extremely hot in a china cup which was placed in a silver under-cup to protect the fingers. People of the higher ranks of society partook of a half cup of strong coffee at a time. It was the custom of the common people to fill their cups to the brim with a weaker coffee. If a Turkish gentleman happened to awaken during the night and was unable to sleep, it was his custom to sit up in bed and drink coffee, after which he would smoke until he fell asleep. Coffee was drunk at all meals and was presented at the same time as the pipe at all social visits, so that many people drank twenty cups daily. Such was the popularity and excessive use of coffee in Turkey and Arabia at this period.

The Christians of Constantinople seem to have been the first to have added sugar to the beverage. It was formerly the custom of the Sultan to add a drop of the essence of amber to each cup of coffee.[6] Some of the Turks and Persians boiled their coffee with a little badiana, a species of anise which they imported from India and which the Turks called badianindi. Others added two cloves cut into pieces, cinnamon, cumin seeds, or some cacouleh, a seed of cardamom. To-day (1924) coffee is taken among all Orientals in the morning and at all meals as well as at every social visit during the day. It is served in cups called fingians, which are much smaller than our familiar American or European coffee-cup. They do not

[6] La Roque Voy. L'Arab. Heureuse (1716) 360.

fill the cup, and no spoons are served, as sugar and milk are not added. The average Oriental consumes ten to twelve cups of strong coffee each day.

Coffee-drinking was first repressed in 1511 by the Viceroy of the Sultan of Egypt (then Governor of Mecca) on the ground that it was a wine. In 1524, the coffee-houses of Mecca were closed by the Kadi. In 1533, the citizens of Cairo were divided into two factions, namely, those who used coffee and the abstainers. In 1554, the coffee-houses of Constantinople were closed on the pretext that charred seeds were charcoal. Coal was forbidden as a food by the Mahometan religion.

The use of coffee-seeds extended to Venice in 1615; and in 1644 Peter della Valle carried coffee-beans to Marseilles. Later, coffee made its way throughout France and England. The coffee-plant was not introduced for cultivation into countries outside of Arabia until about 1700. In 1690, the world's supply came from Arabia and Abyssinia. In the same year, seeds were taken to Batavia; and soon afterward a plant was carried to Amsterdam. About this time, the Dutch introduced coffee-plants into Java. Coffee was possibly introduced into Ceylon by the Arabs prior to the Portuguese invasion. In any case, the Dutch started to cultivate coffee there between 1690 and 1700. In 1712, a seedling plant was given to Louis XIV by Ressons of Holland. This plant bore fruit and died. In 1714, Brancas of Amsterdam, presented Louis XIV with a coffee-tree. The introduction of the coffee-plant into America was accomplished in 1717-1720 by Louis XIV, who commissioned M. Desclieux, Lieutenant of the King, to transport a seedling into Martinique in the West Indies. M. Desclieux deprived himself of a large portion of his water allowance aboard ship in order that the plant might survive the journey. This plant, together with later seedlings from the two plants presented to Louis XIV, became the ancestors of American coffee-trees. In 1722, a coffee-plant was brought from the City of Cayenne, French Guiana, to Para, Brazil. A secondary introduction into Java was made by the Portuguese in 1723. In 1732, Sir Nicholas Lawes established it in Jamaica. Coffee was taken into Rio de Janeiro in 1774 by a Belgian monk named Molke, who procured his plants from the Maranhão district of Brazil. He planted the first ones in the garden of the Capuchin monastery of

Adjuda, which is in the center of the city. Molke and Joachim Bruneo, the then Bishop of Rio de Janeiro, distributed the seeds produced in the monastery garden to neighboring religious institutions and to the laity. From this simple beginning, the millions of coffee-trees under cultivation in Brazil had their origin. The date of the introduction of *C. arabica* L. into India is obscure. Although probably introduced into India early in the eighteenth century, it is certain that coffee-plants reached there early in the nineteenth century. The first systematic plantation was started near Chikmuglur by Mr. Cannon in 1830.

Hemileia vastatrix which devastated the coffee-industry in Ceylon, appeared in 1869; and by 1887 this fungal disease of the leaves had ruined the coffee-plantations. The coffee-plantations of Ceylon, India, Java, Sumatra, Celebes, and the Philippine Islands have been attacked by *Hemileia vastatrix*. The disease is watched by coffee-growers, and every possible means of control is used to check its spread and to prevent its introduction into other coffee-growing countries.

C. arabica L. still produces the great bulk of the world's coffee-supply. Its seeds are the basis of the coffee-beverage the world over. Many varieties have arisen. The ones of economic importance are those listed on pages 48-50 under the Key to the Varieties.

C. arabica L. is an excellent example of the effect of human agency upon the economic history of a plant. This species was transferred from its original home and became a staple crop in widely separated regions of the tropics. Its introduction has met with such satisfactory results in Brazil that that country is now the chief source of the coffee of commerce.

Uses:—*C. arabica* L. is the chief source of the coffee-beverage. The beverage is obtained from the roasted and ground seeds which are prepared by infusion, decoction or boiling, or filtration by use of a percolator.

Coffee-Leaf:—In Sumatra, the coffee-leaves have been used in the preparation of a beverage at least since 1850. The leaves, as well as the seeds, contain caffeine. The natives prefer an infusion of the leaves to that of the seeds. The leaves are never rolled as are tea leaves. They are roasted over a fire of dry bamboo or other wood which produces very little smoke. They become a buff color

when sufficiently roasted, and are then ground to powder. The leaves are used in the same way as coffee-beans in preparing the drink. In Africa, they are used in the same manner as tea-leaves.

Coffee-Wood:—The wood of *Coffea arabica* L. is one of the most compact and durable in the interior of Africa and is well-suited for furniture manufacture such as chairs, tables, bedsteads, etc., as well as for various articles of turnery. It takes an excellent and very durable polish. The African name in Golungo Alto and in Cazengo is *Muriabambe* or *Muria Nbamba,* which is composed of the words *'Muria'* meaning good and *'Nbambe'* meaning antelope, because a species of antelope in those regions shows a preference for the leaves of this tree.

Coffee-Pulp:—In some localities of Persia and Turkey, the pulp of the coffee-berry is dried and roasted. The resulting bitter preparation is known as Sultana Coffee. This term also frequently refers to a weak decoction of the raw beans. In Arabia, the pulp is allowed to dry intact, and is then removed from the seeds and used to prepare a pleasant infusion called *Kisher* or *Kahwe.* Sometimes Orientals use both the pulp and the bean in preparing coffee, and they assert that it is better than the use of the beans alone.

The mature pulp is mucilaginous, saccharine, glutinous, succulent, sweet, and palatable, and is often eaten by the pickers. The ripe pulp of the fruit contains sugar which is converted into alcohol. This source of alcohol is used in a limited area. Eight ounces of dried pulp, when steeped in water until fermentation begins, yield one ounce of spirits by distillation. The thoroughly fermented coffee-pulp serves as an excellent agricultural manure. It is rich in phosphoric acid and phosphates; and its effect as a manure is of two to three years' duration. This use of the coffee-pulp is increasing, and will become of commercial importance. It is preferable to the Peruvian guano because coffee-pulp contains eighty-five per cent of azole. Fermented coffee-pulp is frequently mixed with well-rotted dung. It is also used as a vehicle for the application of concentrated fertilizers. Coffee-pulp has been suggested by Dr. Schortt as an auxiliary to cattle-food.

Coffee-Oil:—Coffee does contain a volatile oil; but the term 'coffee oil' is a misleading trade name for a palm oil which is derived from the more or less burnt kernels which have the odor of coffee.

Coffee in Medicine and its Effect on the Human System:—*Historical:*—Many virtues have been attributed to coffee. Bradley [7] mentions it as advantageous in cases of headache, vertigo, lethargy, coughs, and even tuberculosis. Arabian and Egyptian women drank coffee during their period of menses with good effect, and also during pregnancy in the belief that the infant would not be troubled with worms during its youth. It was considered helpful to persons afflicted with rheumatism or gout; and it was thought that coffee defended the body from pestilential infection. Ellis [8] stated that coffee was used for its antisoporific effect. One learns from Roques [9] that coffee was beneficial in cases of spasmodic asthma, fevers, and was very efficacious in cases of chlorosis in young women. Coffee was much used, in Turkey and Arabia,[10] as an antidote for the narcotic effects of opium. The habitual use of the beverage was considered to act as a preventive against gout and gravel. It is of interest to note that in France and especially in Turkey and Arabia where coffee is used by all the inhabitants, these diseases are practically unknown. Dewces recommended the use of coffee in cases of cholera infantum and even in cholera.[11] Dr. Guillasse [11] of the French Navy reported that in the early stages of typhoid fever, he prescribed coffee as almost a specific. In India,[11] unroasted coffee-infusions were used as a substitute for quinine in cases of intermittent fever and roasted coffee was used as a fragrant and effective deodorizer and minor antiseptic in the hospital wards. Coffee has been used [11] in chronic diarrhoea and, being less astringent than tea, does not cause constipation as readily.

Present Knowledge:—The effects of an infusion of coffee and the physiological action which results from hypodermic injections or other experimental methods with caffeine are not comparable as certain volatile constituents (caffeone) are developed during torrefication. The facts stated below have reference only to the use of the coffee-beverage.

Hot coffee, when prepared from the freshly roasted and ground seeds, is deodorant, antiseptic, and germicidal. An infusion of one-

[7] Bradley Virtue and Use of Coffee etc. (1721) 24-25.
[8] Ellis Hist. Acc't. Coffee (1774) 39.
[9] Roques Phytographie Méd. 2 (1821) 52.
[10] Heraud Nouv. Dict. Pl. Méd. ed. 2 (1884) 148.
[11] Watt Dict. Econ. Prod. Ind. 2 (1889) 488-489.

half per cent will inhibit the growth of many pathogenic organisms. A ten per cent infusion will kill anthrax bacilli in three hours, cholera spirilla in four hours, and most other bacteria in two to six days.[12] Green coffee-infusions do not possess this antiseptic action which is probably due to the empyreumatic products developed during roasting.

Coffee is a cerebrospinal stimulant, promotes wakefulness, and gives relief from fatigue and hunger. The comfortable feeling produced by a cup of coffee is due to the volatile oils which have a carminative effect.[13] In collapse, hot coffee may be administered by the mouth or by the rectum.[14] Coffee is said to increase the peristaltic movements of the intestine [13] and therefore acts as a laxative.[12] Experimentation has convinced the author that a tincture of raw coffee is a more efficient diuretic than the infusion from the roasted bean. This action is useful in medicine, as diuresis serves to remove toxins which are secreted by the kidneys and may be used to lessen the action of such metals as mercury and lead.[15] Coffee as a diuretic is also useful in dropsy.

Coffee taken in moderation assists digestion by increasing secretory activity; but, used to excess, it may cause irritation of the mucous membrane.[13] The coffee-beverage, when prepared from the roasted beans, produces wakefulness and brief stimulation of the intellect. This effect is not produced by an infusion of green coffee.[12] Excessively roasted coffee-beans produce a bitter beverage which induces irritation and super-mental excitement resulting in sick headaches and insomnia. By stimulating physiological activity, coffee increases tissue-waste and promotes the formation and excretion of urea.[12] Observation of a large number of individuals indicates that coffee agrees especially with stout, phlegmatic, and catarrhal persons. It is not as advantageous to bilious individuals or to those who possess an excessively nervous temperament. Experimentation has shown the author that strong coffee lessens the effects of alcoholic beverages, and that, in cases of light nervous headaches not due to gastric disorders, it is immediately effectual.

Although caffeine is not in common use in medicine, it has value

[12] Potter Therapeutics. Mat. Med. & Pharm. ed. 12 (1913) 188-189.
[13] Cushny Pharm. & Therapeutics ed. 7 (1918) 294.
[14] Bastedo Mat. Med. Pharm. & Therapeutics (1914) 249.
[15] Hatcher & Wilbert The Pharm. & the Physician ed. 2 (1908) 382.

as a drug, especially because it is the only stimulant known which is not succeeded by a period of depression. Habitual coffee-drinkers develop a certain degree of immunity from the physiological effects of caffeine. Therefore, its medicinal dosage is uncertain because of marked variations in individual susceptibility.

Prelinnæan References:—Buna Clusius Exoticorum Pl. Hist. (1605) 236 cum ic. semen; Euonymo similis Ægyptiaca, fructu baccis laurisimili C. Bauhin Pinax (1623) 428 ed. 2 (1681) 428; Arbor Bon cum fructu suo Buna Parkinson Theatr. Bot. (1640) 1622 cum ic.; Coffee Frutex ex cujus Fructu fit Potus Ray Hist. Pl. 2 (1693) 1691; Du Caffé Pomet Hist. Gen. Drogues (1694) 204 avec Tabl.; Bon vel Ban Pluk. Almagest. Bot. (1696) 69, t. 272, f. 1; Jasminum arabicum, lauri folio, cujus semen apud nos coffe dicitur B. Jussieu in Act. Acad. Par. (1713) 388, t. 7; Jasminum; Arabicum; Castaneæ folio; flore albo, odoratissimo; cujus fructus Coffy, in Officinis dicuntur Nobis Boerhaave Ind. Alter Pl. Ludg-Bat. 2 (1720) 217; Bon Alpino De Pl. Ægypt. ed. 1 (1592) 36, t. 36; De Bon Vesling De Pl. Ægypt (1638) 21; Bon vel Ban Arbor (Bunchus Arabum) Chabraeo Stirp. Ic. et Sciagr. (1666) 32 cum ic.; Coffea L. Hort. Cliff. (1737) 59; Coffea Royen Fl. Leyd. Prodr. (1740) 239; Coffea L. Hort. Ups. (1748) 41; Mat. Med. ed. 1 (1749) 24.

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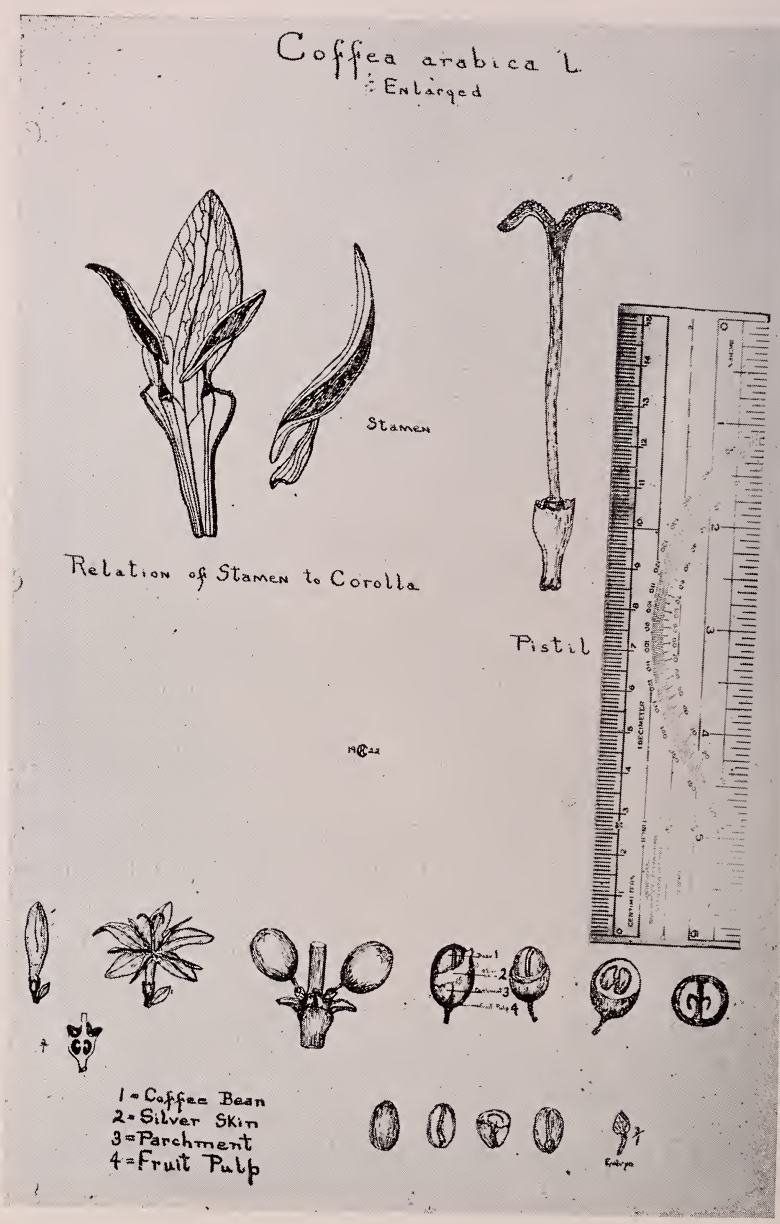

PLATE 13: *COFFEA ARABICA* L.

Fl. Maurit. & Seych. (1877) 152.—Hiern in Oliver Fl. Trop. Afr. 3 (1877) 180.—Kurz For. Fl. Brit. Burma 2 (1877) 27.—U. S. Dept. Agric. Rep. (1878) 194 t. 2 (young plant).—Schomb. Cat. Pl. Gov. Bot. Gard. Adelaide So. Austr. (1878) 93.—Baill. Hist. Pl. 7 (1880) 275 f. 251, 252, 253, 276, f. 254, 405.—Bentl. & Trim. Med. Pl. 2 (1880) 144 t. 144.—Mart. Fl. Bras. 6 pt. 5 (1881-88) 76 t. 11.—Heraud Nouveau Dict. Pl. Méd. (1884) 143, 144 f. 44; 145 f. 45.—Burck in Ann. Jard. Bot. Buitenz. 4 (1884) 50 t. 6 f. 50; Manus. transl. by Herzsohn in l.c. 8 (1890) 148.—Hillebr. Fl. Hawaii (1888) 176.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, (1891) 103 f. 36; Nachtr. (1897) 315.—Trim. Handb. Fl. Ceyl., 2 (1894) 353.—Th. Dur. & Schinz Étud. Fl. Congo (1896) 163.—Hiern Welw. Cat. Afr. Pl. pt. 2 (1898) 488.—Froehner in Notizbl. Bot. Mus. 7 (1897) 233; in Engl. Bot. Jahrb. 25 (1898) 261.—Heck. Pl. Med. & Tox. (1897) 33.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 229, 230.—Lecomte Le Café (1899) 18.—Preuss Exped. Cent. & Südamer. (1900) 352.—Jumelle Les Cult. Col. Pl. Aliment. 1 (1901) 350, 351 f. 92.—Collett Fl. Simlensis (1902) 226.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 21-27; t. 22 f. 1; t. 24 f. 2, 3; t. 25 f. 4; t. 26 f. 5, 6.—Cook. Fl. Bombay 1 (1903) 626.—Wettst. Veg. Südbras. (1904) t. 40 (young plantation).—Safford in Contrib. U. S. Nat. Herb. 9 (1905) 244 t. 30 (Useful Pl. Guam).—DeWild. Mission Laurent 3 (1906) 344 t. 67, 68, 69, 70.—Fauchère Cult. Prat. Caféier (1908) 3 t. 1, 3.—Corr. Fl. Braz. (1909) 5.—T. Dur. & H. Dur. Fl. Congol. (1909) 275.—Lalière Le Café (1909) 45 t. 5.—DeWild. Compagnie Kasai (1910) 1.—Wettst. Handb. Syst. Bot. (1911) 759.—L. H. Bail. Stand. Cycl. Hort. 2 (1914) 823.—Maza & Roig Fl. Cub. ed. 2 (1916) 32, 137.—Culbreth Man. Mat. Med. & Pharm. ed. 6 (1917) 547, 548 f. 371.—Engl. & Gilg Syll. Pflanzenfam. ed. 8 (1919) 339.—Chev. Explor. Bot. Afr. Occid. Franç. 1 (1920) 335.—Urban Symbolæ Antillanæ seu Fundamenta Fl. Ind. Occid. 8 pt. 2 (1921) 676.—Gamble Man. Ind. Timbers (w. descript. wood struct.) ed. 2 (1922) 422.

Economic and Cultural References:—Bradley Virtue and Use of Coffee w. regard to Plague and other infectious Distempers (1721).—Laborie Coffee Planter St. Dom. (1798).—Guillemin, Perrottet & Richard Fl. Senegamb. Tent. (1830-33) 261.—Kosteleszky Med. Pharm. Fl. 1 (1831) 294; 2 (1833) 556; 4 (1835) 1350.—DC. Orig. Cult. Pl. Fr. ed. (1833) 333.—Porter in The Trop. Agric. (1833) 51-84, t. 56.—Duchesne Pl. Util. et Pl. Venén. (1836) 148.—Roques Pl. Us. 2 (1837) 271.—Lindley Med. & Œcon. Bot. (1849) 239.—Archer Pop. Econ. Bot. (1853) 129-133.—Rhind Hist. Veget. King. (1855) 394-396.—Marchand Recherch. Organogr. & Organogen. sur le *Coffea arabica* L. (1864).—Simonds Coffee & Chicory; Their Cult. Chem. Comp. Prepar. for Market & Consumpt. (1864).—Sabonadière Coffee Pl. Ceylon (1870).—Kurz For. Fl. Brit. Burma 2 (1877) 5.—Simonds "coffee" in Trop. Agric. (1877) 27.—Pickering Chron. Hist. Pl. (1879) 811, 831.—Christy New Comm. Pl. & Drugs No. 7 (1884) 79.—Ficalho Pl. Uteis (1884) 199.—Heraud Nouveau Dict. Pl. Méd. (1884) 144, 145, 148.—Boehnke-Reich Der Kaffee in sein. Bezieh. zum Leben

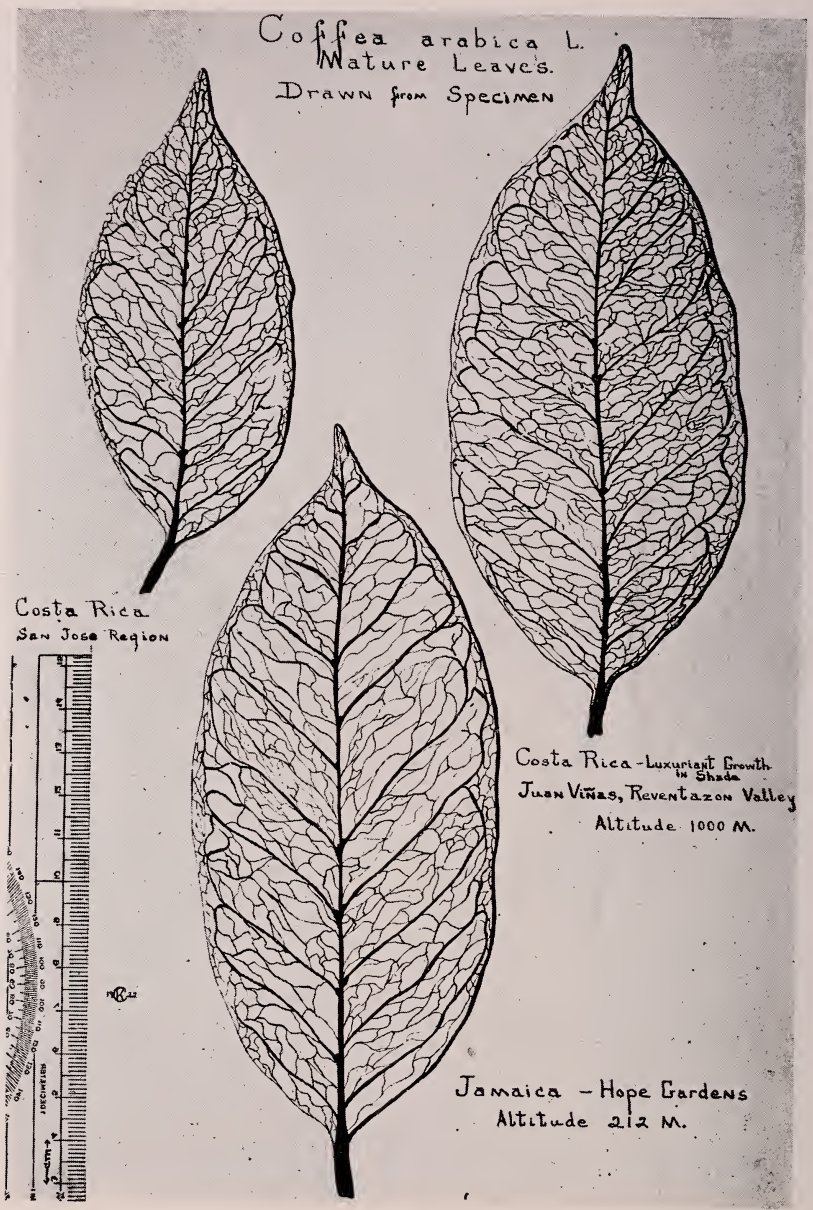

PLATE 14: *COFFEA ARABICA* L.

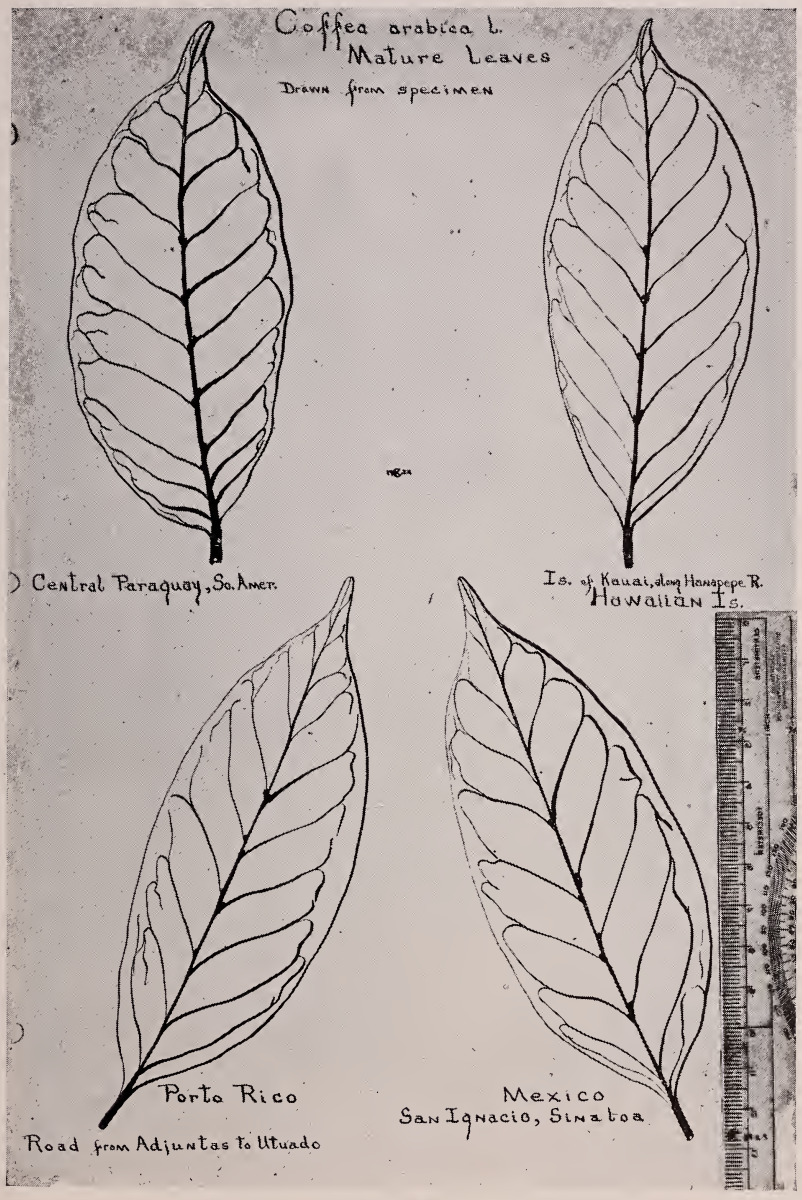

PLATE 15: *COFFEA ARABICA* L.

(1885) 162.—Arnold Coffee: Its Cult. & Profit (1886).—Lanessan Pl. Util. Col. Franç. (1886) 42, 206, 883.—Corre & Lejànne Mat. Méd. (1887) 59.—Mueller Select. Extra-Trop. Pl. ed. 7 (1888) 107.—Kew Bull. (1888) 129; (1893) 123, 128, 321; (1894) 163.—Deflers Voy. Yemen (1889) 143.—Foreman Philipp. Is. (1889) 337.—Watt Dict. Econ. Prod. Ind. 2 (1889) 460-491.—Tschirch Ind. Heil- u. Nutzpflanz. u. Cult. (1892) 58-73, t. 33, 35.—Saenz Memoria Sobre el Cult. del Cafeto (1892).—Raoul Cult. Caféier (1894).—Walsh Coffee Classif. Hist. & Descript. (1894).—Editor in Bull. Bot. Dept. Jamaica "Notes on Coffee" from Laborie's Coffee Planter pt. 12, 2 (1895) 273.—Delgardo Contrib. al Estudio del Café en Venezuela (1895) 1-93.—Heuzé Pl. Industr. 4 (1895) 172.—Hart in Ann. Rep. Roy. Bot. Gard. Trinidad (1896) 13.—Ferguson Coffee Pl. Man. (1898) 1-312.—Lecomte Le Café (1899) 41-332.—Zimmermann "Die Nematodenkrankheit der Kaffeeplanz. auf Java" in Bull. Inst. Bot. Buitenz. 4 (1900) 11; Ueber den Krebs von *Coffea arabica* L. verusacht durch *Rostrella Coffeæ* gen. & sp. n. l.c.—Higgens Prelim. List Vernac. Names Trees, Shrubs, & Woody Climbers Madras Presidency (1901) 47.—Nicolai Der Kaffee u. sein. Ersatzmitt. (1901) 68.—Travera (Transl. by Thomas) Med. Pl. Philipp. (1901) 144.—Dubard Les Caféiers in Agric. Prat. des Pays Chauds pt. 1, 5 (1905) 92; in Bull. Mus. Nat. Hist. Nat. (1907) 279.—Freeman & Chandler World's Comm. Prod. (1907) 174.—Hare, Caspari, Rusby Natl. Stand. Dispens. ed. 2 (1908) 340.—Fauchère Cult. Prat. Caféier (1908).—Hueppe Unters. über Zichorie (1908) 36.—Pittier Pl. Us. Costa Rica (1908) 74, 149, t. 11.—Watt Comm. Prod. Ind. (1908) 363.—Westermann Die Nutzpflanz. Unser. Kolon. (1909) 27-28, t. 8.—Roux Cult. & Comm. Cafés en Abyss. in Agric. Prat. Pays Chauds pt. 2, 10 (1910) 149.—Editor Prod. Mocha Coffee in Agric. News Barbados 10 (1911) 244.—Hartwich Die Menschlich. Genuszm. (1911) 274-278.—Ward Encycl. Foods & Bever. (1911) 160, 169.—Van Wijk Dict. Pl. Names 1 (1911) 346.—Wehmer Pflanzenstoffe (1911) 730.—Editor "A Costa Rican Coffee Estate" in W. I. Comm. Circ. 29 (1914) 486.—Lewkowitsch Chem. Technol. & Anal. Oils, Fats, & Waxes ed. 5, 2 (1914) 371.—Perrot Les Grand. Prod. Végét. Col. franç. (1915) 421, 423 t. 32; Travaux du Lab. Mat. Méd. Ecole Supér. de Pharm. de Paris pt. 5, 10 (1913-1916) No. 3, pg. 9.—Dingle New Atlas & Comm. Gaz. China ed. 2 (1917) xiv.—Griebel in Zeitschr. Nahrungs-u. Genuszm. 35 (1918) 272.—Kraemer Bot. Abstracts No. 5, 1 (1919) 219.

Key to the Economic Varieties of *C. arabica* L.

Leaves succulent; larger than the other varieties of *C. arabica* L.; mature berry large (nearly 2.5 cm. long), red, soft, cherry-like, with silky, glabrous surface, very small proportion of pulp..... *maragogipe* Hort. ex Kew Bull.

Leaves spathulate, attenuated, three times as long as wide (1.4 cm. to 3.0 cm. wide by 5.5 cm. to 12 cm. long), very glossy, veins very distinct; fruit red..... *angustifolia* Miq.

PLATE 16: *COFFEA ARABICA* L.

Leaves long-elliptical, veins 7-8, greenish-yellow color; fruit red.... *straminea* Miq.

Leaves abundant, 5 cm. to 7 cm. wide by 13 cm. to 20 cm. long, veins 9-11, rarely 13; bracteoles highly developed, nearly linear, extending beyond calyx; fruit red.....*stuhlmannii* Warbg.

Leaves small, narrowed toward the tip, three times as long as wide (1.5 cm. to 3.0 cm. wide by 5.0 cm. to 10 cm. long), veins 5-6 of the first rank, not very distinct; branches thin; fruit red..... *intermedia* Froehner

Leaves elliptical, 3.0 cm. wide by 6.0 cm. long; branches articulate, gray; bark transversely fissured; fruit red..... *rhachiformis* (Baill.) Froehner

Leaves glabrous, pointed, narrow, cuneiform; petiole 1 cm. long; fruit black.....*Humblotiana* (Baill.) Froehner

Leaves 4.5 cm. to 6.0 cm. wide by 12.5 cm. to 18 cm. long; fruit yellow, rare.....*amarella* Hort. ex Froehner

Leaves elliptical or oval-oblong, obtusely-acuminate, cuneiform, narrowed, thinly coriaceous, not glandular in axils of veins, 2.0 cm. to 3.5 cm. wide by 7 cm. to 15 cm. long, veins 6-7 of the first rank; fruit white, size of a pea.....*leucocarpa* Hiern

Coffea arabica L. var. *maragogipe* Hort. ex Kew Bull. (1884) 164.

A large plant, resembling *C. liberica* Bull in habit. Branches whippy, with very long internodes. Leaves twice the size of the other varieties of *C. arabica* L., papery in texture, with undulating margin. Flowers and fruit characteristic of *C. arabica* L. excepting the size of the fruit which is nearly 2.5 cm. long. The so-called "parchment skin" or chartaceous integument is thin, not hard or horny. Extraordinarily vigorous plant, attaining a height of 2.4 to 3.0 M. at the age of 3-4 years, and full of fruit or so-called cherries, at that time. The tree bears earlier than other coffees. The mature fruit is red, soft, silky, smooth surface, and it has a proportionally small amount of pulp. The seeds, like the fruit as a whole, are larger than other varieties of *C. arabica* L. This results in a greater yield by weight per acre. Cleaned beans, prior to desiccation, form thirty per cent by weight of the fruit.

Diagnostic Characters of the Variety:—Succulent and large leaves. The large size of the fruit.

Common Names:—Maragogipe Coffee; Brazilian Coffee; Blue Mountain Coffee.

Geographical Distribution:—Brazil. Introduced into Bolivia; India; Ceylon; Java; Queensland; Jamaica.

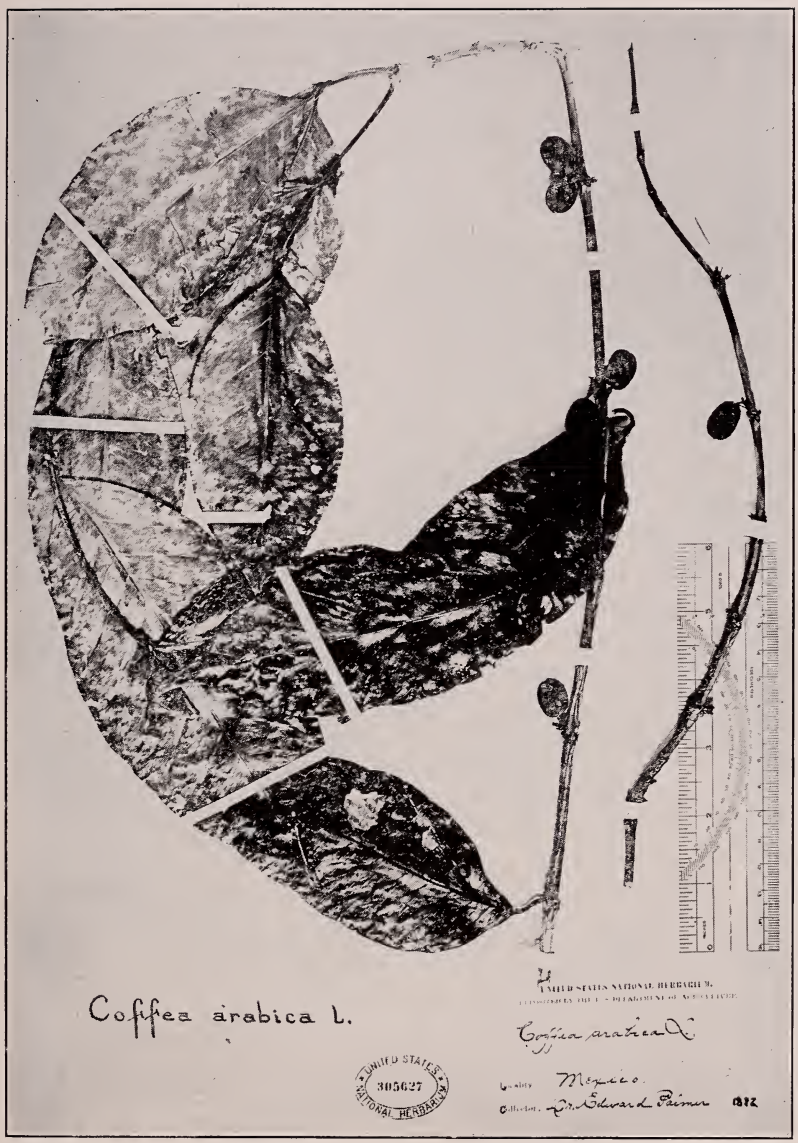

PLATE 17: *COFFEA ARABICA* L.

History:—This variety of *C. arabica* L. was discovered in 1870 by Crisogono José Fernandez near Maragogipe in the province of Bahia, Brazil. On account of the agreeable flavor of its seeds, vigorous growth, early maturity, and large yield, it has become a popular variety cultivated by planters. The heavy nature of the endocarp and the consistency of the pulp offer no hindrance for the machines employed in the working process. It was introduced into England from Brazil by Mr. Thomas Christy, F.L.S., in 1883, and grown successfully in the Palm House of the Royal Botanic Gardens at Kew. It was soon introduced from Brazil into the English colonies. Maragogipe coffee has been grown successfully in Ceylon, Java, Jamaica, and Trinidad. In Ceylon and Java, however, it was attacked by the coffee-leaf fungus known as *Hemileia vastatrix,* which was first noted in 1869; and, by 1881, the Ceylon coffee-industry was ruined and coffee-estates were abandoned. Maragogipe coffee was first cultivated at the Botanic Gardens, Trinidad, in 1887. In Jamaica, seeds were received in 1883, and the plants were distributed in the Blue Mountain district in 1884-5. In Queensland, in 1893, nearly 6,000 coffee-plants—many of them being Maragogipe from Brazil—were set out along the coast at Mackay, Bundaberg, Maryborough, Gympie, Maroochie, Mooloolah, Cleveland, etc. A hybrid has been successful which was produced by fertilizing true *C. arabica* L. with the pollen of the Maragogipe variety. The production of Maragogipe coffee, however, is a comparatively small figure as regards true *C. arabica* L. production.

Use:—It is used largely by commercial concerns as a filler.

Bibliography:—Editorial in Trop. Agric. 4 (1884) 494.—Kew Bull. (1894) 164.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 89.—Froehner in Engl. Bot. Jahrb. 25 (1898) 263.—Lecomte Le Café (1899) 24.—Jumelle Les Cult. Col. Pl. Aliment. 1 (1901) 352.—Chev. Explor. Bot. Afr. Occid. Franç. 1 (1920) 335.

Economic and Cultural References:—Christy New Comm. Pl. and Drugs No. 7 (1884) 79.—Trans. Queensl. Acclim. Soc. June (1893) 56.—Fauchère Cult. Prat. Caféier (1908) 4 t. 4, 6.—Hartwich Die Menschlich. Genuszm. (1911) 277. See also citations under *C. arabica* L.

PLATE 18: *COFFEA ARABICA* L.

Leaves showing effects of leaf-fungus.

Coffea arabica L. var. *angustifolia* Miq.

A tree bearing spathulate and pointed leaves, three times as long as wide, 1.4 cm. to 3.0 cm. wide by 5.5 cm. to 12 cm. long, distinguished by very highly polished or glossy leaves, veins distinct.

Synonymy:—*Coffea angustifolia* Roxb. Fl. Ind. ed. 1 (Wall.) 2 (1824) 195; ed. 2 (1832) 541.—DC. Prodr. 4 (1830) 499.—G. Don Gen. Hist. Dichlam. Pl. 3 (1834) 582.—Miq. Fl. Ind. Bat. 2 (1856-59) 307.—Burck in Ann. Jard. Bot. Buitenz. 4 (1884) 54.

Geographical Distribution:—Celebes (Prov. Menado).

History:—This variety has appeared in the Celebes where it is cultivated to some extent in the Province of Menado.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 263.—Lecomte Le Café (1899) 25.

Economic and Cultural Reference:—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul and Sagot pt. 1, 2 (1897) 90.—Hartwich Die Menschlich. Genuszm. (1911) 278.

Coffea arabica L. var. *straminea* Miq.

A tree bearing long-elliptical leaves with 7 to 8 veins of the first rank; leaf lamina greenish-yellow color.

Synonymy:—*Coffea sundana* Miq. Fl. Ind. Bat. 2 (1856-1859) 306.

Geographical Distribution:—Sumatra (De Vriese); Celebes (Prov. Menado); Java (Preanger District).

History:—This variety occurs chiefly in Sumatra and Java at an altitude of 550 to 1100 M. It is cultivated to some extent.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 263.—Lecomte Le Café (1899) 25.

Economic and Cultural Reference:—Hartwich Die Menschlich. Genuszm. (1911) 278.

Coffea arabica L. var. *Stuhlmannii* Warbg.

A tree with very abundant foliage. Leaves occur in the normal position found in *C. arabica* L. although crowded. Leaves 5 cm. to 7 cm. wide by 13 cm. to 20 cm. long, veins 9 to 11 rarely 13; bracteoles well developed, nearly linear, extend beyond the calyx. Fruit normal size, red.

Common Name:—Bukoba Coffee.

Geographical Distribution:—Bukoba, Africa (Lake Region at about 1200 M).

PLATE 19: *COFFEA ARABICA* L.
VAR. *ANGUSTIFOLIA* MIQ.

History:—This variety was collected by Stuhlmann in a half cultivated and half wild state among banana plants while he was on the Emin Pascha Expedition. It is found in great quantities in the inner African Lake Region, especially at Bukoba.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 263.—Lecomte Le Café (1899) 25.

Economic and Cultural Reference:—Hartwich Die Menschlich. Genuszm. (1911) 277.

Coffea arabica L. var. *intermedia* Froehner in Engl. Bot. Jahrb. 25 (1898) 264.

A small tree with thin, slender branches. Leaves deviate from the normal form of the species. Leaves 1.5 cm. to 3.0 cm. wide by 5.0 cm. to 10.0 cm. long, similar to the leaves of *C. arabica* L. var. *angustifolia* Miq., three times as long as wide; leaf apex, on account of narrow form, appears somewhat longer; leaf narrows down toward the base; veins 5 to 6 of the first rank, not very distinct. Flowers usually 2 to 4 together.

Geographical Distribution:—Lake Region, Ligaijo, Africa.

History:—This variety was collected by Fischer, number 326, at Ligaijo, Africa, where it grows wild. It is also cultivated to a slight extent by the natives. This specimen is identical with the flowerless plant which A. Whyte found at Chiradzulu and the specimen which Scott Elliot collected at Ruwenzori during the expedition of 1893-1894.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 264.—Lecomte Le Café (1899) 25.

Coffea arabica L. *rhachiformis* (Baill.) Froehner in Engl. Bot. Jahrb. 25 (1898) 264.

A shrub which attains 4 to 5 M. in height; branches smooth, gray, articulated, with transversely fissured bark. Leaves elliptical, large, 3 cm. wide by 6 cm. long. Flowers small, 1 cm. long, firmly attached. Fruit red, firmly attached, usually solitary; seeds 1.66 cm. long.

Synonymy:—*Coffea rhachiformis* Baill. in Bull. Soc. Linn. Par. 1' (1885) 514.—Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 234.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul and Sagot pt. 1, 2 (1897) 239.

PLATE 20: *COFFEA ARABICA* L. VAR. *ANGUSTIFOLIA* MIQ.

Geographical Distribution:—Grand Comoro Island.

History:—This variety was discovered in the Grand Comoro Island, where it is now cultivated to a small extent and furnishes a very excellent coffee.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 264.—Lecomte Le Café (1899) 26.

Economic and Cultural Reference:—Hartwich Die Menschlich. Genuszm. (1911) 277.

Coffea arabica L. var. *Humblotiana* (Baill.) Froehner in Engl. Bot. Jahrb. 25 (1898) 264.

A very tall tree, up to 25 M., with gray, shriveled bark. Leaves glabrous, pointed, cuneiform at the base, narrowed; petiole 1 cm. long. Flowers pedunculate, 2.5 cm. long and wide; peduncle 1 cm. long, corolla-tube broadly lanceolate; small glandular calyx-margin. Fruit black, obovate, 1.5 cm. long, smooth, with longitudinal furrows; seeds over 1 cm. long.

Synonymy:—*Coffea Humblotiana* Baill. in Bull. Soc. Linn. Par. 1 (1895) 514.—(Baill.) Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 234.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul and Sagot pt. 1, 2 (1897) 238.—Wehmer Pflanzenstoffe (1911) 734.

Geographical Distribution:—Grand Comoro Island.

History:—This variety was discovered in the Grand Comoro Island where it is now cultivated to a slight extent by the natives. This variety is devoid of caffeine (0.00%) according to the analysis by M. le professeur Bertrand.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 264.—Lecomte Le Café (1899) 25.

Economic and Cultural References:—Bertrand in Compt. Rend. 141 (1905) 209; 132 (1901) 161.—Hartwich Die Menschlich. Genuszm. (1911) 277, 300, 825.—Wehmer Pflanzenstoffe (1911) 734.

Coffea arabica L. var. *amarella* Hort. ex Froehner in Engl. Bot. Jahrb. 25 (1898) 263.

A small tree bearing leaves 4.5 cm. to 6.0 cm. wide by 12.5 cm. to 18.0 cm. long. Fruit yellow, with a remarkably high caffeine-content; rare.

Common Names:—Botucatú Coffee; Golden Drop Coffee; Amarillo Coffee.

Geographical Distribution:—Botucatú, Brazil.

History:—This variety was discovered in 1871 in Botucatú District in the Province of São Paulo, Brazil. It is cultivated in this region to a very slight degree. It has been introduced into India by the English.

Bibliography:—Froehner in Engl. Bot. Jahrb. 25 (1898) 263.—Lecomte Le Café (1899) 24.—Jumelle Les Cult. Col. Pl. Aliment. 1 (1901) 352.

Economic and Cultural References:—Pobéquin Essai sur la Fl. Guin. Franç. (1906) 352.—Fauchère Cult. Prat. Caféier (1908) 4.—Hartwich Die Menschlich. Genuszm. (1911) 277.

Coffea arabica L. var. *leucocarpa* Hiern in Trans. Linn. Soc. Lond. ser. 2, 1 (1876) 171.

A glabrous shrub with terete branches, somewhat compressed toward the extremities. Leaves short, 2 cm. to 3.5 cm. wide by 7 cm. to 15 cm. long, elliptical or oval-oblong, obtusely acuminate, cuneiform, narrowed, thinly coriaceous; 6 to 7 first-rank veins, inconspicuous, not glandular in axils; stipules pointed, 0.31 cm. long, ovate, sheathing at the base; petiole not longer or only slightly longer than the stipules, i.e., petiole 0.31 cm. to 0.42 cm. long. Flowers few, aggregated in axillary clusters; bracts ovate, 0.2 cm. to 0.31 cm. long, i.e., shorter than the small fruiting pedicel. Fruit single or in pairs, white, erect, size of a pea; seeds 0.62 cm. long.

Geographical Distribution:—Sierra Leone.

History:—This white-fruited variety of *Coffea arabica* L. was first described from a specimen in the collection of Th. Vogel dated June, 1841. This variety is considered by some botanists to be individualistic enough to warrant its elevation to specific rank. It is cultivated to a slight degree in Upper Guinea.

Bibliography:—Hiern in Trans. Linn. Soc. Lond. ser. 2, 1 (1876) 171; in Oliver Fl. Trop. Afr. 3 (1877) 181.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, (1891) 104.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 231.—Froehner in Engl. Bot. Jahrb. 25 (1898) 264.—Lecomte Le Café (1899) 25.—Jumelle Les Cult. Col. Pl. Aliment. 1 (1901) 352.

Economic and Cultural Reference:—Hartwich Die Menschlich. Genuszm. (1911) 277.

Coffea congensis Froehner in Notizbl. Bot. Gart. Berlin No. 7, 1 (1897) 233, 235.

A slender, thinly-branched tree or tall shrub. Leaves thickly coriaceous, 4 cm. to 6 cm. wide by 12 cm. to 16 cm. long, apex prolonged for about 1 cm.; veins 6 to 7 (5 to 9 in its various varieties) of the first order, clearly distinguishable; petiole over 1 cm. long. Flowers yellowish, aggregated in 4 to 8 membered axillary fascicles, each flower subtended by 1 or 2 bracts which extend beyond the calyx; corolla fissured for two-thirds of its length; tube 0.4 cm. long; lobe ovate-lanceolate, 1.5 cm. long; calyx glabrous, slightly dentate. Anthers firmly attached, 0.5 cm. long, completely exserted. Fruit similar to *C. arabica* L. but somewhat smaller, 1.6 cm. long, 0.7 cm. in diameter, ovoid with a faint longitudinal suture; pericarp thin; seeds oblong-elliptical, 0.6 cm. long. Stone cells very numerous in the testa.

Diagnostic Characters of the Species:—Flowers and fruits in January; flowers yellowish, not very fragrant; calyx only slightly dentate; fruit smaller than *C. arabica* L.

Geographical Distribution:—Congo: Lake Tchad.

History:—The species was collected in the Congo region of Africa. It was first described in 1897. In the regions bordering on the equator, it can be cultivated up to 800 M. It is apparently insusceptible to *Hemileia vastatrix* according to its behavior in this regard when it was investigated in Madagascar. The caffeine content of the seeds is 1.19%. It is not very productive, and its cultivation has not been largely extended. It embodies two economic varieties; namely, *C. congensis* Froehner var. *Chalotii* Pierre mss. ex DeWild.; and *C. congensis* Froehner var. *subsessilis* DeWild. The other varieties are not known to be of economic importance. It is questionable whether they are valid varieties, as they possess an exceedingly close inter-relationship and approximation to some forms of *C. arabica* L.

Use:—It is used as a local substitute to some extent for the seeds of *C. arabica* L. in the tropical regions of Africa and Madagascar.

Bibliography:—Froehner in Notizbl. Bot. Gart. Berlin 1 (1897) 233, 235; in Engl. Bot. Jahrb. 25 (1898) 254, 265.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Th. Durand & DeWild. Mat. Fl. Congo 2 (1898) 75.—Lecomte Le Café (1899) 27.—DeWild. Les Caféiers (1901) 15.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 28.—Chev. in Bot. Centralbl. 93 (1903) 70;

PLATE 21: *COFFEA CONGENSIS* FROEHNER

From Fauchère Cult. Prat. Caféier (1908) t. 61.

in Compt. Rend. d. Séances De l'Acad. d. Sci. Par. 140 (1905) 517-520. —DeWild. Mission E. Laurent 3 (1906) 335 t. 71, 73.—DeWild. Pl. Trop. Grand. Cult. 1 (1908) 90 t. 19; Compagnie Kasai (1910) 1.

Economic and Cultural References:—Fauchère Cult. Prat. Caféier (1908) 7 to 8.—Harwich Die Menschlich. Genuszm. (1911) 274.—Perrot Travaux Lab. Mat. Méd. Ecole Supér. de Pharm. de Paris pt. 5, 10 (1913-1916) no. 3, pg. 11; Les Grand. Prod. Végét. Col. Franç. (1915) 421, 430 t. 34 f. 61.

Coffea congensis Froehner var. *subsessilis* DeWild. Miss. Laurent 3 (1906) 337, t. 73.

A tree bearing elliptical leaves. Leaves cuneiform at the base, rather sharply obtuse at apex, acumen short; petiole 8 mm. to 9 mm. long, lamina 5 cm. to 12 cm. long by 1.5 cm. to 4.5 cm. wide; lateral veins 7 to 8, anastomosing in arches before reaching the margin; glands axillary, small or not appearing on upper surface; opening by an irregular slit, often oval, at angle of veins; stipules widely triangular, slightly pointed; bracts foliaceous, linear, 4 mm. long. Flowers arranged in 2 to 3 axillary cymes of 1 to 2 flowers each, usually solitary; cyme peduncle short, more or less flattened, lightly attached to fruit and bearing 1 to 2 superposed calycules; flowers 7 to 8-merous; lobes 12 mm. to 15 mm. long, tube about 10 mm. long. Fruit 14 mm. long by 10 mm. in diameter, and bearing a prominent 1 mm. disk at the summit; disk very shortly contracted, usually not exceeding the calyculus. When two fruits are found subtended by the same calyculus, one has a much longer pedicel than the other.

Diagnostic Characters of the Variety:—Prominent anastomosis of the leaf-veins. Pedicel scarcely exceeding the calyculus. Bracts linear, foliaceous, divergent, persistent below the fruit, and giving the fruiting glomerule a compact appearance.

Geographical Distribution:—Stanley-Falls; Batekalela; Island of Lualaba.

History:—This variety was collected at Stanley-Falls and on the island of Lualaba in 1896, and at Batekalela in 1904. Laurent mentions this variety as indigenous in the above localities; but it was not described authentically until 1906.

Use:—As a local substitute for *C. arabica* L.

Bibliography:—DeWild. Miss. Laurent 3 (1906) 337, t. 73.—T. Dur. and H. Dur. Syll. Fl. Congol. (1909) 276.

PLATE 22: *COFFEA CONGENSIS* FROEHNER

From DeWild. Miss. Laur. 3 (1906) 337, t. 73.

1. Fruiting Branch. **2.** Fruit. **3.** Flower.

Coffea congensis Froehner var. *Chalotii* Pierre Mss. ex DeWild. Les Caféiers (1901) 17.

A tree with elliptical leaves. Leaf-lamina opaque, 10 cm. to 19 cm. long by 4.5 cm. to 11 cm. wide, apex acuminate, base cuneiform, paired lateral veins 8 to 9; petiole 12 mm. to 22 mm. long. Inflorescence axillary, very often solitary, comprising 3 to 4 flowers surrounded by a calyculus; outer calyculus foliaceous, highly developed; inner calyculus of shorter bracts. Flowers 5-merous, corolla 18 to 23 mm. long, tube as long as lobes; calyx of 5 distinct, triangular lobes; disk longer than calyx.

Diagnostic Characters of the Variety:—It is larger than the species proper, *C. congensis* Froehner; height often 7 to 8 M. Flowers whiter, more fragrant. Fruit long, elliptical; seeds grayish; pedicel always exceeds calyculus in length.

Geographical Distribution:—Gabon; Congo.

History:—This variety was first collected by A. Dewevre in 1896 in the Congo; also by Chalot (no. 20 & 47) and by R. P. Klaine (no. 1691) in 1899; and was described in manuscript by M. Pierre. Marc Laurent collected it at Wangata in August, 1903. It was also found by Em. Laurent and L. Pynaert (no. 250). The first published description, however, was by DeWildermann in 1901. This variety resembles *C. arabica* L.; but curiously it has not been largely cultivated by the natives.

Use:—Largely as a substitute for the seeds of *C. arabica* L.

Bibliography:—DeWild. Les Caféiers (1901) 17; and Miss. Laurent 3 (1906) 335 t. 71, 72, f. 54; Pl. Trop. Grand. Cult. 1 (1908) 90.—T. Dur. and H. Dur. Syll. Fl. Congol. (1909) 276.

Coffea mauritiana Lam. Encycl. 1 (1783) 550.

A greatly branched, glabrous shrub with slender branches; attains a height of 25 M. Bark whitish in the young plant; gray and rugose in the mature plant. Leaves glossy; upper side dark green, lower side sometimes lighter, dull or brownish green; oblong, subcoriaceous, subobtuse, 5 to 7.5 cm. wide by 9 to 14 cm. long; apex short, obtuse; base cuneiform; petiole short, flattened; venation of lamina very slender and graceful on both sides; stipules minute, 0.3 cm. to 0.4 cm. long, lanceolate, deltoid. Flowers 1 to 4 together, sessile, in the axils of the leaves, 5-merous; corolla white, 0.62 cm. long, tube short; calyx short, 0.2 cm. long, subtended by a pair of

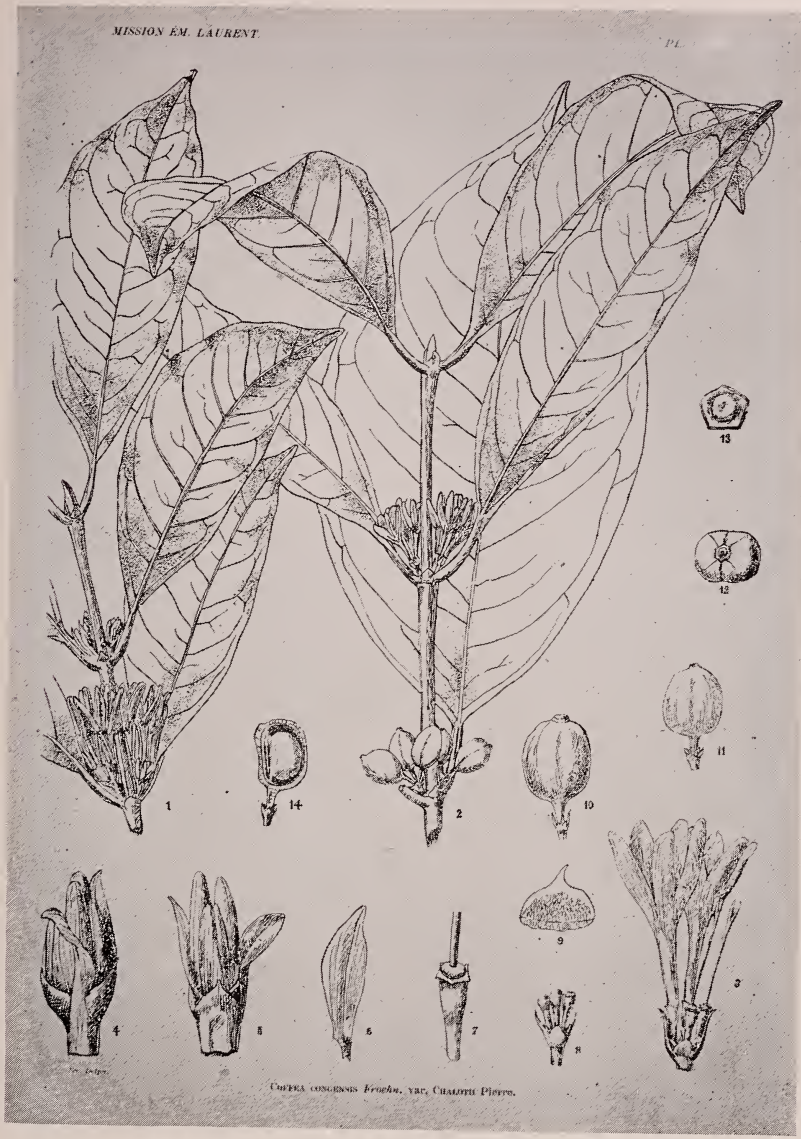

PLATE 23: *COFFEA CONGENSIS FROEHNER*

From DeWild. Miss. Laur. 3 (1906) t. 71.

1. Flowering Branch.
2. Flowering and Fruiting Branch.
3. Portion of Inflorescence.
4. Partial Inflorescence.
5. Partial Inflorescence.
6. Bract.
7. Flower:—Corolla removed.
8. Young Fructification.
9. Stipule—inner aspect.
10. Fruit.
11. Fruit.
12. Fruit:—seen from above.
13. Disk.
14. Seed in situ.
(Longitudinal section.)

small, deltoid, fimbriated bracteoles bearing 5 distinct, deltoid teeth; calyx-margin extending beyond the calyculus. Stigma and anthers exserted; anthers 0.42 cm. long. Fruit drupaceous, oblong to obovate, narrowed toward the base, with small calyx scar; seeds narrowed below, 4 layered endocarp, cells narrowed in the same direction; stone cells of testa are long, slender, strongly knotted; cell-walls are remarkably and irregularly thickened; pores large, oblique.

Diagnostic Characters of the Species:—Leaves differing in color above and below; char. in form (See Plate); venation slender, graceful. Small calyx scar. Fruit, seeds, and endocarp-cells narrowed basally. Remarkable and irregular thickenings of testa cell-walls. Pair small deltoid, fimbriated bracteoles subtending the calyx.

Synonymy:—*Coffea sylvestris* Willd. in Roem. and Schult. Syst. Veg. (1819) 201, No. 28. *Coffea arabica* L. var. β Willd. Sp. Pl. 1 (1797) 974.

Common Names:—Café marron in Bourbon; café batard; caffeyer de Bourbon.

Geographical Distribution:—Mauritius; Bourbon; Is. Madagascar. In the high mountainous and forested regions.

History:—*Coffea mauritiana* Lam. was discovered in Bourbon in 1715. It is referred to as café marron. In French West Africa, the seeds of *Cassia occidentalis,* a coffee substitute, are designated by the same term. *C. mauritiana* Lam. seeds give a bitter infusion. This species and *C. arabica* L. have been crossed by Frappier and Le Héry, and the resulting seed resembles the latter species. This cross appeared in Java in 1876 under the name *C. mauritiana* and has been treated by some authors as a variety of *C. arabica* L. *C. mauritiana* Lam. seeds contain a very low percentage of caffeine, only 0.07%.

Use:—The seeds are used as an adulterant for the seeds of *C. arabica* L. When taken alone, the beverage is said to be slightly intoxicating. In view of its low caffeine-content, it is evident that this report is exaggerated.

Bibliography:—Lam. Encycl. 1 (1783) 550; Tabl. 2 (1792) ed. 1823, t. 160 f. 2.—Willd. Sp. Pl. 1 (1797) 974.—Spreng. Syst. Veg. 1 (1825) 755.—DC. Prodr. 4 (1830) 499.—G. Don Gen. Hist. Dichlam. Pl. 3 (1834) 581.—Duchesne Pl. Util. et Venén. (1836) 148.—Hiern in Trans. Linn. Soc. ser. 2, 1 (1876) 173.—Baker Fl. Maurit. Seych. (1877) 152.—Courdemoy Fl. de l'Île de la Reunion (1895) 506.—

PLATE 24: *COFFEA MAURITIANA* LAM.

Froehner in Notizbl. K. Bot. Mus. 7 (1897) 234.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 229, 232.—Froehner in Engl. Bot. Jahrb. 25 (1898) 273.—Lecomte Le Café (1899) 39.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 20.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 35.

Economic and Cultural References:—Heraud Nouveau Dict. Pl. Méd. (1884) 145.—Lanessan Pl. Util. Col. Franç. (1886) 42, 206.—Corre & Lejanne Mat. Méd. (1887) 60.—Reprint from Maurit. Planter's Gaz. in Trop. Agric. 15 (1895) 79.—Sebire Les Pl. Util. Sénégal (1899) 179.—Van Wijk Dict. Pl. Names 1 (1911) 346.—Hartwich Die Menschlich. Genuszm. (1911) 274, 300, 825.

Coffea Zanquebariae Lour. Fl. Cochinch. 1 (1790) 145.

A shrub or small tree, 1.8 M. high, glabrous, erect, closely branched. Branches cinereous, rather thick, short, subterete; older ones with gray bark bearing transverse and longitudinal fissures; younger twigs brown, compressed. Leaves glabrous, oval or obovate, 3.5 cm. to 6 cm. wide, 5 cm. to 11 cm. long, obtuse or shortly pointed (4 mm.) cuneiform at base, chartaceous; lateral veins 5 to 8 pairs of the first rank with little hairy tufts in the axils; upper side dull; glossy below; petiole 0.2 cm. to 0.62 cm. long; stipules ovate apiculate, connate at the base, 0.2 cm. to 0.3 cm. long. Flowers white, axillary, 1 to 3 in a cluster, hexamerous or heptamerous, shortly pedicellate. Calyculus extending beyond the smooth calyx-margin; bracteoles deltoid or subtruncate, apiculate, all falling short of the minute calyx-limb. Fruit ovate or oblong, dark red; stem of fruit elongates after flowering and becomes as long as fruit which is 1.25 cm. to 1.5 cm. long; dark red fruit turns black or brownish-black when dried; capitate disk; longitudinally nerved.

Diagnostic Characters of the Species:—Leaves chartaceous, transverse section shows considerably elongated but rarely branched sclerencyhma; fruit-pedicel as long as the fruit; fruit longitudinally nerved; cells of pulp layers are radically elongated; seeds resemble *C. arabica* L. in size and form.

Synonymy:—*Amazona Africana* Spreng. Syst. Veg. 2 (1825) 126; *Hexepta axillaris* Raf. Sylva Tellur. (1838) 164.

Common Names:—Zanzibar Coffee.

Geographical Distribution:—Zanzibar coast; Mozambique.

History:—This species is indigenous in German East Africa along the Zanzibar coast. It was introduced into Mozambique by the

PLATE 25: *COFFEA ZANGUEBARIAE* LOUR.

Portuguese. This species has been cultivated and, in 1880, 9300 kg. of excellent coffee-seeds were harvested in Nossibe.

Use:—As a substitute for *C. arabica* L.

Bibliography:—Lour. Fl. Cochinch. 1 (1790) 145.—Lam. Encyc. Suppl. 2 (1811) 15.—DC. Prodr. 4 (1830) 500.—G. Don Gen. Hist. Dichlam. Pl. 3 (1834) 582.—Hiern in Trans. Linn. Soc. ser. 2 (1876) 172; in Oliver Fl. Trop. Afr. 3 (1877) 182.—Froehner in Notizbl. K. Bot. Mus. (1897) 234.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 229, 232.—Hiern Welw. Cat. Afr. Pl. 2 (1898) 489.—Froehner in Engl. Bot. Jahrb. 25 (1898) 274.—Lecomte Le Café (1899) 40.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 36.—L. H. Bail. Stand. Cycl. Hort. 2 (1914) 823.

Economic and Cultural References:—Lanessan Pl. Util. Col. Franç. (1886) 883.—Sebire Les Pl. Util. Sénégal (1899) 179.—Hartwich Die Menschlich. Genuszm. (1911) 273, 306.—Van Wijk Dict. Pl. Names 1 (1911) 347.

Coffea Swynnertonii S. Moore in Journ. Linn. Soc. Bot. 40 (1911) 95.

A greatly branched shrub, terete, bearing glabrous (viscid when young) ash-colored bark, with transverse fissures. Leaves small, oblong or oblong-lanceolate, obtuse, petiole short, attenuated; blade thinly coriaceous, entirely glabrous on both sides; secondary veins of both surfaces forming 5 or more ascending arches below, and spread out above from the midrib to the margin, and considerably recurved; stipules awl-shaped, widened at the base, rigid. Flowers synanthous, axillary, often 2 to 4; pedicel short, with simple calyculus possessing dentate margin; corolla smooth, funnel-shaped tube; lobes 8 to 9, narrow, ovate-oblong, obtuse, very little longer than the tube; calyx-limb very brief, obscurely denticulate; stamens 8 to 9, filaments exserted, bearing 4-partite, shorter, oblong, obtuse anthers; style exserted, elongated arms linear. Fruit berry-like, narrow, ovoid-oblong, dry, 2-seeded. Perennial shrub, flowering in October and fruiting in December.

Diagnostic Characters of the Species:—Leaves vary from 2.5 cm. by 1 cm. wide to 3.5 cm. long by 1.8 cm. wide in size, copiously furnished with white microscopic punctures above; rather olive color or brown above when dry, paler beneath; petiole about 2 mm. long; stipules 2 mm. to 2.5 mm. long. Pedicel 1.5 mm. to 2 mm. long. Calyculus scarcely 1 mm. long. Flowers white. Ovary 1 mm.

PLATE 26: *COFFEA CANEPHORA* PIERRE EX FROEHNER

long. Calyx 0.3 mm. long. Corolla-tube 7 mm. long by 1.5 mm. wide at the base, 4.5 mm. wide at throat; lobes not over 9 mm. long. Filaments 1.5 mm. long, anthers 5 to 6 mm. long. Style 11 mm. long, stigmatic arms 5 mm. long. Fruit 9 mm. long, 6.5 mm. wide; seeds 5.5 mm. long, dark-gray.

Common Name:—Inyambane Coffee.

Geographical Distribution:—Chirinda at 900 M.; Madanda forests at 120 M.; Portuguese East Africa.

History:—*Coffea Swynnertonii* S. Moore was collected and described by Mr. Moore and published in the Journal of the Linn. Soc. Bot. 40 (1911) 95.

This species is very similar to *C. stenophylla* G. Don from which it differs chiefly in the much smaller and non caudate-acuminate leaves, the short stipules, the short-toothed calyculus, and the smaller berries and seeds. Mr. Moore's specimen No. 2133 is the plant in flower; and No. 578 is surmised by Mr. Swynnerton, and according to the publication of the Linnæan Society correctly so, to be the fruiting stage; No. 579 (in fruit) from the vicinity of the mouth of the Buzi river where the settlers designate an identical form—often with somewhat larger leaves (4.5 cm. long by 2 cm. wide) than is accredited in the original species description—as Inyambane coffee. This coffee grows wild in quantities along the Juababa River in Portuguese East Africa, at an altitude of about 300 metres. Seed was brought from this region a few years ago; and the beverage prepared from these berries is said to be of excellent quality and much used by the settlers.

Use:—As a substitute for the seeds of *C. arabica* L.

Bibliography:—Moore in Journ. Linn. Soc. Bot. 40 (1911) 95.

Coffea canephora Pierre ex Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 233, 237.

A tree or shrub bearing dark brownish gray, faint, longitudinally striated branches. Leaves nearly elliptical, narrowed at both extremities about 17 cm. wide and 25 cm. long (in its varieties, sometimes varying 15 cm. to 30 cm. long by 5 cm. to 11 cm.) in size; upper side glossy, dark green; lower side more yellow; 13 paired veins of the first order, and the finely netted venation is also prominent on lower side as well as the paired veins; petiole about 1.5 cm. long. Stipules

PLATE 27: *COFFEA CANEPHORA* PIERRE EX FROEHNER

about 0.7 cm. long, narrowed from a common base to the tips, distinct and prominent midrib elongated into a linear point. Inflorescence in large clusters. Flowers in sets of 1 to 6 in an axillary head surrounded with a double set of involucral bracts or calycules below the calyx; outer bracts of 2 short, triangular lobes and 2 elongated lobes at least twice as long as the others; inner calyculus of short lobes; 3 to 5 flowers shortly pedicelled; corolla is about the size of *C. liberica* Bull, and 5- (rarely 4-) merous; tube 0.9 cm. (varying in its varieties from .5 cm. to 1.4 cm.) long, lobes lanceolate, broadened about 1.3 cm. (in its varieties 0.7 cm. to 1.5 cm.) long; calyx bears 4 very short teeth. Anthers 1 cm. long, acuminate; filament 0.3 to 0.4 cm. long, attached to the lower third of the anther. Stigma of style 1.2 cm. long, exserted. Fruit about 1.4 cm. to 1.3 cm. long by 0.8 cm. wide; on the rounded side, the suture of the carpels continues as a deep groove. The reddish brown outer portion appears above the calyx scar; pedicel short, surrounded by the withered calyculus in a collar-like fashion. By the frequent abortion of one seed, half of the fruit arches itself over so that the calyx scar and pedicel appear closely approximated.

Diagnostic Characters of the Species:—Note the fruit description above. Flowers very numerous (up to 40) in a fascicle. Fruit mass may be 5 cm. in diameter.

Geographical Distribution:—African Tropics; Native Coffee of Ishiras; Gabon (Herb. L. Pierre R.S.K. No. 247); Java and Madagascar by introduction.

History:—*Coffea canephora* Pierre ex Froehner was collected in Gabon, Africa, and was described in 1897. It is a very precocious species, and often yields 100 kg. of coffee per acre at the age of four years. In equatorial regions, it may be cultivated up to an altitude of 800 metres. It has been introduced and cultivated in Madagascar and Java, where plantations yield 600 to 900 kg. of coffee per acre. *C. canephora* Pierre ex Froehner is susceptible to *Hemileia vastatrix;* and this fact has hindered its extended cultivation. The caffeine-content of the seeds is 1.97%.

This species is exceedingly variable and as many as nine varieties have been described. Pierre recognized and described seven of which I believe only one is distinct enough in its individualistic composition to warrant description as a separate economic form at the present

writing. M. Pierre lists and describes in manuscript, *C. canephora* Pierre ex Froehner var. *Hiernii* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *Hinaultii* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *kouilouensis* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *muniensis* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *oligoneura* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *Trillesii* Pierre mss. ex DeWild.; *C. canephora* Pierre ex Froehner var. *Wildemannii* Pierre mss. ex DeWild. In addition to these varieties, one finds the variety *opaca* Pierre in Bull. Jard. Col. Nogent-sur-Marne (1904) 117 f.c.; and the variety *sankuruensis* DeWild. in DeWild. Miss. Laurent 3 (1906) 333 t. 77 f. 52, 53.

It seems probable, as M. Pierre himself suggests, that these varieties will be placed in synonymy by further study or at best, I believe, will only be elevated to forms of *C. canephora* Pierre ex Froehner or subvarieties of the distinct variety *C. canephora* Pierre ex Froehner var. *kouilouensis* Pierre mss. ex DeWild. I find myself unable to obtain sufficient material to straighten out this obvious tangle.

Use:—*C. canephora* Pierre ex Froehner is superior to many coffees in productivity and in the quality of the infusion prepared from its seeds. Its seeds are widely used wherever it is indigenous, for the seeds *C. arabica* L.

Bibliography:—Froehner in Notizbl. d. Kgl. Bot. Mus. 7 (1897) 233, 237.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, Nachtr. (1897) 315.—T. Dur. & DeWild. Mat. Fl. Congo. 2 (1898) 75.—Froehner in Engl. Bot. Jahrb. 25 (1898) 254, 269.—Lecomte Le Café (1899) 32-35 t. 33, f. 6 (habit).—DeWild. Les Caféiers 1 (1901) 19, 37.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 32.—DeWild. Miss. Laurent 3 (1906) 330; Pl. Trop. Grand. Cult. 1 (1908) 89 t. 17.—Compagnie Kasai (1910) 1.—Chev. Explor. Bot. Afr. Occid. Franç. 1 (1920) 335.

Economic and Cultural References:—Pobéquin Essai sur la Fl. Guin. Franç. (1906) 352.—Fauchère Cult. Prat. Caféier (1908) 8.—Agric. News Barbados 9 (1910) 133.—Harwich Die Menschlich. Genuszm. (1911) 825.—Perrot Travaux Lab. Mat. Méd. Ecole Supér. de Pharm. de Paris pt. 5, 10 (1913-1916) No. 3, pg. 10; Perrot Les Grand. Prod. Végét. Col. Franç. (1915) 421-37, 424 t. 33.

Coffea canephora Pierre ex Froehner var. *kouilouensis* Pierre mss. ex DeWild. Les Caféiers (1901) 21.

A small tree bearing large, elliptical leaves. Leaves sometimes

rather small, rounded or cuneiform toward the base, acuminate at the apex; petiole thick, 15 mm. long; blade up to 25 cm. long by 10 cm. wide; paired lateral veins 10 to 13, usually 12, stout and prominent on both surfaces. Inflorescences in compact heads with double calycules surrounding 1 to 6 flowers, commonly 4 in one group. Flowers 5-merous; corolla-tube 5 mm. long in adult flowers, about as long as the corolla-lobes, occasionally longer. Fruit 1 cm. long, furrowed, nearly sessile; seed 7 mm. long by 4.5 mm. to 5 mm. wide, distinctly smaller than the seeds of *C. canephora* Pierre ex Froehner.

Diagnostic Characters of the Variety.—Leaves vary, on different specimens and on the same plant, from a rounded to a cuneiform base. Leaves are longer, more elliptical, with more accentuated cross veins than in *C. canephora* Pierre ex Froehner. Corolla is as large as that of *C. canephora* Pierre ex Froehner but the lobes are usually a little longer than corolla-tube in this variety.

Geographical Distribution:—Indigenous in Mayomke and Kouilou. Cultivated in Luvituku and Mayomke, Gabon, and especially along Kouilou.

History:—This variety was collected by R. P. Klaine (No. 1928a) in August, 1900, and (No. 1928b) in January, 1901, in Gabon. M. Pierre distinguishes three subvarieties; namely, *C. canephora* Pierre ex Froehner var. *kouilouensis* Pierre mss. ex DeWild. subvarieties *grisea, flavescens,* and *latifolia* which are separated mainly on the leaf characteristics of hue and size, both of which are tremendously variable in this variety and species; so much so that I hardly consider it justifiable to utilize these distinctions in this regard. This variety itself deserves and is receiving increased attention in cultivation.

Use:—As a substitute for the seeds of *C. arabica* L.

Bibliography:—DeWild. Les. Caféiers (1901) 21.—Miss. Laurent 3 (1906) 334 t. 101.—T. Dur. & H. Dur. Syll. Fl. Congol. (1909) 276.
Economic and Cultural References:—DeWild. Les Caféiers (1901) 22; Pl. Trop. Grand. Cult. 1 (1908) 89.—Hartwich Die Menschlich. Genuszm. (1911) 825.—Perrot Les Grand. Prod. Vég. Col. Franç. (1915) 430.

Coffea liberica Bull in Retail List. New, Beautif. & Rare Pl. No. 97 (1874) 4.

A glabrous, evergreen shrub or tree, 5.4 M. to 10.8 M. high,

PLATE 28: *COFFEA CANEPHORA* PIERRE EX FROEHNER VAR. *KOUILOUENSIS* PIERRE

From DeWild. Miss. Laur. 3 (1906) t. 101.

glossy in appearance because of the nature of the leaves. Branches glabrous, spreading, subterete, somewhat compressed toward the free extremities. Leaves 11.3 cm. to 15 cm. to 30 cm. long by 3.75 cm. to 5.0 cm. to 11.9 cm. wide; elliptical-obovate, shortly acuminate, cuneiform or obtusely narrowed at the base, somewhat undulated at the margin, thinly coriaceous, dark, glossy green above, lighter and dull beneath, paired lateral veins 8 to 12 with axillary glands opening by a small aperture beneath; petiole 0.9 cm. to 1.6 cm. long; stipules broadly ovate, apiculate, connate at the base, shorter than the petiole, stipule 0.3 cm. to 0.4 cm. long. Flowers 6- to 8-merous, subsessile, several in a cluster, axillary, 2.5 cm. long when expanded; bracteoles connate, calyculate, depresso-deltoid, subtruncate, all shorter than the subtruncate calyx; sometimes one oval bracteole is produced above the others; corolla-lobes 6 to 8, oval, obtuse, about as long as the tube, spreading. Anthers 6 to 8, wholly exserted, 1.25 cm. long; filaments 0.62 cm. long. Style exserted, bifid; calyx-limb annular, very short. Fruit in globular or oval berry-like form, 1.9 cm. to 2.5 cm. long or even more, yellowish-red, turning black when mature; seeds 1.25 cm. or more long. Mature fruit remains hanging on plant for 2 months, and remains hard and fibrous. Caffeine-content of the seed 1.29 to 1.68%.

Diagnostic Characters of the Species:—Leaves larger than any other economic species. Flowers in bloom nearly the entire year; 1 bracteole often produced above the others. Berry larger than any other economic species; pericarp 5 times as wide as *C. arabica* L. and has fibro-vascular bundles not only in the inner half but intermixed, in limited number, in the outer portion; thereby restricting the very considerable tenacity of the tissue. The thicker mesocarp corresponds to a still thicker endocarp.

Synonymy:—*Coffea arabica* Benth. in Hook. Nig. Fl. (1849) 413.

Common Names:—Liberian Giant or Liberian Coffee; Abeokuta Coffee; Monrovian Coffee.

Geographical Distribution:—Native of West Africa; Liberia; S. W. Africa, Golumgo Alto, Cazengo; abundant and indigenous along river Luinha. Widely distributed and cultivated in Trop. Africa. Introduced into India, Ceylon, Madagascar, West Indies, Brazil, Guiana, Surinam, East Indies, Java, etc.

History:—Liberian Coffee is native in the negro republic, Liberia, and was early introduced into other regions along the West African coast, from Sierra Leone to Angola. This large-berried coffee was called to the attention of Sir Joseph Hooker in 1872, at which period *Coffea liberica* Bull was under cultivation in the Gold Coast and in Sierra Leone. During the same year, Sir John Pope Hennessy, Governor of the West African Settlements, sent nine plants to Kew; but they were dead upon arrival. About this time, however, Mr. C. S. Salmon, acting administrator of the Gold Coast, made it possible to obtain 480 seeds from the Rev. T. B. Freeman, who had a plantation of coffee on the Secoom River near Accra. Plants from these seeds were raised in India; and the following year Mr. Bull of Chelsea, England, imported living plants. He published the first description of it as *Coffea liberica* Bull. This name was adopted by Mr. Hiern in his paper "On the African species of the genus *Coffea*," in the Trans. Linn. Soc., ser. 2, 1 (1876) 169-176, where he described it in detail, and figured the plant under the name given by Mr. Bull in preference to an unpublished manuscript name in the Herbarium of Afzelius.

This species became known in Europe about the time the coffee-leaf disease appeared in Ceylon. It was claimed that it was resistant to this fungus disease; and the Royal Botanic Gardens at Kew supplied plants and seeds to Indian and Ceylon planters. Moreover, it was hailed as a species which flourished at sea level whereas *C. arabica* L. required the hilly and mountainous districts of the tropics for successful cultivation. These two factors resulted in its immediate introduction into all tropical regions. It has attained its most extensive cultivation, excepting its native habitat in West Africa, in the West Indies, Ceylon, Malay Peninsula (Selangor), North Borneo, Sumatra, Java, and India where it is mainly grown in Sylhet, Assam, Burma, and the Andaman I. Laerne says that it is "little thought of" in Brazil since "it produces little and that irregularly." It is rather extensively cultivated along the eastern coast of Madagascar, where hybrids have arisen which produce a superior product. Hybrids have occurred in other localities wherever Arabian and Liberian coffee are grown in approximation. The hybrids are said to be immune or but very slightly susceptible to the leaf-blight.

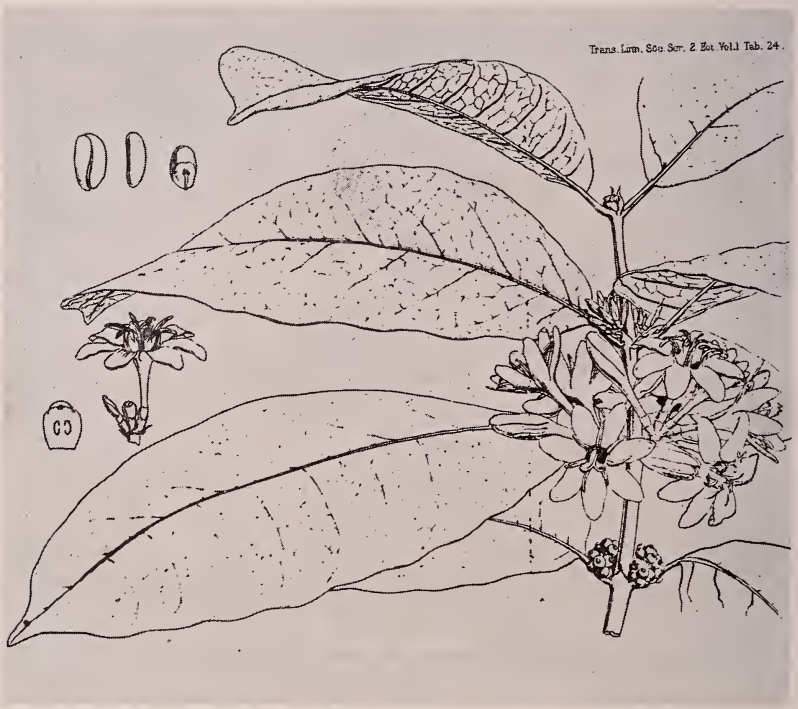

PLATE 29: *COFFEA LIBERICA* BULL

From Hiern in Trans. Linn. Soc. ser. 2, 1 (1876) t. 24.

PLATE 30: *COFFEA LIBERICA* BULL

Grafting of Liberian on to Arabian coffee has not been successful. The reverse graft, however, is promising. Such plants suffer less from the attacks of parasites than the ungrafted specimens, especially from such an enemy as nematode worms which frequently attack the roots of *C. arabica* L. but do not attack *C. liberica* Bull. This, the hardy Liberian Root System and the grafted Arabian plant, produces stems in a very desirable combination (see Fauchère Cult. Prat. Caféier (1908) text t. 8).

Liberian seems to have some distinct advantages over Arabian coffee; for the former yields regularly and freely, its fruits do not fall as soon as mature, and it is a much hardier species. The berries are more difficult to clean than the Arabian coffee-berries; but special machinery will deprive them of even the parchment. The beans are rank and oily. If carefully and slowly dried, however, they bring a price sufficient to reimburse one for the trouble and expense of the preparation.

At the present time (1924) Liberian Coffee is considered by the planters of the tropical plains to be superior to Arabian, and is largely grown in India and Java. In America, Arabian coffee still holds its own. The 'pro' and 'con' in regard to Liberian Coffee can be shown by quoting—with a few additions—from Kew Bull. (1890) 247-8 as follows:

(1) It is not susceptible to the fungus, or only in such a way that the health of the tree is but slightly affected; at least, much less so than *C. arabica* L.

(2) It is a tree attaining a height up to 9 M. before fifteen years of age; and consequently, it is not injured by drought.

(3) Judging by trees under cultivation, and the way they continue to grow, and by the fact that they do not begin to bear until 4 to 5 years old, this species may be taken as much longer lived.

(4) It is a heavier bearing tree when once well started; those under the observation of the writer in Kew Bull. for 1890 yielded 10 to 20 cwt. per acre. This is considerable when one calculates the amount of clean coffee yielded and finds that only 700 trees to the acre can be grown instead of at least double that number of *C. arabica* L.

(5) Being deep-rooted, it is not affected by drought, while a very slight shower is quite sufficient to bring out and set the blossom;

which has the further advantage of fading and falling off within the day of its opening, so that it is hardly possible that it can be injured by rain or hail as is so often the case with the delicate *C. arabica* L. blossom. Even in the driest season, when other plants appear on the point of destruction, these look cool and green and do not even turn a leaf.

(6) Cultivation cost is slight. No pruning is required beyond pulling off suckers for the first three years. The crop is borne on the same areas of the tree (or extensions of them) year after year; therefore, no old wood is to be cut out. The tree's being tall and thick, prevents the growth of weeds in large numbers; and if they grow they do not affect the plant as it is deep-rooted.

(7) Berries—size of small walnuts—remain fixed on the tree for many weeks after they are ripe enough to be picked; eventually they fall off and may be gathered from the ground. In case of labor scarcity, this fact is a great advantage.

Against these good points, one may set the following:

(1) This species gives very little return until at least the fifth year, while some return is obtained from Arabian coffee plants in the second year.

(2) The commercial market value seems, as a rule, to be less.

(3) The flowering season is mainly in March and April, and berries take 14 months to ripen, i.e., until July of the following year. Thus, the tree carries two crops at one time, all mixed together in the same branches. At the same time, one can see large reddening fruit approaching maturity, small fruit about the size of a pea, of the current season, and also large, heavily scented blossoms. All these mixed together among the large, dark, glossy leaves give the tree an exceedingly rich and handsome appearance.

Uses:—As *Coffea arabica* L. substitute. The beans are of a coarser flavor but are used universally by middlemen to strengthen grades which by themselves are flavorless. The seeds contain 1.29 to 1.68% of caffeine. Liberian coffee which grows wild and cultivated throughout Liberia and the entire Guinean Coast, is exported chiefly to England and Europe.

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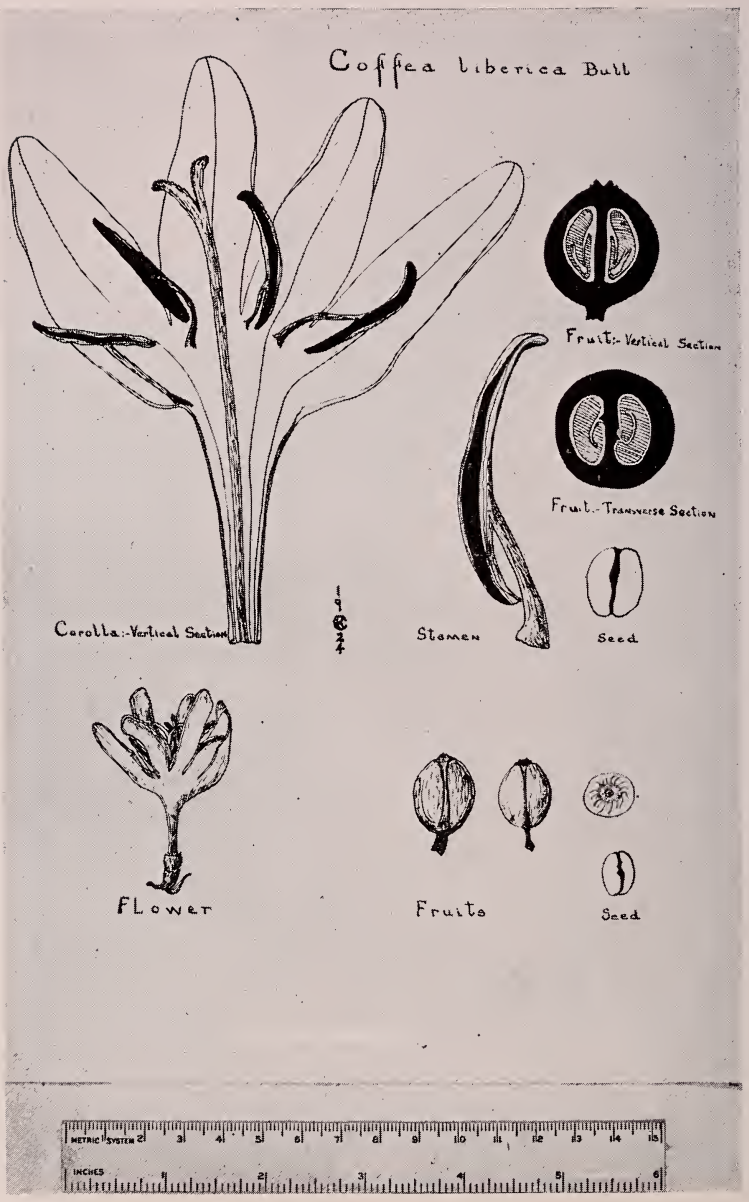

PLATE 31: *COFFEA LIBERICA* BULL

PLATE 32: *COFFEA LIBERICA* BULL

PLATE 33: *COFFEA LIBERICA* BULL

PLATE 34: *COFFEA LIBERICA* BULL

Oliver Fl. Trop. Afr. 3 (1877) 181.—United States Dept. Agric. Rep. (1878) 194 t. 1 (young plant).—DC. Orig. Cult. Pl. (Fr. ed. 1883) 336; (Eng. ed. 1885) 418.—Burck in Ann. Jard. Bot. Buitenz. 4 (1884) 56 t. 6, f. 52.—Ficalho Pl. Uteis (1884) 204.—Mueller Select Extra-Trop. Pl. ed. 7 (1888) 108.—Kew Bull. (1888) 261-263; (1890) 107, 245-253; (1892) 277-282; (1893) 204-206; (1894) 132; (1895) 12, 21, 273, 296-299; (1896) 77-79; (1897) 325-328; (1919) 57.—Andre in Rev. Hort. (1890) 104 f. 30, 31.—Herzsohn (transl. of Burck's Mss.) in Ann. Jard. Bot. Buitenz. 8 (1890) 148.—Vankeirsbilck in Rev. Agric. 10 (1896) 135-137, 162.—U. S. Year Bk. Dept. Agric. (1897) 197.—Editor in Der Tropenpflanzer 1 (1897) 290-296.—Froehner in Notizbl. K. Bot. Mus. 7 (1897) 233.—K. Schum. in Engl. & Prantl Nat. Pflanzenfam. 4, Abt. 4, (1891) 103 f. 36, 105, Nachtr. (1897) 315.—Raoul Cult. Caféier in Man. Cult. Trop. de Raoul & Sagot pt. 1, 2 (1897) 229, 231.—Froehner in Engl. Bot. Jahrb. 25 (1898) 269.—Hiern Welw. Cat. Afr. Pl. 2 (1898) 489.—Lecomte Le Café (1899) 35 t. 37 f. 6; Cat. Pl. Econ. in Hort. Col. (1900) 63, 64.—Zimmermann Ueber den Krebs v. *C. arabica* L., verurs. durch Rostrella *Coffeæ* gen. & sp. n. in Bull. Inst. Bot. Buitenz. 4 (1900) 21.—DeWild. Les Caféiers 1 (1901) 18, 39; & Miss. Laurent 3 (1906) 338 t. 104.—Valeton Die Art. d. Gattung. *Coffea* L., Prismatomeris Thw. u. Lachnostoma Korth. in Bull. Inst. Bot. Buitenz. No. 8 (1901) 15.—Cornaillac El Café, la Vainilla, el Cacao, etc. (1903) 33.—Safford in Contrib. U. S. Nat. Herb. 9 (1905) 245 (Useful Pl. Guam).—Pobéquin Essai Fl. Guin. Franç. (1906) 316.—Corr. Fl. Braz. (1909) 5.—DeWild. Compagnie Kasai (1910) 1.—Wettstein Handb. Syst. Bot. (1911) 758 f. 532.—L. H. Bail. Stand. Cycl. Hort. 2 (1914) 823.—Engl. & Gilg Syll. Pflanzenfam. ed. 8 (1919) 339.—Chev. Explor. Bot. Afr. Occid. Franç. 1 (1920) 336.

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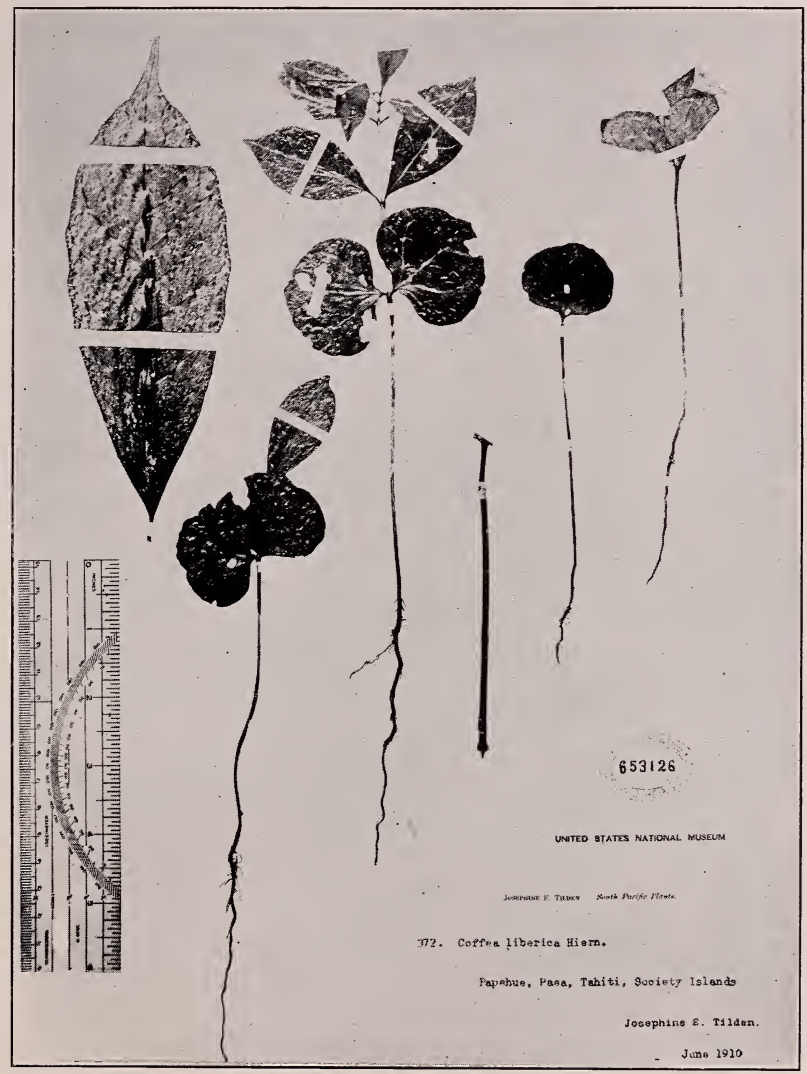

PLATE 35: *COFFEA LIBERICA* BULL

Morris "Notes on *Coffea liberica* Bull," in Ferguson Coffee Plant. Man. (1898) 229-279.—Boutilly V. Le Caféier de Liberia sa cult. et sa manig. (1900).—Jumelle Les Cult. Col. Pl. Aliment. 1 (1901) 379-384; Agric. Prat. Pays Chauds 2 (1902) 169, 624.—Cramer De Achteruitgang van de Liber. Koffie op Java; Welke Houding Moeten Wij. Tegenover Haar Aannemen in Teysmannia 18 (1907) 762-780.—Freeman & Chand. World's Comm. Prod. (1907) 176 (pl. in flow.), 178 (in flow. & fr.), 185 (pl. 3 to 4 yrs. old in Java).—Fauchère Cult. Prat. Caféier (1908) 7.—Hare, Caspari, Rusby Nat. Stand. Dispens. ed. 2 (1908) 340-344. —Dudgeon Agric. & For. Prod. Brit. W. Afr. (1911) 35.—Hartwich Die Menschlich. Genuszm. (1911) 273.—Van Wijk G. Dict. Pl. Names (1911) 346.—Wehmer Pflanzenstoffe (1911) 733.—Perrot Travaux Lab. Mat. Méd. Ecole Supér. de Pharm. de Paris pt. 5, 10 (1913-1916) No. 3, pg. 9; Les Grand. Prod. Végét. Col. Franç. (1915) 421, 422 t. 32, 423-437; Nigeria 3 (1915) 364-366.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

Coffea robusta Linden in Cat. Pl. Econ. Col. Hort. Col. Bruxelles (1900) 64, t. 65.

A small tree, 3 M. to 3.6 M. high. Branches stout, terete, glabrous. Leaves large, 25 cm. long by 15 cm. wide as a maximum, oblong-elliptic, obtusely caudate-acuminate, rounded at the base, chartaceous, dull on both surfaces, glabrous; midrib flat above, prominent below; 9 to 12 paired lateral veins, looped and much branched within the margin, slightly arcuate, diverging from the midrib at an angle of 45 degrees, lateral veins distinct above, prominent below, veins lax; petiole 1.25 cm. long, glabrous; stipules interpetiolar, broadly triangular, long-mucronate, 0.6 cm. to 0.8 cm. long, about 0.8 cm. broad at the base. Flowers in dense axillary clusters, about 4.4 cm. in diameter, commonly with a few small leaves intermixed; corolla 5-merous, tube 1 cm. long; calyx minute, entire; anthers exserted, 1 cm. long, slightly twisted when dry. Fruit 1.25 cm. in diameter, about the size of *C. arabica* L. and *C. stenophylla* G. Don or about one half the size of *C. liberica* Bull; outer skin thin; 2-seeded; cherry-like in color when ripe.

Diagnostic Characters of the Species:—General outline of the tree is rounded. Leaves large, handsome; 9 to 12 lateral veins, greatly looped within the margin; stipules 0.6 cm. to 0.8 cm. long by 0.8 cm. wide. Fruit 2-seeded and about the size of *C. arabica* L.

Synonymy:—*Coffea Laurentii* Wildem. in Compt. Rend. Congr. Intern. Bot. (1900) 234.

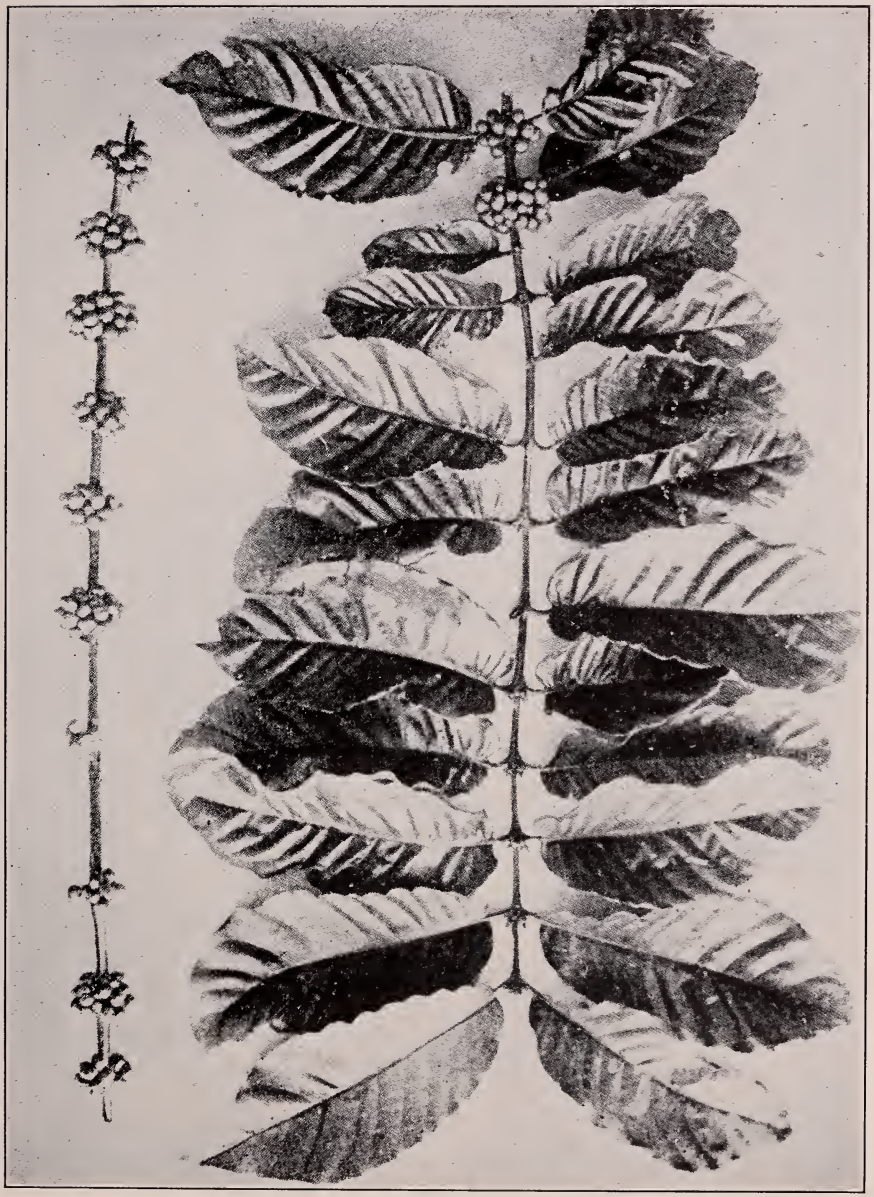

PLATE 36: *COFFEA ROBUSTA* LINDEN

Common Names:—Wild Congo Coffee; Robusta Coffee; Rio Nuñez Coffee.

Geographical Distribution:—Native of the Congo, Africa. Now cultivated throughout Tropical Africa, and introduced into Java, Sumatra, Trinidad, and India.

History:—*Coffea robusta* Linden was originally collected in the Congo region of Africa. It was first described in 1900. Its value as a cultivated coffee was first realized in Java. Seeds were sent from Brussels to Java in 1900. In 1915, it occupied some thousands of acres interplanted with *Hevea brasiliensis* (H.B.K.) Muell.-Arg. or Para Rubber. This species of coffee was introduced into the Botanic Gardens at Entebbe, Uganda, in 1901. Seedlings were sent out from that station as well as from Kew, England. In 1912, sixty-five acres were under cultivation in Uganda. In 1915-1916, many more trees were planted. This species is very prolific. It grows along banks of streams and prefers moist situations and not too shady a habitat. Like Liberian coffee, it is well adapted for growing at low elevations, from sea level to over 600 M. It has the advantage of possessing the robust habit of *C. liberica* Bull and the superior quality and the delicate aroma of *C. arabica* L. The plant is not, like *C. liberica* Bull, pyramidal in form, but is rounded in outline. Since it first became known from the Rio Nuñez river region, it is frequently referred to as Rio Nuñez coffee. *C. robusta* Linden matures very early; and, at the age of four years, it produces nearly 200 kilogrammes of coffee per hectare (about 2 acres). This species frequently yields 500 grammes of coffee when only three years old. Mature plantations in Java produce 1200 kilogrammes per hectare. Although this species does not yield as heavily as some, its extensive cultivation in India and Ceylon is assured since it matures early, grows well at low levels, and, up to the present time at least, has completely resisted the coffee-leaf fungus—*Hemileia vastatrix*. There were large areas of *C. robusta* Linden planted in the Uganda Protectorate in 1919. In 1920, there were 260 acres of *C. robusta* Linden in Uganda.

Use:—*C. robusta* Linden is cultivated on a commercial scale as a substitute for *C. arabica* L.

Bibliography:—Linden in Cat. Pl. Econ. Col. Hort. Col. Bruxelles (1900) 64, t. 65.—Kew Bull. (1901) App. 3, 88.—DeWild. Miss. E.

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Coffea excelsa A. Chev. in Rev. Cult. Col. 12 (1903) 258.

A tree, 6 M. to 15 M. high, bearing grayish and longitudinally fissured bark. Leaves 18 cm. to 28 cm. long by 9 cm. to 12 cm. wide; petiole short, 1 cm. long; lamina usually obovate-lanceolate, sometimes obovate-spathulate or slightly club-shaped, ending abruptly in an obtuse apex; 6 to 9 paired lateral veins, raised on the lower surface. Inflorescence in axillary cymes, 1 to 5 flowers in each cyme. Flowers white, fragrant. Each cyme is surrounded by 2 to 3 calycules with resinous surfaces more or less fringed at the margin. Corolla total length 20 mm.; tube 8 mm. to 10 mm. long; lobes, always 5 in number, 10 mm. to 12 mm. long by 6 mm. wide; stamens entirely green in color, 10 mm. long, anthers occupy about 6 mm. and the filaments 4 mm.; style slender, 15 mm. to 20 mm. long, 2 filiform stigmatic processes; calyx greatly reduced or absent, shorter than the disk, calyx-lobe rather circular. Caffeine-content of the seed is 1.89%.

Diagnostic Characters of the Species:—Leaves very large. Stamens wholly green in color. Flowers in February and March.

Common Name:—Senoussi Coffee.

Geographical Distribution:—Tropical Africa; Sudan; Central Africa; Chari River Region; Bata; Kotto.

History:—This gigantic species, which occasionally reaches the height of 20 M., was discovered in the region of Lake Tchad in 1904, and was described by A. Chevalier in 1905. It grows abun-

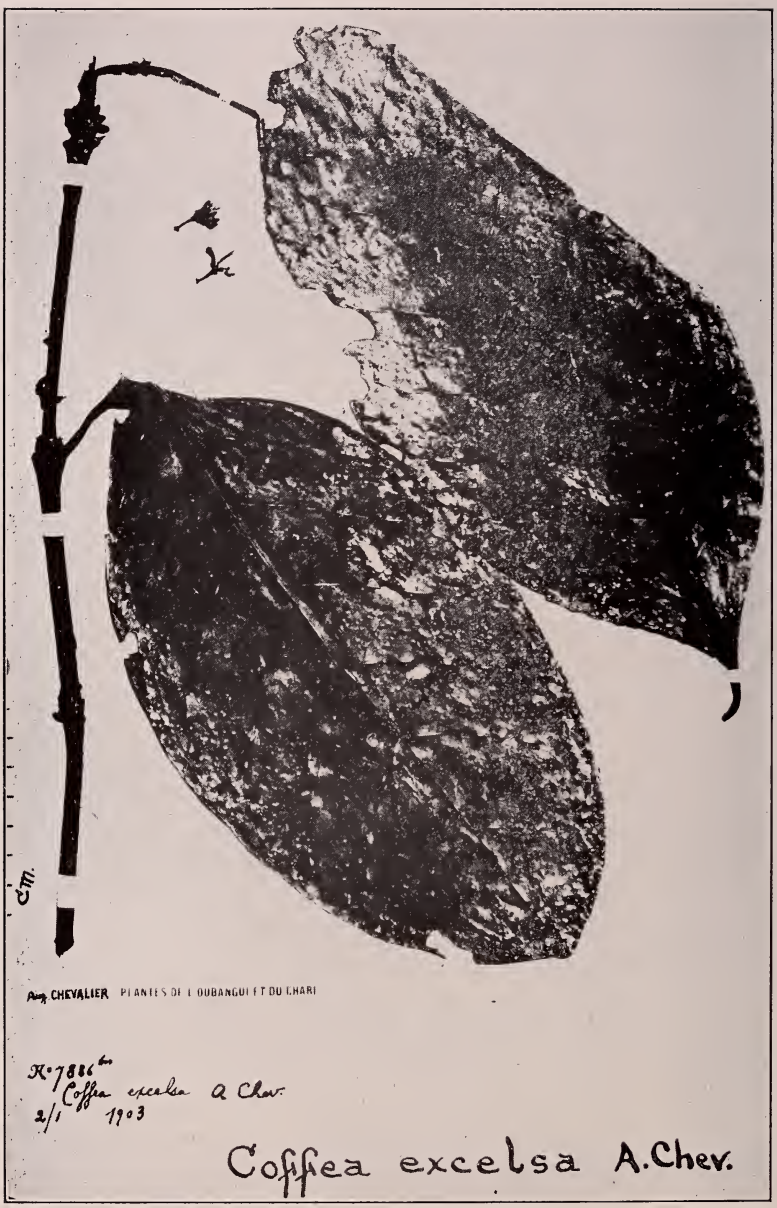


PLATE 37: *COFFEA EXCELSA* A. CHEV.

dantly in the eastern forest along the Chari river, Africa, between 8° and 8°30′ latitude north. It is found also in the region of Bata (West Central Sea Coast) and commonly in the region of Kotto along the banks of the Oubanqui river, at an altitude of 500 M. to 800 M.

C. excelsa A. Chev. is never found in flooded areas. It is admirably adapted to the arid regions of the Sudan. It has recently been introduced into the Trinidad Botanic Gardens, and is reported to be of considerable value. The plots of *C. excelsa* A. Chev. which were planted at Kampala, Uganda, in 1915 and 1916, have not, however, yielded as well as *C. arabica* L. and *C. robusta* Linden. In March, 1922, the beans of *C. excelsa* A. Chev. were valued at only about forty-seven shillings per cwt. on the London market. Its seeds produce an agreeably flavored beverage.

Use:—It is cultivated commercially for use as a filler and as a substitute for the seeds of *C. arabica* L.

Bibliography:—A. Chev. in Rev. Cult. Col. 12 (1903) 258; in Compt. Rend. Acad. Sci. Par. No. 8, 140 (1905) 517-520.

Economic and Cultural References:—Freeman & Chandler World's Comm. Prod. (1907) 181.—Hare, Caspari, & Rusby Nat. Stand. Dispens. ed. 2 (1908) 341.—Hartwich Die Menschlich. Genuszm. (1911) 274, 825.—Wehmer Pflanzenstoffe (1911) 734.—Perrot Travaux Lab. Mat. Méd. Ecole Supér. de Pharm. de Paris pt. 5, 10 (1913-1916) No. 3, pg. 10; Les Grand. Prod. Végét. Col. Franç. (1915) 421-437.—Editor in Bull. Imp. Inst. 20 (1922) No. 3, pg. 295.

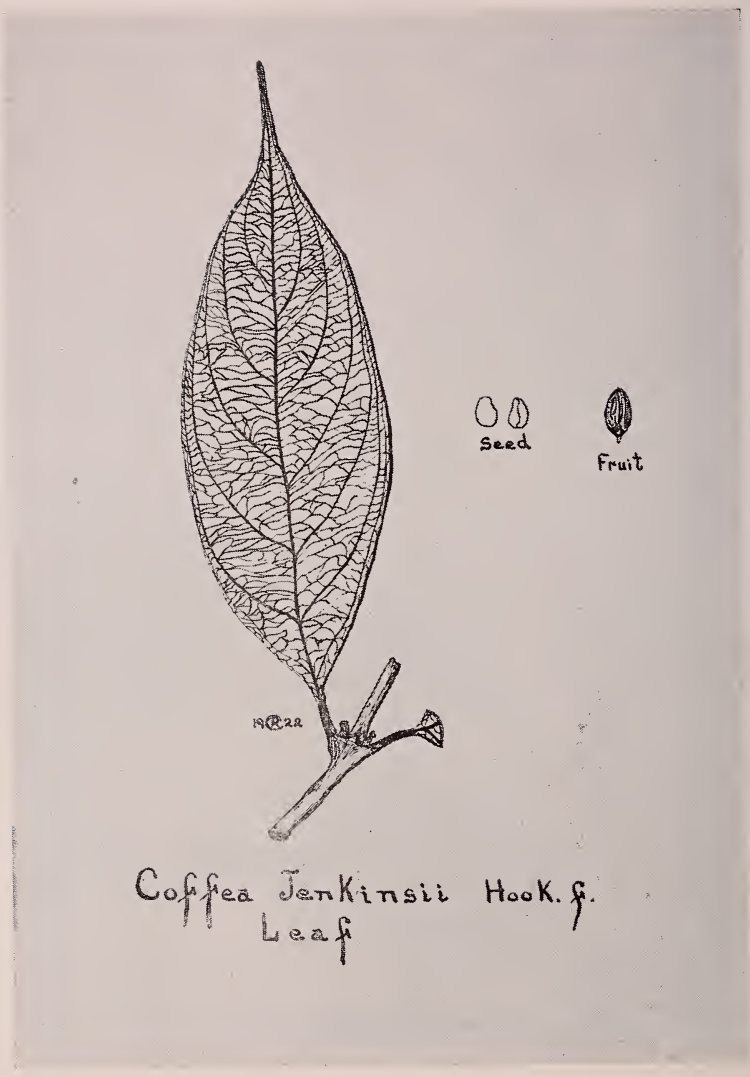


PLATE 38: *COFFEA JENKINSII* HOOK. F.

CHAPTER IV

Genus *COFFEA* L.: Section II: *LACHNOSTOMA* Hook. f.

Coffea Jenkinsii Hook. f.
Coffea ligustroides S. Moore.
Coffea khasiana Hook. f.

Coffea Jenkinsii Hook. f. Fl. Brit. Ind. 3 (1882) 155.

A glabrous shrub. Leaves 1.2 cm. to 4.0 cm. wide by 7 cm. to 14 cm. long, elliptic-lanceolate to caudate-acuminate, base acutely narrowed, apex attenuated, apex 1.5 cm. long; petiole 0.5 cm. long; lamina broadest at the middle or below; 5 to 6 paired veins of the first rank; stipules 0.4 cm. long. Flowers axillary; corolla-tube longer than the lobes, mouth glabrous, lobes acute, 4 in number; calyx quadridentate. Fruit ellipsoid, 1 cm. long by 0.5 cm. broad.

Diagnostic Characters of the Species:—Closely allied to *C. khasiana* Hook f. but *C. Jenkinsii* Hook. f. is almost entirely glabrous, only the younger shoots being puberulous. Leaves narrower, with fewer prominent veins. Flowers larger. Fruit and seeds different, —the seeds of *C. Jenkinsii* Hook. f. being 0.83 cm. long, ellipsoidal in form. This species resembles, in habit, the non-economic species *C. salicifolia* Miq. of Java.

Geographical Distribution:—Himalaya Region; Khasia Mts. (Alt. 900 M. to 1200 M., Jenkins, Griffith—Kew Distrib. No. 3015); East Bengal.

History:—This species was collected by Jenkins and Griffith about 1880. Although its seeds are of a fair quality, it has not been extended beyond local cultivation.

Use:—Mainly as a substitute for the seeds of *C. arabica* L.

Bibliography:—Hook. f. Fl. Brit. Ind. 3 (1882) 155.—Froehner in Engl. Bot. Jahrb. 25 (1898) 255, 276.—Lecomte Le Café (1899) 40.—Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 7, 26, 32.

Economic and Cultural References:—Sebire Les Pl. Util. Sénégal (1899) 179.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

PLATE 39: *COFFEA JENKINSII* HOOK. F.

PLATE 40: *COFFEA JENKINSII* HOOK. F.

Coffea ligustroides S. Moore in Journ. Linn. Soc. Bot. 40 (1911) 94.

A glabrous shrub with the younger branches somewhat resinous, slender, not greatly crowded at first but later becoming close and rounded out by the foliage. Leaves oblong-lanceolate; apex generally obtuse but frequently cuspidate; petiole short; lamina thinly coriaceous; secondary veins on both surfaces forming about 8 small, spreading arches; stipules wide at the base, gradually diminishing into a long, pointed apex. Flowers solitary, axillary; pedicel distinctly longer than the ovary; calyculus double, margin lobed or slightly truncate; corolla 4-partite; tube funnel-form; lobes ovate-oblong, obtuse, very little longer than the tube; calyx-limb poorly developed. Stamens 4; filaments short; anthers exserted, linear-oblong, obtuse. Style exserted; arms linear. Ovary narrowly ovoid; ovules affixed to the center of the septum. Fruit oblong, without sap, usually 1-seeded. Perennial shrub, flowering in December; fruiting in July.

Diagnostic Characters of the Species:—Leaf-lamina possesses many minute, pellucid glands; 5 cm. to 7 cm. long by 1.5 cm. to 2 cm. wide, dark olive color above when dry, green below; veins quite distinct above, somewhat less prominent below; stipules about 4 mm. to 5 mm. long. Pedicel 4 mm. long. Flowers white. Ovary 1.5 mm. long. Corolla-tube 5 mm. long; throat 3 mm. in diameter; lobes 6 mm. long; 4 in number. Anthers 4 mm. long; filaments rather thick. Style 7 mm. long, arms capitulate, 2 mm. long. Fruit yellowish, about 1 cm. long by 7 mm. broad; seeds 7.5 mm. long, oblong. The tetramerous flowers and the small leaves assist in distinguishing this species from any closely allied, economic form.

Common Name:—Chirinda Coffee.

Geographical Distribution:—Chipete Forest Patch in Gazaland, Africa. Altitude 1140 M.

History:—This comparatively new species of economic *Coffea* was first adequately described and published in the Journal of the Linnæan Society, Bot. 40 (1911) 94. It had, however, been collected previously, at least as early as 1905; for the specimen which I have studied was collected by Mr. C. F. M. Swynnerton in December of that year. His specimen No. 67, was kindly loaned

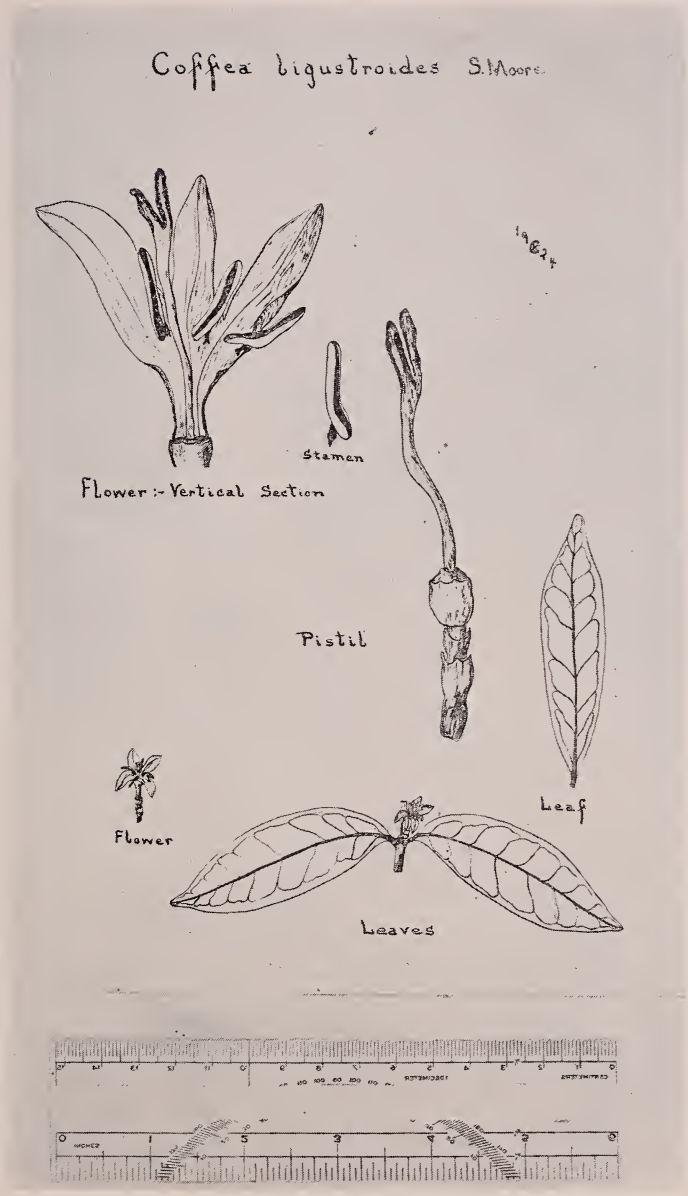


PLATE 41: *COFFEA LIGUSTROIDES* S. MOORE

PLATE 42: *COFFEA LIGUSTROIDES* S. MOORE

to me by the U. S. Nat. Herb., Smithsonian Institution, Washington, D. C.

C. ligustroides S. Moore is the plant which yields the so-called Chirinda coffee. It forms the main undergrowth of the Chipete Forest Patch. The crop is always small, although heavier in alternate years. The dense shade under which most of it grows is prejudicial to heavy cropping. The fruits are commonly eaten by the forest bulbuls and robins as well as by the baboons and the natives. This coffee is much used, and it is considered to be excellent by the natives of Gazaland.

Use:—The seeds are used as a substitute for the seeds of *C. arabica* L.

Bibliography:—S. Moore in Journ. Linn. Soc. Bot. 40 (1911) 94.

Coffea khasiana Hook. f. Fl. Brit. Ind. 3 (1882) 154.

A rambling shrub or small tree with gray, somewhat transversely fissured bark. Branches and leaf-veins on the lower surface are puberulous; younger branches bear appressed hairs. Leaves 7.5 cm. to 20 cm. long by 2.5 cm. to 7.5 cm. wide, elliptic-lanceolate, caudate-acuminate; 7 to 8 paired lateral veins given off at a very oblique angle from the midrib, sometimes with abundant short hairs on the under surface; greenish when dry; apex attenuated, 1.5 cm. to 3.0 cm. long; lamina dull, membranaceous; petiole short, 0.62 cm. long; stipules triangular, broad at the base, apex attenuated, making the total length of the stipule about 1 cm. Flowers in very shortly-branched, pubescent cymes; pedicel exceedingly short with a cup of connate bracteoles; corolla 0.7 cm. long, yellowish; tube cylindrical, 0.4 cm. long; mouth villous; lobes acute, ovate, commonly shorter than the tube; calyx quadridentate, lobes acute, glabrous, teeth erect; calyculus 0.25 cm. long, and extending beyond the 0.5 mm. high, quadridentate margin of the calyx. Style short; arms linear. Anthers 0.15 cm. long, projecting beyond the corolla-tube. The 1.2 mm. long stigmatic processes of the 0.5 cm. long style, project beyond the corolla-tube. Fruit-pedicel short; globose in form, smooth, longer than wide, about 1 cm. long by 0.6 cm. wide, with hairy, persistent calyx-teeth. Seeds orbicular, ventrally plane or rarely concave.

Diagnostic Characters of the Species:—Mouth of the corolla-tube

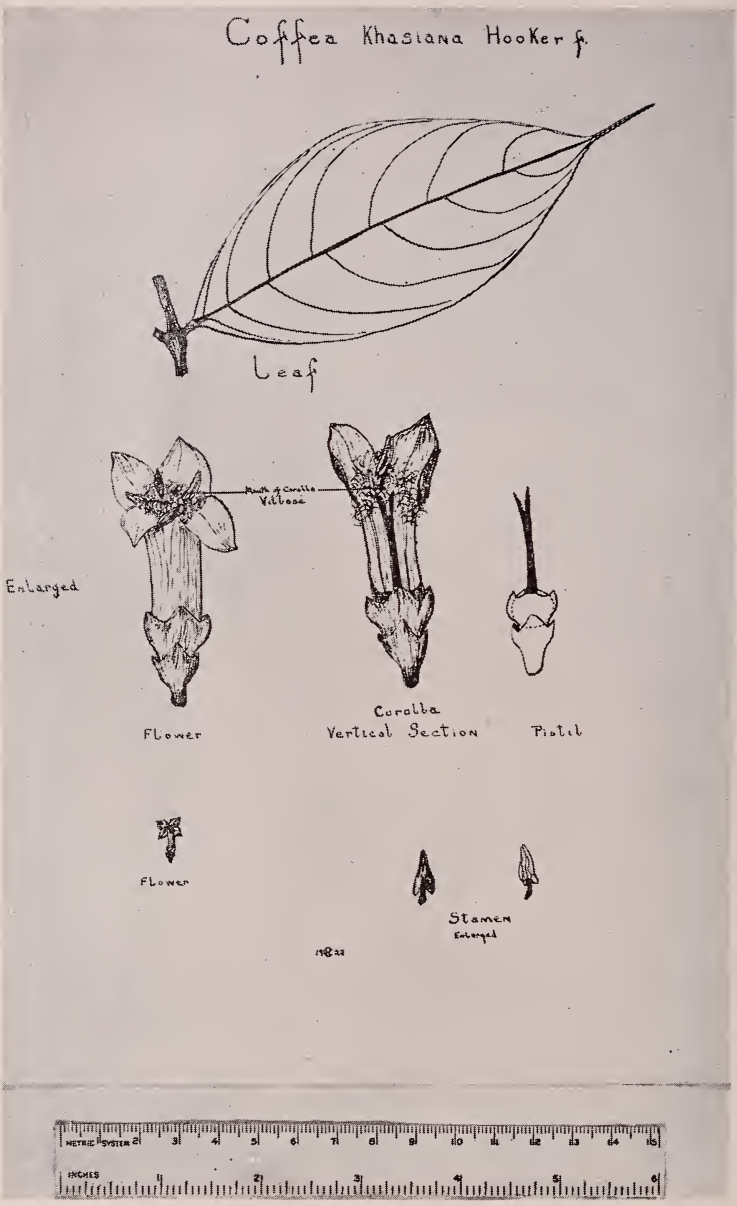


PLATE 43: *COFFEA KHASIANA* HOOK. F.

exceedingly villose. Leaves with a long, tail-like tip. Seeds plano-convex whereas the seeds of the other economic species under the Section *Lachnostoma,* have ellipsoidal seeds as in the case of *C. Jenkinsii* Hook. f.; or oblong seeds as in the case of *C. ligustroides* S. Moore.

Synonymy:—*Lachnostoma khasiana* Korth. in Ned. Kruidk. Arch. 2 (1851) 202; in Miq. Fl. Ind. Bat. 2 (1856-59) 257.

Geographical Distribution:—Himalaya region; Mysore; Khasia and Jyntea Mts.

History:—*Coffea khasiana* Hook. f. was first noted about 1871 as indigenous in the Khasia Mts. at an altitude of over 600 M. It was observed several times by C. B. Clarke at an altitude of 1350 M. The description of this plant as *C. khasiana* Hook. f. appeared in 1882, and was based largely on Herb. Ind. Or. Hook. f. & T. Nob. specimen No. 6.

It is closely allied to *Coffea densiflora* Blume of Java and Sumatra. It is gathered by the natives, but has never become a widely cultivated species.

Use:—As a substitute for the seeds of *C. arabica* L.

Bibliography:—Hook. f. Fl. Brit. Ind. 3 (1882) 154-155.—Froehner in Engl. Bot. Jahrb. 25 (1898) 255, 276.—Lecomte Le Café (1899) 40. —Valeton in Bull. Inst. Bot. Buitenz. 7 (1901) 7, 8, 11, 13, 26, 27, 30, 31.

Economic and Cultural References:—Sebire Les Pl. Util. Sénégal (1899) 179.—Gamble Man. Ind. Timbers ed. 2 (1922) 422.

PART II

ECONOMIC DISCUSSION OF COFFEE

CHAPTER V

INTRODUCTION TO ECONOMIC DISCUSSION OF COFFEE

§ a. INDIGENOUS GEOGRAPHICAL DISTRIBUTION OF THE ECONOMIC SPECIES OF THE GENUS: *COFFEA*

AFRICA:

West Coast:—Sudan—*Coffea excelsa* Chev.
This species is also indigenous in Central Africa.
Sierra Leone—*Coffea stenophylla* G. Don.
Coffea liberica Bull.
Liberia—*Coffea liberica* Bull.
Calabar—*Coffea liberica* Bull.
Congo and Gabon—*Coffea canephora* Pierre.
Coffea congensis Froehner.
Coffea robusta Linden.
Gazaland—*Coffea ligustroides* S. Moore.
East Coast:—Abyssinia—*Coffea arabica* L.
Mozambique—*Coffea Zanguebariæ* Lour.
Coffea racemosa Lour.
Coffea Ibo Froehner.
Mauritius; Bourbon; Madagascar—*Coffea mauritiana* Lam.
Portuguese East Africa—*Coffea Swynnertonii* S. Moore.

ASIA (all in mountainous areas):
Himalaya (850 M.); Java; Sumatra—*Coffea bengalensis* Heyne ex Roem. & Schult.
Travancore: Ceylon (1100 M.)—*Coffea Wightiana* Wall.
Coffea travancorensis Wight & Arn.

PLATE 45: A BRAZILIAN COFFEE PLANTATION

Courtesy Chase & Sanborn Co.

Bengal—*Coffea bengalensis* Heyne ex Roem. & Schult.
Coffea Jenkinsii Hook. f.
Coffea khasiana Hook. f.
East India—*Coffea fragrans* Wall. ex Hook. f.

§ b. THE PRINCIPAL COFFEE-GROWING COUNTRIES AND EXPLANATION OF TERMS USED IN COMMERCIAL CLASSIFICATION

BRAZIL:—Rio, Santos, Bourbon Santos.

Rio coffees are lowland and strong varieties. Most Santos coffees are highland, mild and much better flavor.

Rio coffees—Beans vary in size; color dark green to light yellow; heavy body; distinctly characteristic flavor and aroma.

Santos coffees—Beans vary in size; color green and rich yellow to pale yellow; excellent quality and milder than Rio; substituted widely for Java.

Bourbon Santos—Beans small; acid or vinous; formerly sold as "Mocha" seed.

Red Bean Santos—From Campinas district; richer than other Santos.

Other minor types of Brazilian coffee are Victoria or Capotinea, Bahia, and Liberian Rio.

There are eight distinct grades of Rio coffee recognized in trade. Examination of these type grades in the collection of Economic Plant Products at the Bussey Institution for Applied Biology of Harvard University shows clearly grades two to eight inclusive, grade one being ideal and non-existent. Santos coffees are exported from Santos, and are the best Brazilian coffees. They make up the bulk of the commercial coffee.

COLOMBIA:—Bucaramanga, Bogota, "Savanilla."

Bucaramanga coffee—Beans large, solid; liquor full, fragrant aroma. One of the finest of American coffees.

Bogota coffee—Beans large, uniform; color bluish green; liquor full-bodied, round, fragrant. This coffee forms the basis of numerous high-grade blends.

"Savanilla" coffee is merely a general term used commercially for all Colombian coffees.

ECUADOR:—Guayaquil.

Guayaquil is the name of the port, and is the term used to designate all Ecuadorian coffees. They are of a good grade.

BOLIVIA:—Yungas.

Yungas coffee of Bolivia is excellent in appearance and quality and rivals Mocha. Other districts producing coffee are Caupalican, Espiritu Santo, and Valle Grande.

PERU:—Carabaya, Huánuco, Choquisongo, Chanchamayo.

Peruvian coffees are of a very good grade and quality and are known by the district name in which they are grown.

VENEZUELA:—Maracaibo, La Guayra.

Maracaibo coffees are graded, when washed, into several varieties known as Cucuta, Mérida, Boconó, Tovar, San Cristóbal, and Trujillo (the least desirable). The first two named are excellent coffees; beans large, round, solid; color rich yellow; liquor choice.

La Guayras are likewise separated into types known as Caracas, Porto-Cabello, and Coro:

Washed Caracas—Beans large; color bluish; excellent grade.

Milled Caracas—Beans medium; color yellowish.

Porto-Cabello and Coro—Beans small to medium; color dark to light green.

Minor Venezuelan types are Carupano and Angostura.

CENTRAL AMERICA:—Guatemala, Costa Rica, Salvador.

I have listed these types in the order of their excellence:

Guatemala—"Coban" is the best grade,—beans large, shapely; color blue.

Costa Rica—Beans large, handsome.

Salvador—Beans medium, well developed, heavy; color greyish yellow. The principle production of El Salvador is coffee. Three classes are recognized according to the following terms:

1. Cojulpeque—grown in a very temperate climate; moist soil; quality excellent.

2. Ahuachapam—grown in a moderately warm climate; quality very good.

3. Sonsonate—grown in a moderately warm climate; quality superior.

Minor Central American types are Nicaragua, Honduras, and Panama.

MEXICO:—Tepic, Caracolillo.

Tepic (Mexican Mocha)—Beans small, hard; color steel-blue; liquor creamy, aromatic.

Caracolillo (Mexican Pea-berry)—Beans round. The pea-berry form of coffee.

Minor Mexican coffees are:

Oaxaca (pronounced Wah-har-kar)—Beans large, well developed; color blue, whitish when aged.

Cordoba or Mexican Jack—Beans large; color yellow.

Coatepec coffee—Beans large, well developed; more acid than the preceding types.

Colima—Beans medium, flat, fairly well developed.

A very minor coffee is grown in Tuxpan and is used only locally.

Coffee raising is one of the most profitable industries in Mexico; and, because of its proximity, the United States consumes the greater part of Mexican coffee exports. Nearly all of the American companies located in Mexico ship their coffee to St. Louis, Missouri, where it is roasted, ground, and stored for sale. In 1900, Mexico produced 88,000,000 pounds; and, in 1910, the United States alone imported over 35,000,000 pounds from Mexico.

JAVA AND OTHER DUTCH EAST INDIAN ISLANDS.

Java coffee has developed as a term for all East Indian coffees. Sometimes East Indian coffees, other than those grown on Java itself, are known by the trade name of Padang, Mandheling, Corinchie, Timor, Kroe, etc., according to the district in which they grew. Washed East Indian coffees are referred to as Blue Bean Java. *Coffea liberica* Bull shrubs, grown in the East Indies, produce the so-called Liberian-Java. The best Java is a very excellent coffee. Most of the Java coffee consumed in the United States is imported from Sumatra, while most of the Celebean products go to Europe. Fresh Indian coffees are all light sea-green or blue-green. They change color during transportation and with age; and are graded

commercially into brown, yellow, and pale grades, the first bringing the highest prices. This gradation, however, is not efficient; for some light beans furnish a more pleasing liquor than many dark types.

Ceylon and India.

Ceylon Types:

1. Native—grown in lowlands; beans large, flat, whitish; quality poor.
2. Plantation—carefully cultivated; beans large, well-developed, regular in size; color light bluish or green tint; quality good.
3. Liberian-Ceylon—a hybrid of *Coffea liberica* Bull; beans smaller and paler then true *Coffea liberica* Bull; liquid milder but pleasant.
4. Ceylon-Mocha—obtained by separation from the plantation type; beans small, very even, and uniform. It resembles genuine Mocha in appearance and flavor.

Indian Types:

1. Malabar—Beans small, hard; quality excellent.
2. Mysore—Beans large; color bluish-green; liquor rich, strong.

Arabia:—"Mocha," Tehama, Harrar.

Mocha is merely an exporting town surrounded by deserts, and is not a coffee-growing area. It is not so important to-day from the standpoint of a shipping port, as Aden and Hodeidah. The United States receives its Mocha coffee from Aden. The best Arabian and true Mocha coffee is grown in the province of Yemen. The beans are small, hard, round, regular in size; color olive-green when fresh and a rich semi-transparent yellow when aged; odor, when freshly roasted, is characteristic; quality is the best; liquor creamy, rich, heavy, a trifle acid, extremely aromatic and fragrant. Most Mocha coffee is still raised and prepared under primitive conditions and hence, as it appears on our market, it is no better than the best Brazilian Santos. Tehama Arabian coffee is greatly inferior to Yemen Mocha. Harrar coffee is an Abyssinian coffee. The beans are of the same color as true Mocha, but are longer, more pointed; and the odor is rank and leathery. It is shipped from Aden as Long-berried Mocha.

PLATE 46: COFFEE PRODUCTION: COMMERCIAL AREAS

West Indian Islands.

Martinique—Beans long, flat, rather thick, covered by whitish or silvery pellicle; color green; stronger than Mocha but the aroma is less agreeable.

Jamaica Coffee (Blue Mountain Coffee)—Beans flat, medium; color bluish; liquor excellent. "Plain-grown" Jamaica coffee is much inferior. The beans are large, flat, hully; color whitish; liquor strong, grassy in flavor.

Dominica—Beans large, thick, flat; color dark green to white; extremities of beans are pointed; quality varies from inferior to very good.

Haitian and San Domingo—Beans large, flat, whitish; liquor mild, pleasant.

Guadeloupe—Beans glossy, hard, long, clean; even green color to greyish; quality good.

Cuban—Best grades from Guantanamo, Alquizar, and San Marcos districts; and the Sierra Maestra plantations. Beans large, whitish, rounded on the normally flat side; liquor pleasant.

Porto Rico—Beans regular, well-formed; color yellow to greenish; liquor of good flavor.

Barbados—Beans nearly round in shape; quality similar to Haitian type.

Philippine Islands.

Luzon Type—Beans small, hard; liquor rich and of good flavor.

Manila Type—Beans medium, regular in shape; color pale green; liquor fine, aromatic. Its sources are the districts of Cavite, Batangas, and La Laguna.

Zamboango Type—Beans large, flabby; color yellowish; liquor weak, coarse, poorest of all the Philippine Types.

Hawaiian Islands.

Hawaiian coffee is the general term applied to the product of any of the islands which produce coffee such as Mani, Kauai, and Hawaii. The beans are medium in size, possess a pleasing aroma, and have a mild, delicate flavor.

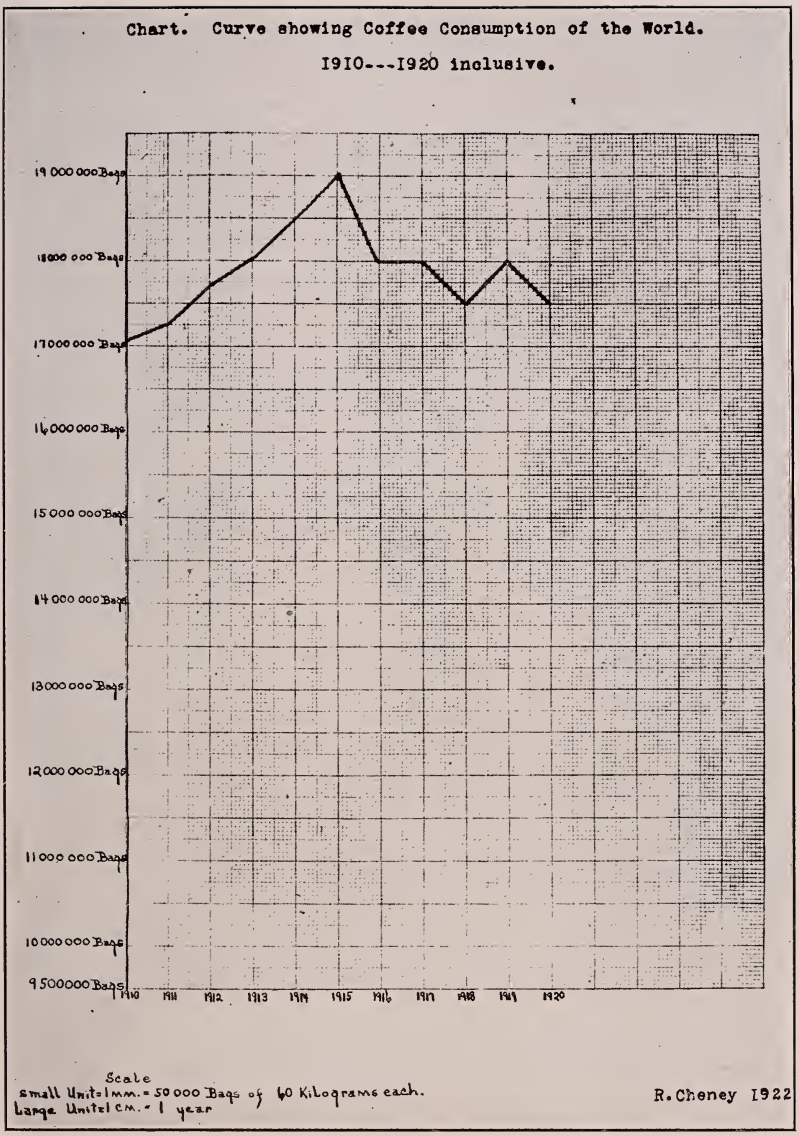


PLATE 47: COFFEE CONSUMPTION CURVE

Australia.

Australian coffee-beans are large; color greenish, aroma agreeable; and possess a good flavor.

Minor Coffee-producing Areas.

Under this head, one may include Western Africa; the Island of Reunion (Bourbon); British Guiana, which produces "Demaerara" coffee; French Guiana, which produces "Cayenne" coffee; Dutch Guiana, which produces "Surinam" coffee; Birmania; Liberia; Fiji Islands; New Guinea; and Samoa.

§ c. COFFEE PRODUCTION AND CONSUMPTION

Not only is coffee the favorite beverage of many millions of people; but the annual production and consumption of nearly 3,000,000,000 pounds of coffee-beans has made it one of the primary economic products of the world. In certain countries such as El Salvador and Brazil, coffee is the chief crop. The success or failure of the coffee-crop vitally affects the economic condition of all coffee-growing countries.

I have briefly summarized by means of the following tables, graphs, and maps, the production of coffee by countries, the importation, the consumption, and other statistical data regarding coffee. Subsequent figures clearly outline the economic development of coffee during the last twenty-five years.

Annual Coffee Production in Kilogrammes.

The figures listed below for the year 1900 are compiled from miscellaneous sources and are approximate only:

Year:—1900.			
Mexico	40,000,000	Kilogrammes.	
Costa Rica	16,215,000	"	
El Salvador	27,280,000	"	
Guatemala	52,000,000	"	(Year 1894)
Honduras	909,000	"	(Year 1891)
Nicaragua	9,000,000	"	
Bolivia	682,000	"	
Brazil	655,620,000	"	
Colombia	?		

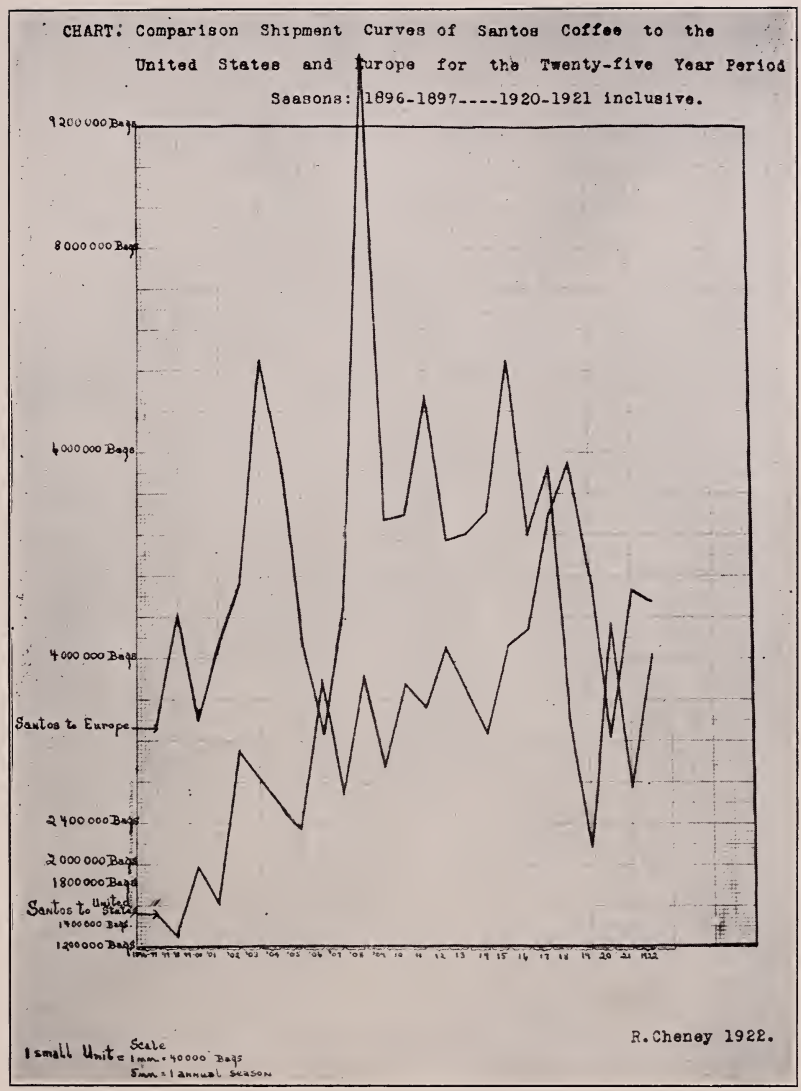


PLATE 48: COMPARISON SHIPMENT CURVES FOR SANTOS COFFEE TO THE UNITED STATES AND EUROPE

Year: 1900.—*Continued*		
Ecuador	2,273,000	Kilogrammes. (Year 1893)
Peru	?	
Venezuela	48,000,000	"
Cuba	7,800,000	"
Porto Rico	27,273,000	"
Dutch Guiana	361,000	"
Arabia	909,000	"
Africa	318,000	"
British India	320,000	"
Ceylon	636,000	"
Java & Sumatra	53,636,000	"
Borneo	35,360,000	"
Hawaiian Islands	155,000	"

The foregoing table indicates that the world's total coffee-production for the year 1900 was approximately between 950,000,000 and 1,000,000,000 kilogrammes, or from 2,000,000,000 to 2,200,000,000 pounds.

World's Production of Coffee for the Season July 1, 1917—June 30, 1918.

The figures listed below are in accordance with the estimates of Messrs. G. Duuring & Zoon, Kolff & Witkamp, Leonard Jacobson & Zonen, Brokers, of Rotterdam.

Type.	Quantities in Bags of 60 Kilos. each.
Rio Coffee	2,952,000
Santos Coffee	12,143,000
Bahia and Victoria	850,000
Mexico, Costa Rica, Guatemala, New Granada, and Central America	1,600,000
Laguayra, P. Cabello, Maracaibo	1,500,000
Cuba, Porto Rico, and British West Ind.	175,000
Hayti	300,000
Java (Government and Private)	800,000
Padang	300,000
Menado, Macassar, Timor, etc.	50,000
British East Indies and Manila	170,000
Africa, Moka, etc.	130,000
Total	20,970,000

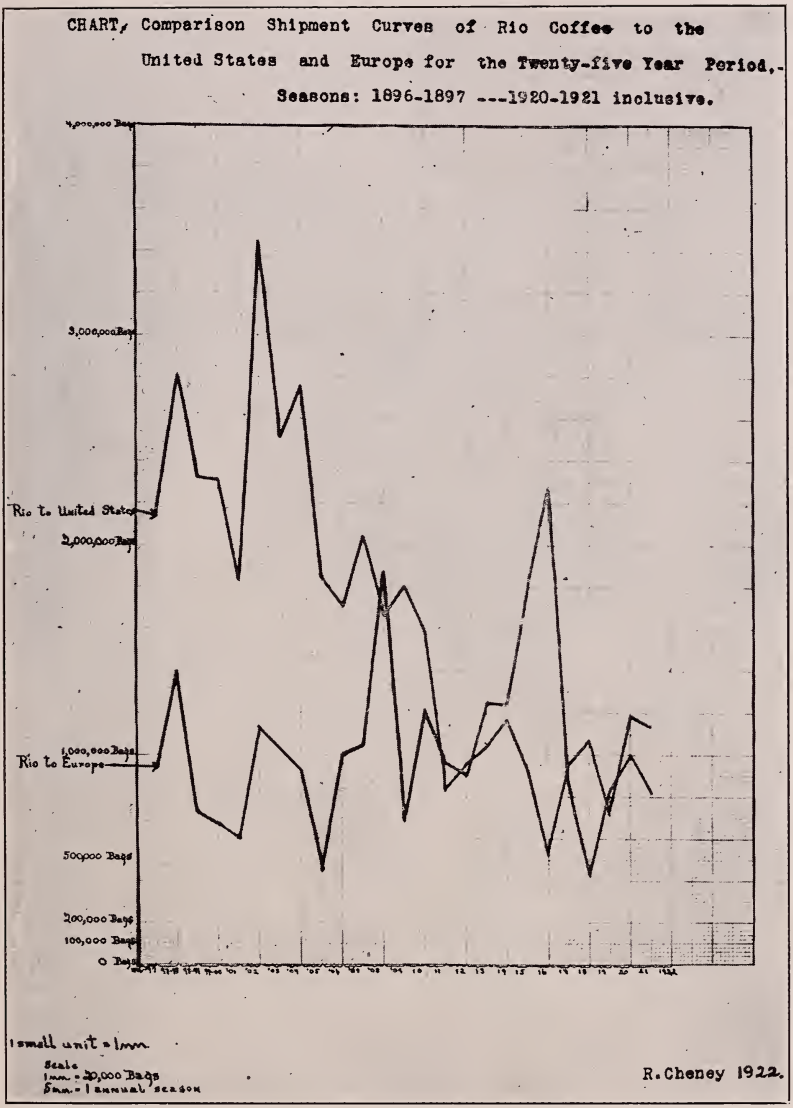
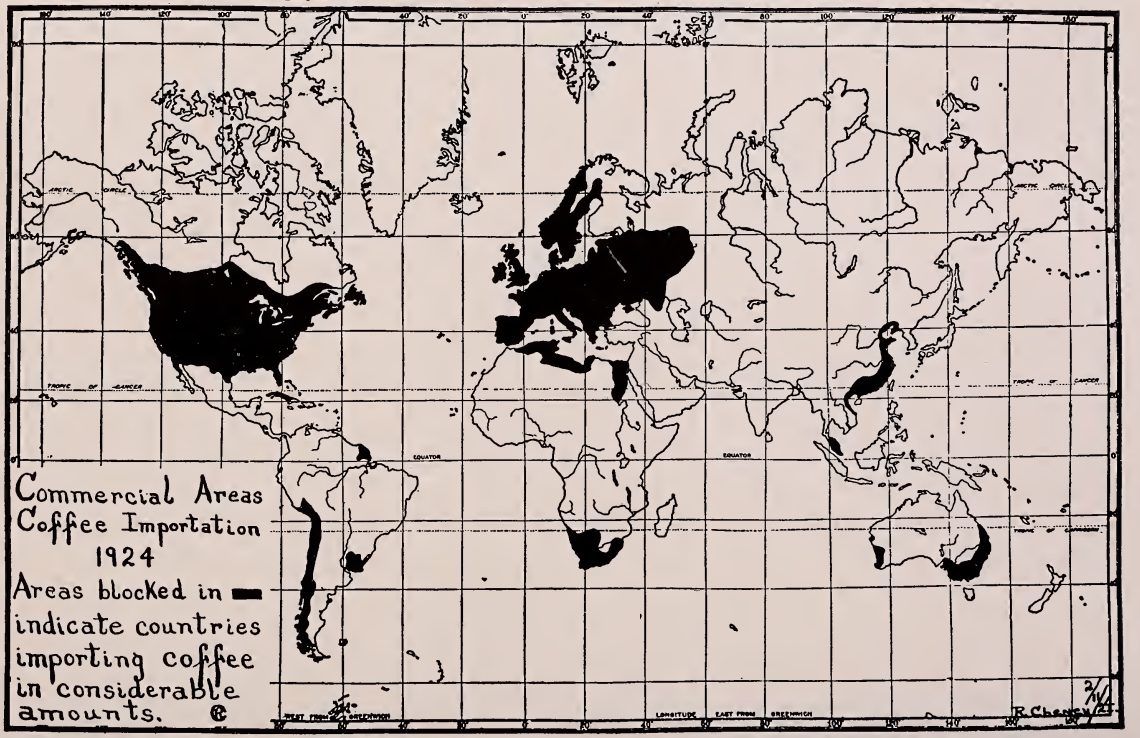


PLATE 49: COMPARISON SHIPMENT CURVES FOR RIO COFFEE TO THE UNITED STATES AND EUROPE



Note:- For Coffee-Producing Countries see previous Map.

PLATE 50: COFFEE IMPORTATION: COMMERCIAL AREAS

These figures indicate that the present annual World Production of coffee is between 1,250,000,000 and 1,300,000,000 kilogrammes or from 2,750,000,000 to 3,000,000,000 pounds.

Chief Coffee Importation Ports.

The principal European markets are England, Havre, Hamburg, Bremen, Holland, Trieste, Antwerp, Copenhagen, Bordeaux, and Marseilles.

The principal markets of the United States are New Orleans, Baltimore, and New York City. Although Boston has large wholesale distributing houses, seventy-five per cent of the coffee handled is obtained from New York.

CHAPTER VI

PREPARATION OF THE COFFEE-BEAN

The coffee-bean, as one obtains it from the retail merchant, is the coffee-seed after it has been removed from its pulp and parchment coverings. It has been dried and usually roasted. The processes to which the beans are subjected are exceedingly important, as they affect the aroma and flavor of the beverage.

I have outlined the treatment which is applied in the chief coffee-growing areas and by the wholesale coffee-houses of the importing countries:

§ a. PLANTATION TREATMENT

(1) Arabia:—In this region, the coffee-trees produce their principal crop in May. The ripe berries are shaken from the trees and fall upon cotton cloths which are spread over the ground. The fruit is spread out on a matting to dry the berries intact, as the Arabians, unlike the inhabitants of other coffee-producing countries, prepare a tea-like infusion from the pulp. The dried berries are passed under heavy wooden or stone cylinders which break the pulps and separate the beans. The process of winnowing follows, after which they are placed in the sun to dry; or they are placed in the shade and dried by air, and the hulling-process is delayed for a period of eighteen months. Subsequent to hulling, the beans are ready to use or ship.

(2) West Indies, Mexico, Central America, and parts of Brazil:—The fruit is picked one by one by hand several times a year, or a branch is held down with one hand while the berries are stripped off with the other. This method results in the removal of many leaves and stems which become mixed with the fruit. Men and women, both Whites and Indians, are employed to gather the crop. The laborer carries his full wicker basket to the mill. The berries

are usually sun-dried for several days, by being spread out over a mortar-covered and inclined area, in order that the pulp and the outer covering of the beans may separate. The berries are spread out in a thin layer (six to eight inches thick) in order to prevent fermentation which sours and injures their flavor. Uniform drying is accomplished by a frequent stirring of the berries. The beans are gathered with a long wooden implement in the form of a broad plank bearing a handle about one and one-half metres long. This plank is scraped over the drying-pavement or court. In this manner, it drags off the beans. The coffee is ready to be removed from the drying-courts when the parchment of the bean has changed from its slippery condition to a brittle state. This drying-process requires a week in fine weather and two weeks or more if the weather is wet or devoid of sunshine. Tropical dews are exceedingly heavy; and hence the bean-covered drying-courts are covered with mattings during the night. This sun-drying process results in a good product, but it is a very delicate process, since the color and quality of the bean depend largely on its duration and method. This procedure is not so advantageous as a drying-machine because a drying-ground is expensive, owing to the greater amount of labor required. Moreover, a drying-court desiccates less coffee in a given period and not so well as a drying-machine. Ordinarily, in the West Indies, a mill is used to remove the pulp while fresh. In many American plantations, the fresh berries are placed at once in large tanks of water in which they ferment and the pulp is separated from the beans which are then cleaned by machinery and dried for three to four days by spreading out in a thin layer over a stone court where they are stirred occasionally to accelerate the desiccation. Drying by means of the sun's rays is done prior to the parchment removal. The coffee is then stored until perfectly dry, at which time the beans are spread out over brick-paved courts and exposed again to the sun's rays for two to three days. When the coffee-beans are sufficiently dry to be difficult to break with the teeth they are crushed (hulled) by a man, mule, horse, or water-driven mill. The beans are then transferred to a winnowing-mill which, in the West Indies, consists merely of four pieces of tin on a rapidly revolving axle. The resulting production of wind fans away all of the pellicles and other débris from the coffee. The beans are then placed upon tables and

sorted out by hand into uniform sizes. The coffee is exposed for a third time to the sun or to stove heat; and, when totally dry, it is packed in bags or barrels and stored in a dry and covered place.

(3) Modern Methods in Brazil and Large Production Areas of the East:—Freshly picked fruit is separated from its pulp by a pulping-machine. Such machines are of diverse types; and their pulping-ability varies from twenty bushels per hour by means of small hand pulpers to one hundred and fifty bushels by water or steam power. Pulping is done at once, or at least within half a day after picking, in order to avoid the injurious fermentation of the pulp which has a deleterious effect on the beans.

The resulting parchment-covered beans are slimy and require washing. The moist pulped beans are left in a pile for four to six hours in order to induce slight fermentation which facilitates the removal of the glutinous substance covering the parchment. The beans are placed in a tank of water which is stirred by two workmen by means of long-handled shovels. The water passes through freely, and the beans are passed on to a second and third tank where they undergo the same treatment and are not removed from the last one until well cleansed. Modern washing-machines are now largely used. These machines can handle one hundred and fifty quintals per hour, and require only one tank.

The product of this process is dried before being subjected to the harrowing-machine which removes the parchment. Desiccation is accomplished by the use of a stove or drying-machine. The centrifugal type of drying-apparatus does not completely dry the coffee, and is used only in combination with drying-grounds. The common type of drier consists of a cylinder, a stove, and a ventilator. The four compartments of the cylinder are filled alternately with equal quantities of coffee to obtain better balance and facility of rotation. The cylinder is filled through small inlets. When filled, the cylinder is put in motion and the ventilator and the stove are lighted simultaneously. The important thing for the manipulator to do is to watch the thermometer to ascertain that the heat does not exceed 66° C. The hot air, entering the cylinder, is divided into thirty-four thousand small currents, which gives the cylinder a great velocity and disperses the moisture more rapidly. The cylinder rotates twice per minute. The ventilator throws a great current

of air through the heated tubes which give it the required temperature. Some drying-machines release seventy per cent of the moisture from tin baskets containing two hundred and fifty pounds of coffee in twenty minutes. These efficient machines have the basket of coffee secured about the shaft near the pulleys which rotate at a minimum velocity of seven hundred revolutions per minute. The beans are removed from the basket at the bottom. Well-dried coffee may be stored in the parchment if desired. To remove the parchment, the beans are passed through a shelling-machine which consists of a metal, grooved cylinder which rotates within an adjustable, metal and grooved covering. The beans, passing between the cylinder walls and the surface-covering, are rid of their parchments by friction. The process is a rapid one. The beans are then polished and sized. Separating machines readily manipulate one thousand pounds a day. The beans are then packed in bags containing sixty kilogrammes each, which are labelled according to the grade and are stored in dry, well-ventilated, and non-odorous warehouses, as coffee is readily impregnated with foreign odors.

Sometimes coffee is prepared from the dry state of the berries, in which case the dried pulp and parchment are removed at the same time and sizing follows immediately. This dry method operation is easier, but the product deteriorates in quality and price because the fermentation, which occurs when the berries are dried in the sun, affects their flavor. Moreover, the hulling-machine breaks and scratches the bean when submitted to this process in the dry state. In spite of an inferior product, this is the method used by small and primitive planters. In the dry process, no washing or pulping is necessary. The entire fruit is dried on prepared courts as ordinary parchment coffee. Desiccating layers are only two to three centimeters thick. The winnowing-process is longer; but otherwise the process is precisely as the outline indicated above for the Wet Manipulation of coffee.

§b. TREATMENT BY WHOLESALE DISTRIBUTORS

(1) United States:—Raw coffee, as received in large bags by the wholesale distributors, is shovelled into a separating-machine. The perforated shelves of the separator are submitted to constant agitation which results in the division of the coffee-beans into uniform

sizes. As the beans are transferred by suction to a milling-machine, the stones and other débris drop out into a waste-container. The process of milling removes the silver skin and whatever parchment may have escaped extraction during the plantation treatment. Blending is now accomplished by weight, a method which insures uniformity. The blended coffee is then roasted in perforated cylinders which revolve continuously over a furnace fire which maintains a moderate and constant temperature in order to preserve the aroma of the coffee. Excessive heat is avoided as it would decompose the acid, the gum, and the resinous contents.

The leading coffee-houses in the United States roast in quantities of two hundred and ten to two hundred and sixty pounds per cylinder at a time. The best results favor the lower quantity. The period of roasting varies somewhat; but the customary time ranges from twenty to thirty minutes according to the dryness of the raw beans. The experienced roasters are able to recognize the critical point by the color of the beans which in general is more reddish than brown and never black, and by the aroma emitted. When the beans are sufficiently roasted, the cylinder is immediately emptied, and the steaming beans pass into a shallow truck which is air-cooled from below. The beans are shovelled about until they cease to steam, and are then allowed to cool without agitation. The sudden contact of the coffee with the air from above and below causes the cessation of the evaporation process and the consequent concentration of the volatile oil in the beans. When cooled, the coffee-beans are packed whole, or are ground and placed in bags or tins, in which form they reach the consumer.

It is desirable to roast American and West Indian coffees separately from Mocha coffee if they are to be blended, as Mocha coffee requires less roasting. Over-roasting causes it to lose its volatile properties. It has reached its critical stage when it becomes a brown, cinnamon color, while American and West Indian coffees, in which dampness predominates over the oily principle, must be roasted until a chestnut brown hue is attained.

Regardless of the care practiced by the commercial houses in hermetically sealing their retail containers, ground coffees always lose a considerable part of their aromatic strength and usually in direct

proportion to the length of time they have been ground. Raw coffees, however, improve with age if stored in a dry place.

(2) Europe:—Ordinarily the treatment is similar to the method practiced in this country. I may add that, in India and sometimes in Europe, a quantity of lard is placed in the roaster to cover the surfaces of the beans with a slight coating which prevents the evaporation of the essential oil. Another practice consists in sprinkling sugar over the coffee when taken from the roaster. It is unquestionably preferable, however, not to utilize either of these means.

CHAPTER VII

COMMERCIAL SOPHISTICATION AND SUBSTITUTION

Throughout the history of commercial production, the coffee-bean has been subjected to adulteration and 'doctoring' in the raw, roasted, and ground form. Until the recent legislation and enforcement of the Pure Food Laws, the coffee-business in the United States involved much fraud. Although there is much less manipulation than previously practised, the coffee-business is far from being free from this evil. Excessive adulteration and substitution still exist in Europe. Subsequent discussion will indicate clearly the extent of past and present sophistication in Europe and in this country.

The adulteration of coffee is accomplished at various times during its preparation for retail trade. The producer mixes old and inferior beans with new and better ones. The export manipulator to complete orders often adds beans of different grades, growths, and varieties. The wholesale merchant in both the producing and consuming countries adds small African and Indian beans and considerable quantities of Liberian and Robusta coffees to Arabian coffee. I have found that Liberian and Robusta coffees, which are much less desirable as regards the quality of the resulting infusion in respect to aroma and flavor, are widely used as fillers. Fair grade beans are sorted out to obtain a uniform size and sold as Mocha and Java; and of course, to demand the highest price. The Pure Food Laws have helped to discourage this deception in the United States. Coffee which has suffered from dampness or damage from sea water during transportation is sometimes picked over, washed, decolorized with lime water, washed again, dried rapidly, colored by slight roasting, and dyed with nitric acid or by use of cosmetics. The production of coffee to suit the color prejudices of dealers is accomplished by the treatment of the beans with graphite, bone black, soot, chromate of lead, Scheele's green, yellow ochre,

burnt umber, Prussian Blue, ultramarine, Venetian red, chalk, talc, etc. The coffee-beans are first moistened with water and a little gum, resin, or shellac, and then shaken with the pigment. The production of the desired color of the bean has resulted in as high as seventy-five per cent profit.

Formerly, many imitation coffee-beans were manufactured with great care to resemble the genuine coffee-seed. The introduction and extent of the previous use of spurious coffee-beans in the United States trade can be best estimated from the contents of an article which appeared in the New York *World* in 1890 as follows:—

The average bulk of the genuine coffee imported into the United States is 8,000,000 bags, or 130,000,000 pounds per annum. Experts estimate that fully twenty per cent of the coffee sold to consumers is bogus, which raises the consumption to 216,000,000 pounds. Taking 30 cents per pound as the average retail price, the people of America pay 65,000,000 dollars every year for this one article of food, of which 13,000,000 dollars is paid for roasted and ground beans, peas, rye, or a manufactured article in no way resembling the Brazilian berry. To this must be added the production and sale of what are called "coffee substitutes." So extensive is this business that it is quite safe to say that consumers pay 12,000,000 dollars for what they believe to be cheap coffee. This raises the total expenditure to 77,000,000 dollars, and it represents a sale of 276,000,000 pounds, for the "substitute coffee" usually sells at 20 cents per pound. It will thus be seen that 96,000,000 pounds of bogus coffee are sold in the United States every year, and some estimates place it at 120,000,000 pounds. Taking the lowest figures, 25,000,000 dollars are received for substances which can be profitably placed on the market at six cents a pound. The manufacturers, therefore, receive 6,000,000 dollars for their goods, while the retailers gain a profit of 18,000,000 dollars. There are two kinds of bogus coffee, an imitation bean and the ground article. The bean is the most difficult to produce, and it is only recently that actual success in this direction has been attained. The bogus bean must not only look like the genuine berry when raw, but it should be capable of taking a proper colour when roasted. A very good specimen is now manufactured in Philadelphia and Trenton, being composed of rye flour, glucose, and water. The soft paste is then moulded and carefully dried. To the eye of an expert, the presence of this imitation is easy of detection, and it cannot be used to any great extent among wholesalers. But when coffee goes to the retailer, adulteration begins. Sometimes the retailer is deceived but nine times out of ten he is the one who introduces adulteration. The ground article is very easily produced for a proper colour and an aroma of coffee is assured by the addition of strong decoctions of coffee essence.

When mixed with real coffee even the expert eye and tongue may be deceived, while to the ordinary consumer it seems to be the genuine

product. Bogus coffee-beans have only a slight resemblance to the natural berry, for though they possess the proper form, the cicatrice on the inner surface is too smooth. Then again the grey colour of the raw bean is not quite up to the mark, but when these manufactured beans are roasted with 5 per cent of genuine coffee, they find a ready sale. These bogus beans can be made at a cost of 30 dollars per 1,000 pounds, and when mixed with 50 pounds of pure coffee the whole 1,000 pounds cost 37.50 dollars, or 3¾ cents per pound, so that a profit of nearly 100 per cent is the result. There are any number of "coffee substitutes," the Hillis variety being the most successful. This company is already manufacturing 10,000 pounds per week, it being sold by the barrel to retailers in nearly all of the New England, Middle, and Western States. The profits of this concern are supposed to be 300 dollars per day, and its operations have reached such a scale that the stockholders were offered nearly 1,000,000 dollars for their secret and business, but it was declined. No one accustomed to coffee-drinking would imagine that a decoction of this stuff was like either Mocha or Rio, but when mixed with four times its bulk of genuine coffee only an expert could detect the imposition. The manufacturers of these "coffee substitutes" claim that they are not violating the law of adulterating of food products because they do not sell their goods as coffee, but simply as a substitute. While this may be true, it does not apply to the retailer who mixes the bogus stuff with good coffee, and sells the whole as the genuine article. Though manufactories may be beyond the penalties of the adulteration law, they should be suppressed; for without them, coffee-adulteration by retailers would be impossible. When it is to be remembered that the American people are compelled to pay 25,000,000 dollars for ingredients that can be manufactured for one-fifth the sum received by coffee-growers, the necessity for the suppression of this nefarious trade is apparent. Oleomargarine cannot be sold as butter, neither should "coffee substitutes" be made to masquerade under the name of Java, Mocha, or Rio.

The French government seized a factory at Lille which was manufacturing daily forty to fifty kilogrammes of beans which proved to be composed of chicory, flour, and ferrous sulphate. Imitation beans in England were formerly made of chicory. A sample from Roumania consisted of coffee-grounds, chicory, and peas. American factitious beans frequently consisted of wheat flour, chicory, bran, and some coffee; or rye flour, glucose, and water. Rehnstrom's English Patent 14,970 in 1889 gives a preparation for substitute coffee which consists in boiling down milk in a vacuum to a paste which was formed into cakes, dried below 100°, cut into pieces like coffee-beans, and roasted. Other factitious beans have been composed of peas, acorns, beans, lupines, fire clay, peanuts, etc., as listed on subsequent pages.

Coffee-beans are frequently glazed with sugar or egg or dipped into a gummy mixture of the two. It is undoubtedly practised to improve the appearance of inferior grades. It has been claimed by manipulators that the glazing treatment aids in clarifying the infusion and improves the keeping qualities of the beans. Since coffee loses 15 to 20 per cent in weight during torrefication, the roasted beans are sometimes steamed, the addition of water adding considerable weight, and then faced with some greasy substance such as fat, palm oil, paraffin, vaseline, waxes, or glycerine, to prevent evaporation. Moore's English Patent 5033 of 1889 describes a coffee-coating of milk or condensed milk, ground or powdered glue, "liquid glycerine," and refined lard, with the addition of bicarbonate of soda, fine salt, and vinegar.

Poor imitations of coffee-beans, called coffee-pellets, were formerly common adulterants and are still occasionally sold to retail merchants who add them when they grind the coffee for the purchaser. These pellets are made of various seeds, chicory, roasted wheat mash which has been colored with red ochre, etc. Some pellets are composed of roasted ground peas, pea hulls, and cereals, glued together with molasses. As early as 1867, machines appeared on the market which would give the appearance and form of coffee-beans to various plant products. These adulterants consist usually of 1 to 15% of roasted coffee and 85% chicory, flour, beans, peas, etc. These machine-made products stimulated attempts to defraud the public. The practice flourished in the United States until the passage of the Pure Food Laws which have largely checked this abuse.

Ground coffee is the form which is subject to the most sophistications. A factitious coal-tar dye, Naphthol Brown, has been used. A surprisingly large number of ground roots, seeds, cereals, and saccharine matters such as caramel, roasted dates, figs, etc., enter into this form of manipulation as will become apparent by a study of my list of adulteration sources. Chicory root is dried, cut into small pieces, and roasted as the basis for most mixtures. Large areas in Belgium and Northern France are devoted to the cultivation of chicory. Chicory is sold in Europe and in the United States as an addition to coffee. Among the poorer classes in those regions it is used as a coffee-substitute but used alone; the infusion is bitter, unpleasant, and possesses an offensive odor.

Some coffees, from which the caffeine has been largely removed, exist on the market to meet the demands of those who are unable to consume the pure product. To obtain this product, the unground beans are exhausted with water in a vacuum, and the caffeine is removed from the infusion by means of a solvent. The resulting caffeine-deficient beans are impregnated with decaffeinated infusion, after which process, the beans are dried in a vacuum. The flavor of the infusion from such beans is inferior to that of untreated coffee, but it is superior to the infusion of coffee-substitutes. Kaffee Hag is the chief decaffeinated coffee on the United States market to-day. There have been and still exist on the American and European markets, certain products which are 100% coffee-substitutes, as the subsequent lists impress. Most of these substitutes have appeared in response to the demands for a coffee-like beverage by persons whose constitutions seem to be unable to take coffee itself because of gastric or nervous disturbances. The following is a list of the commercial terms for United States coffee-substitutes: Ralston Cereal Coffee; Grain-o; Postum Cereal Coffee; Instant Postum; Ayer's Hygienic Substitute for Coffee; New Era Hygienic Coffee; Shredded Cereal; J. W. Clark's Phosphi Cereal Nervine Coffee; Minute Brew; Drinket; and numerous others which are all preparations of various cereals. Gairing's Grains of Health contains roots and vegetables and some coffee. Old Grist Mill Entire Wheat Coffee is a mixture of wheat, peas, and coffee. Fischer Mills Fresh Roasted Malt Coffee and Kneipp Malt Coffee are composed of malt or barley. Kentucky Coffee is made of *Caesalpinia pulcherrima* Sw. Jaffee is a mixture of prepared fruits and grains. Ko-Loc is a liquid coffee-substitute. It is used alone or mixed with ordinary coffee. It is prepared by a treatment of coffee-beans, but is practically free from caffeine. It is also used as a coffee flavoring extract.

In Europe, much adulteration and pure substitution still persists in the name of economy. There is little doubt but that a reduction in the price of coffee would rapidly result in the disappearance from European trade of the majority of these compounds, as they are in no case as palatable as coffee. Moreover, all coffee-substitutes and adulterants, excepting rare European samples containing ground Cola nuts, are devoid of the exceedingly desirable volatile oil and the alkaloid caffeine which give coffee its most palatable and stimula-

tive qualities. The following is a list of commercial terms for European coffee-substitutes:

Almond Coffee (originally made of the tubers of *Cyperus esculentus* L.; later of acorns, chicory, and dandelion roots).

Africanischer Nuszbohnen Kaffee consists of peanuts.

Bayrischer Kaffee consists of beets, figs, legumes, and rye.

Café de Rheims and Rations Coffee of the French Army consist of chicory and coffee.

Datal Kaffee consists of chicory, coffee, figs, and wheat.

Deutscher or Französischer Kaffee consists of chick peas.

Domkaffee consists of chicory.

Figine conists of chicory and figs.

German Soda Coffee consists of cereals, chicory, and sodium carbonate.

Homeopathischer Gesundheitskaffee consists of chicory, cocoa shells, and wheat.

Hygienischer Nahrkaffee consists of acorns and cereals.

Jamaika Kaffee consists of barley.

Kanon consists of chicory, coffee, and rye.

Kraft Kaffee, Frucht Kaffee, and Allerwelts Kaffee, consist of lupine seeds.

Malto Kaffee consists of malt or a mixture of malt and other cereals.

Melilotin Kaffee consists of chicory, coffee, and date-stones.

Mogdad, Neger, and Stephanie Kaffee consist of cassia seeds (*Cassia occidentalis* L. and *C. sophora* L.).

Mokara or Feigenkaffee consists of figs.

Saladinkaffee consists of maize.

Schwedische Kontinental Kaffee consists of *Astragalus boeticus* L. seeds.

Sudan Kaffee consists of *Parkia biglobosa* (Willd.) Benth. seeds. (Synonymy:—*Parkia africana* R. Br.).

Ungarischer Kaffee consists of chicory, coffee, and lupines.

§ a. BOTANICAL SOURCES OF COFFEE SUBSTITUTES AND ADULTERANTS

Division—Embryophyta Asiphonogama

Subdivision:—Pteridophyta

Class:—Filicales

FAMILY SOURCE	GENUS AND SPECIES	PART USED
Polypodiaceæ	*Dryopteris* (Aspidium) *Filix-mas* Michaux ..... (Male fern)	Rhizome (with chicory).
Salviniaceæ	*Salvinia coffeoides* Heckel (?)	?

Division:—Embryophyta Siphonogama

Subdivision:—Gymnospermæ

Pinaceæ	*Juniperus communis* L.....	Berry.
	Pseudotsuga taxifolia (Lamb.) Britton	Leaf.

Subdivision:—Angiospermæ

Class:—Monocotyledoneæ

Gramineæ	*Agropyrum repens* Beauvais—(Couch Grass)	Rhizome (with chicory).
	Hordeum vulgare L.....	Roasted grain.
	Oryza sativa L.....	Seed.
	Secale cereale L.....	Seed.
	Triticum æstivum L. (Postum)	Roasted grain and molasses.
	Zea maize L.....	Seed.
Cyperaceæ	*Cyperus esculentus* L. (chufa tuber)	Root tubercle or bulblet with chicory.
Palmæ	*Copernicia cerifera* Mart. (Wax Palm)	Seed (nut).
	Phoenix dactylifera L. (Date Palm)	Seed.
	Phytelephas macrocarpa Ruiz & Pav. ..... (Ivory Palm)	Seed (nut).
Liliaceæ	*Asparagus officinalis* L.....	Seed (with chicory).
	Ruscus aculeatus L.....	Seed.
Iridaceæ	*Iris Pseudo-acorus* L.....	Seed.
Musaceæ	*Musa paradisiaca* L.....	Fruit.

Class:—Dicotyledoneæ

Subclass:—Archichlamydeæ (Choripetalæ and Apetalæ).

FAMILY SOURCE	GENUS AND SPECIES	PART USED
Juglandaceæ	*Carya pecan* (Marsh.) Engl. and Græbn.	Ground shells.
	Juglans regia L.....	Fruit.
Betulaceæ	*Corylus Avellana* L.....	Seed.
Fagaceæ	*Castanea vesca* L..... (Syn., Castanea vulgaris L.)	Seed.
	Fagus sylvatica L. (Beechmast i.e. mature fruit).....	Nut.
	Quercus Ballota Desf.....	Acorn cotyledons.
	Quercus æsculus L.....	" "
	Quercus hispanica Lamk.....	" "
	Quercus Ilex L.....	" "
	Quercus pedunculata Ehrh.....	" "
	Quercus sessiliflora Sm.....	" "
Moraceæ	*Cannabis sativa* L.....	Fruit.
	Ficus carica L..... (Sold as "Mochara" in England and Europe at one half the price of coffee.)	Mature Fruit, roasted and pulverized.
	Morus alba L.....	Berry.
Proteaceæ	*Brabejum stellatifolium* L.....	Seed.
Polygonaceæ	*Fagopyrum esculentum* L.....	Seed.
Chenopodiaceæ ...	*Beta vulgaris* L.....	Roasted and ground root.
Caryophyllaceæ ...	*Spergula arvensis* L. (Spurry)	Seed.
Lauraceæ	*Sassafras officinale* Nees and Eberm.	Fruit, bark, and root.
Capparidaceæ	*Boscia angustifolia* Rich.....	Seed.
	" *octandra* Hochst.	Seed.
	" Pechueli Kunze (called Omutendereti)	Root.
	Boscia senegalensis Lam.....	Seed.
Saxifragaceæ	*Ribes Grossularia* L. (European Gooseberry)	Seed.
	Ribes rubrum L.....	Seed.
Rosaceæ	*Prunus Amygdalus* Baill.....	Seed used in combination with *Cassia* buds and rye or wheat seeds.
	Rosa canina L.....	Fruit.
Leguminosæ	*Arachis hypogaea* L.....	Seed.
	Astragalus boeticus L. (Vesce à café) ..... (Syn., A. excapus L. (Swedish	Seed.

FAMILY SOURCE	GENUS AND SPECIES	PART USED
	Coffee) or A. galegiformis L. (?).)	
	Cæsalpinia pulcherrima Sw....	Seed.
	Canavalia ensiformis DC.....	Seed.
	Cassia affinis Benth.....	Seed.
	" *bicapsularis* L.....	Seed.
	" *corymbosa* Lam.	Seed.
	" *occidentalis* L.	Seed.
	(Wild Coffee, Coffee Weed, Negro, Senna or Mogdad Coffee. A common European adulterant.)	
	Cassia quinquinangulata Rich..	Seed.
	" *sericea* Sw.	Seed.
	" *Sophera* L.	Seed.
	" *tora* L.	Seed.
	Ceratonia Siliqua L. (Carouge)	Fruit.
	Cicer arietinum L. (Chick Pea)	Seed.
	Cytisus scoparius Link. (Scotch Broom)	Seed.
	Gleditsia tricanthos L. (Amer. Bean Tree)	Seed.
	Glycine soja (L.) Sieb. & Zucc.	Seed.
	Gymnocladus dioica (L.) Koch-Kentucky Coffee Tree.....	Seed.
	Lathyrus tuberosus L.....	Tuber.
	" *Montanus* Bernh. ...	Tuber.
	Lupinus alba L.....	Seed.
	" *angustifolius* L.....	Seed.
	" *luteus* L.	Seed.
	" *reticulatus* Desr.	Seed.
	Parkia biglobosa (Willd.) Benth.	Seed.
	(Syn., P. africana R. Br.)—Sudan Coffee.	
	Parkia filicoidea Welw.—Sudan Coffee	Seed.
	Parkia roxburghii D. Don—Sudan Coffee	Seed.
	Phaseolus angularis (Willd.) W. F. Wright.....	Seed.
	Pisum sativum L.....	Seed.
	Prosopis alba Griesb.....	Seed.
	Robinia pseudo-acacia L. (Locust Tree)	Seed.
	Soja hispida Moench.....	Seed.
	Tetragonolobus purpureus Moench	Seed.
	(Syn. Lotus)	

FAMILY SOURCE	GENUS AND SPECIES	PART USED
	Trigonella Foenum-græcum L. (fenugreek)	Seed.
	Vicia faba L.	Seed.
	Vigna sinensis (L.) Endl. (Cherry Bean or Cowpea)	Seed.
Buxaceæ	*Buxus sempervirens* L.	Seed.
	Simmondsia californica Nutt.	Nut.
Aquifoliaceæ	*Ilex aquifolium* L.	Berry.
Aceraceæ	*Acer tataricum* L. (Siberia)	Seed.
Vitaceæ	*Vitis vinifera* L.	Seed.
Malvaceæ	*Abelmoschus esculentus* (L.) Mey	Seed.
Malvaceæ	*Abutilon muticum* Sweet	Seed.
	Hibiscus esculentus L. (ochro)	Fruit.
Sterculiaceæ	*Cola acuminata* (Beauv.) Schott & Endl. (Chief source of Sudan Kola Nut Coffee. Sold in Europe under the term "Kolatina.")	Seed (nut).
	Cola vera K. Schum.	Seed.
	Theobroma cacao L.	Cacao seeds and husks.
Myrtaceæ	*Eugenia disticha* DC.	Fruit.
Umbelliferæ	*Daucus carota* L.	Root.
	Pastinaca sativa L.	Root.
	Sisum Sisarum L. (Sweet Root)	Base of Stem and Root.
Cornaceæ	*Cornus mas* L.	Seed.

Subclass:—Metachlamydeæ or Sympetalæ.

Oleaceæ	*Ligustrum Ibota* Sieb.	?
	Olea europæa L.	Seed (kernel).
Convolvulaceæ	*Ipomœa Batatas* (L.) Poir.	Root.
Polemoniaceæ	*Gilia ciliata* Benth. (Syn., *Linanthus ciliatus* (Benth.) Greene.)	Flowering head.
Solanaceæ	*Hyoscyamus* sp.	Seed.
	Solanum tuberosum L. (Tuber is half cooked and roasted with chicory.)	Tuber.
Rubiaceæ	*Cephælis* sp.	Seed.
	Coffea arabica L.	Leaf.
	" *arabica* L.	Pulp of Berry.
	Coprosma sp.	Berry.
	Cremospora coffeoides Hemsl. (Wild Coffee)	
	Diplospora sphærocarpa DC.	Seed.
	Gærtnera vaginata Lam. (Mus-	

FAMILY SOURCE	GENUS AND SPECIES	PART USED
	sænda Coffee)	Seed.
	Galium aparine L.	Fruit and roots with chicory.
	" *palustre* L.	Fruit.
	Gallieniera (Galiniera) coffeoides Del.	Seed.
	Mussænda sp.	Seed.
	Pavetta Baconia Hiern.	Seed.
	Psychotria latifolia H.B.	Seed.
	Randia genipæflora DC. (Wild Coffee)	Seed.
Caprifoliaceæ	*Triosteum aurantiacum* Bicknell (?)	Seed.
	Triosteum perfoliatum L. (Wild Coffee)	Seed.
Compositæ	*Cichorium intybus* L.	Ground Root.
	Gundelia Tournefortii L.	?
	Helianthus annuus L.	Seed.
	Scorzonera hispanica L.	Root.
	Taraxacum officinale Webber.	Root.

Note:—Other adulterants which have been used, the species source of which I am unable to state, include dried prunes, pears, carob bean pods, charcoal, red slate, dried pellets consisting of ground peas, pea hulls, various cereals, etc., held together with molasses, clay pellets, kaolin, evaporated skimmed milk preparations of artificial beans, innumerable beans, peas, cereals, sawdust, oak bark, burnt sugar, biscuits, brown bread, pilot bread, and even baked ox liver.

§b. DETECTION OF COFFEE SOPHISTICATIONS

(The following methods do not assume to render the precise quantitative determination of each adulterant.)

I. Whole Beans

A. Raw Bean Tests:

1. If all one variety, the beans—prior to blending—should be uniform in size, appearance, and color. Irregularity indicates artificial beans.

2. The beans should be free from stems, stones, dirt, and other foreign substances.

3. Transverse section of bean should show uniform color throughout; if interior is lighter in shade, artificial coloring is indicated.

4. Water-treatment for various inorganic color matters:

Procedure:—Wash in water; rub with dry towel.

Test:—Rubbing will remove cosmetic, if present.

Procedure:—Soak beans in cold water. Treat sediment, using appropriate qualitative chemical methods for the suspected coloring-matter (Scheele's green, chrome yellow, Venetian red, etc.).

5. Alcohol-treatment for organic coloring-matters.

Procedure:—Shake beans in alcohol.

Test:—Alcohol is not colored by genuine coffee.

Procedure:—Evaporate alcoholic solution to dryness. Take up residue in water.

Test:—Solution will give characteristic reactions of coal-tar dyes if coloring matter is present.

(a) Indigo Detection:

Procedure:—Treat sample with dilute nitric acid. Filter; saturate filtrate with sulphuretted hydrogen. Extract Indigo by agitating with chloroform.

(b) Prussian Blue Detection:

Procedure:—Prussian Blue and Alkanet root may be separated by warming coffee-sample with a solution of potassium carbonate. Add hydrochloric acid; and Prussian Blue precipitates. Prussian Blue, if present in considerable quantities, may be detected in the sediment, obtained after shaking in water, by the following procedure:—Dissolve the sediment in hot alkali; filter and acidify with HCl; add drop of ferric chloride. Test:—Precipitation occurs if Prussian Blue is present.

(c) Ultramarine Detection:

According to Leach, "If the residue on the paper after treatment with hot alkali, on removal to a porcelain dish and treatment with concentrated H_2SO_4, yields hydrogen sulphide (recognize by odor or by the blackening of lead acetate paper), ultramarine is present."

B. Roasted Bean Tests:

1. Density-test for factitious beans:

Procedure:—Place a small handful of beans on surface of full beaker of water.

Test:—Factitious beans are heavier than water and sink; whereas, genuine coffee-beans are lighter and float.

2. Alcoholic treatment:

(a) For sugar glazing:

Procedure:—Higler's process is satisfactory and is as follows:—Digest 10 grms. coffee-sample three times for ½ hr. with quantities of 100 c.c. cold alcohol (1 vol. 90% alcohol to 1 vol. H_2O). Decant alcohol each time and make up to 500 c.c. Filter. Evaporate a considerable portion to dryness. Weigh and deduct ash. (To allow for action of solvent on beans, deduct 0.83 for each 100 parts of dry coffee. Difference may be taken as due to caramel.)

(b) For shellac and resin:

Procedure:—Shake beans with alcohol for 10 minutes. Evaporate to dryness in dish. Ignite residue.

Test:—Characteristic resinous odor indicates adulterant.

(c) For graphite (which adheres closely and is not removed by shaking):

Procedure:—Warm samples with alcohol containing potassium hydroxide.

Test:—Graphite readily removed if present.

3. Spath's petroleum treatment for facing-matters such as fat, vaseline, paraffin, wax, etc.:

Procedure:—Extract 100-200 grms. sample with light petroleum for 10 minutes. Decant petroleum spirit; repeat process several times. Evaporate petroleum extract to dryness. Digest with warm water. Extract fatty matter with light petroleum. Filter and evaporate to dryness.

Test:—Examine residual fatty matter by usual methods for waxes and fats.

II. Roasted and Ground Coffee.

A. Physical Tests:

1. Dry treatment:

Procedure:—Press sample between fingers.

Test:—If it cakes, adulterated—probably with chicory and cereals.

2. Cold-Water Treatment:

Procedure:—Place sample gently upon surface of cold water in a beaker; or shake sample in test-tube of cold water, and allow to stand aside; in which case, coffee rises to the surface. Allow to remain 15 minutes.

Test:—Pure coffee, because of its oil content, does not imbibe water, and floats with the exception of a few highly carbonized portions, and gives little or no color to the water. Chicory, caramel, and forms of burnt sugar absorb water, sink, and produce strong brownish-red streaks in descending; and, by diffusion, tint the entire liquid. Chicory possesses 3 times the tinctorial power of coffee. Roasted roots, berries, mineral ingredients, rye, corn, beans, peas, lupines, figs, etc., communicate a similar coloration, but less rapidly and to a less extent than chicory. Caramel gives a deep brown color, and the solution has a bitter taste. Inorganic coloring-matters in the sediment may be sought by ordinary qualitative methods.

Procedure:—Place a sample upon a flat glass plate. Moisten with few drops of water.

Test:—Pure coffee remains hard when tested with a needle. Adulterants become soft.

3. Warm or Boiling-Water Treatment:

Procedure:—Agitate a sample in boiling water. Allow to settle.

Test:—Genuine coffee gives a clear and limpid solution. Most adulterants—because of the presence of starchy and saccharine matters—yield a thick, brown, turbid, gummy liquor.

Procedure:—Specific Gravity Infusion Test after Messrs. Graham, Stenhome & Campbell. Boil 1 part of sample with 10 parts H_2O; filter. Determine density of infusion at 15.5° C.

Test:—Pure coffee-infusions, because of their almost absolute freedom from sugar, as compared with cereal and root adulterants, have sp. grav. of 1.00986. Most infusions of adulterants have a higher value; for example, pure chicory-infusion has sp. grav. of 1.02821.

4. Salt Treatment:

Procedure:—Shake sample in test-tube filled with saturated solution of common salt.

Test:—Pale amber liquid; sample floats if pure coffee. Dark

yellow or brown liquid; sample mostly sinks if adulterated (probably with chicory and cereals).

5. Alcoholic Treatment for removal of organic coloring matters, sugar, egg-albumen, etc., as under "Whole Bean Treatment."

B. Chemical Analysis:

1. Chicory Detection:

Procedure:—Boil 10 grms. sample with 250 c.c. of water. Strain liquid. Precipitate with slight excess of basic lead acetate. Allow precipitate to settle.

Test:—Pure coffee—supernatant liquid, colorless. Presence of chicory—supernatant liquid colored; the tint is roughly indicative of the proportion of chicory present.

2. Starch Test (indicative of such adulterants as beans, peas, acorns, and all cereals):

Procedure:—Exhaust sample with ether to remove fat. Decolorize with alcohol. Boil sample for few minutes with 10 parts water. Allow to become cold. Add some dilute H_2SO_4. Drop in cautiously, with agitation, a solution of potassium permanganate until coloring matter is nearly destroyed. Strain liquid or decant from insoluble matter. Decolorize with animal charcoal. Add solution of iodine.

Test:—Blue coloration if positive. As small a quantity as 1% can be detected by this method. Genuine coffee is free from ready formed starch.

3. Ash Content as means of detecting adulteration:

(a) Pure coffee—very nearly white in color; 3.5 to 4.5% (rarely 5%) in quantity.

(b) Adulterated coffee—often tinted ash; red tint indicates some iron compound as adulterant; high ash percentage.

(c) For constituents of Pure Coffee Ash, see Section under "The Chemistry of Coffee," page 157 *et seq.*

4. Caffeine Content:

U. S. and European substitutes and adulterants are devoid of any caffeine; therefore the absence of caffeine assures complete substitution.

(a) Caffeine Detection by the "Murexid Test" with the ma-

terial in a solid state or with the sample residue from the evaporation of a liquid:

Procedure:—(Allen) Heat small quantity of the solid or powdered material in a white porcelain dish. Cover with a few drops of strong HCl. Add (immediately) a fragment of potassium chlorate. Evaporate to complete dryness on water bath. (If caffeine be present, production of reddish-yellow or pink color is noted.) Cool. Treat residue with very little ammonia water, applied on the point of a stirring rod.

Test:—If positive, purple color (murexion).

(b) For Quantitative Extraction of Caffeine, see "Allen's Modification of Stahlschmidt's Method" under section on "Chemistry of Coffee."

C. Microscopic Examination:

1. With hand lense (See Plate 2, Genus *Coffea*: Fruit Morphology):

(a) Coffee-beans possess a characteristic shape with a very characteristic cleft on the ventral surface which is absent on many poorly manufactured beans.

(b) A portion of the parchment investment always remains adhering closely in the cleft of genuine beans. The membrane is always absent in factitious beans although sometimes the cleft is filled with fine sawdust (powder).

(c) Cross-section through the center of a bean shows a characteristic furrow with a fragment of the parchment; and the line of the embryo in the endosperm.

(d) Cross-section through the germ end shows the furrow; the line of the embryo and a portion of the embryo (through cotyledons or radicle).

(e) Longitudinal section, taken parallel to and slightly to one side of this cleft, shows the characteristic long line of the embryo and the germ at one end.

2. With low-power microscope:

(a) Raw bean tissue examination:

Preparation of Bean:—Soak raw beans in water several hours or in equal parts of alcohol and glycerin for 1 to 2 days.

Preparation of seed-coat:—Cut a bean lengthwise through the

furrow on the flat side. Strip off small piece of silvery seed-coat. Mount in glycerin or chloral hydrate.

Diagnosis:—If true coffee-bean, the seed-coat is exceedingly characteristic. See Plate 2, Genus *Coffea:* Fruit Morphology.

Preparation of Endosperm:—Soften as for seed-coat examination. Mount thin transverse section of bean in chloral hydrate.

Diagnosis:—Characteristics of true coffee endosperm.

(1) Epidermis plus first layer or two in approximation possesses cell-walls of uniform and even diameter. (See Photomicrograph.)

(2) Remaining endosperm consists of irregularly polygonal parenchymatous cells with exceedingly characteristic, knotty, thickened walls—best seen in microtome sections—and very large pits often forming ovate spaces occasionally as long as the width of the cell. These cells contain brilliant, colorless, spherical oil globules, and protein matter. One who is sufficiently familiar with the various commercial coffee-beans is able to recognize the seeds of *Coffea liberica* Bull, which are utilized commercially as fillers, from those of *Coffea arabica* L., since Arabian coffee-seeds are not only much smaller in size and less coarse in general structure but the entire endosperm is composed of polygonal cells of a fairly uniform size; whereas the endosperm of Liberian coffee exhibits polygonal cells in the outer portion but toward the center the cells become distinctly oblong and rectangular (see Photomicrograph).

Preparation of Embryo:—Soften seed as above and dissect out embryo.

Diagnosis:—True coffee-embryo possesses a thick radicle and two cordate, leaf-like cotyledons. See Plate 2, Genus *Coffea:* Fruit Morphology. Cotyledons are composed of delicate parenchymatous cells.

(b) Ground roasted coffee tissue examination.

Preparation:—Spread out sample on white paper.

Diagnosis:—Jet black particles are frequently caramel. If so, they will dissolve in water, giving it an intense brown color and bitter taste.

Preparation:—Sift to separate fine particles (powder). Soften some of the coarser ones. Section any suspicious particles in pith. Decolorize sections by short maceration in solution of chlorinated soda. Examine in dilute glycerin.

Diagnosis:—Compare with prepared sections of true coffee-bean for seed-coat and endosperm structure.

Preparation:—Decolorize the fine powder. Centrifuge or otherwise separate. Wash with distilled water. Examine in dilute glycerin (or macerate for a day in ammonia to render the tissues transparent and mount in ammonia).

Diagnosis:—Compare with coffee-bean tissues. No foreign tissues should be present. The coffee endosperm cells are distinctive, and oil globules are detectable in them. Bits of the seed-coat appear in the powdered—very finely ground—preparation as delicate silver-like patches and the sclerenchymatous cells of the seed-coat are readily observed, appearing as peculiarly characteristic spindle-shaped, thick-walled cells. These cells should be sought for, as they are always present in genuine coffee. A few small spiral vessels are present. (See Plate 2, Genus *Coffea:* Fruit Morphology.) The most common adulterant of coffee, namely, ground roasted chicory root, is readily detected by decolorizing the powdered sample with a solution of chlorinated soda; wash, stain with Soudan red, and note the lactiferous vessels which are characteristic of it. Furthermore, the ground sample, digested for fifteen minutes in a solution of potash in a water bath, washed, and mounted in glycerin or chloral hydrate, will show the diagnostic characters of abundant parenchymatous tissue in wood and cortex, of lactiferous and many small sieve tubes with transverse plates in the cortex, and of vessels with large pits in the wood.

Note:—If, in examination of ground coffee, starch is ascertained by the chemical tests, thereby indicating cereal or other adulteration, the sample should be exhausted with ether to remove the fat and subsequently treated with alcohol to dissolve the coloring matter, before the residue is examined microscopically to determine the adulterant.

Conclusion:

Preparation of coffee for commercial purposes results in the removal of the greater portion of the seed-coats so that the bean consists largely of the endosperm. It is necessary to have prepared sections of the various adulterants of coffee for comparative examination as well as to be familiar with the characteristics of genuine coffee-tissue. With this information at hand, the microscopic determina-

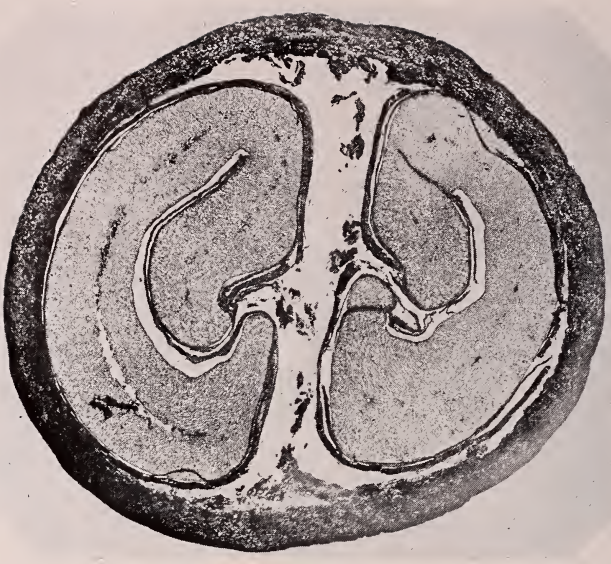


PLATE 51 A: *COFFEA ARABICA* L.
Fruit:—Transverse Section.
Magnification 12 ×.

PLATE 51 B: *COFFEA ARABICA* L.
Endocarp (parchment):—Transverse Section.
Magnification 500 ×.

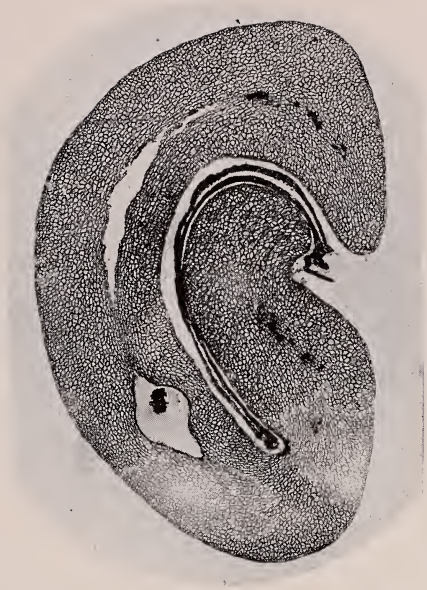


PLATE 52 A: *COFFEA ARABICA* L.
Santos Coffee Bean:—Transverse Section.
Magnification 12 ×.

PLATE 52 B: *COFFEA ARABICA* L.
Rio Coffee Bean:—Transverse Section.
Magnification 12 ×.

PLATE 53 A: *COFFEA ARABICA* L.
Santos Coffee Bean:—Transverse Section.
Magnification 12 ×.

PLATE 53 B: *COFFEA ARABICA* L.
Santos Coffee Bean:—Longitudinal Section.
Magnification 12 ×.

tion of commercial coffee is the only absolutely positive and reliable method of diagnosis.

Having determined that the sample is 100% coffee, it should be remembered that it is of primary importance to make an infusion to test the aroma and flavor, as coffee may be pure and yet possess such an aroma and flavor as to render it totally undesirable for beverage purposes.

I have been convinced from the examination of samples of the coffee-products from many of the leading commercial wholesale coffee concerns and innumerable retail samples, that there is very little substitution and adulteration of the whole bean by the large reputable houses, although it is still met with in other concerns. The mixing of various grades is commonly detected. Glazing and facing are practised to a considerable extent. Ground coffee is subject to considerable adulteration, as samples from Massachusetts Retail Stores contained roasted chicory root, peas, beans, bread, wheat, pellets, oats, charcoal, etc. Chicory is, as has always been the case, the chief adulterant. The chefs of certain hotels order a 10% chicory content, in which case the addition is scarcely to be classed as an adulterant as it adds certain desirable qualities which are highly prized by some trade.

During the past seventy-five years, thirty-eight botanical families including ninety-eight genera and one hundred and twenty-three species have been utilized as sources for coffee-substitutes and adulterants.

In regard to the blending of coffee, it should be said that such mixtures as that of equally choice beans of American strength-giving coffee, soft Java, and the deliciously flavored Mocha, are unquestionably an improvement over many pure type coffees. Blending is accomplished at the wholesale houses by weight, which assures a uniform product.

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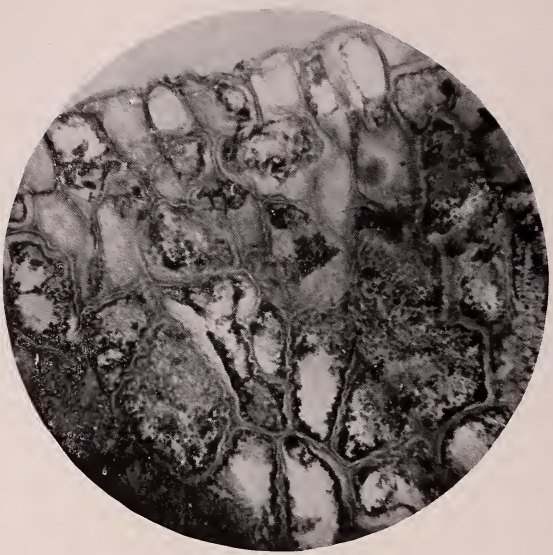

PLATE 54 A: *COFFEA ARABICA* L.

Epidermis and Endosperm:—Transverse Section.

Magnification 500 ×.

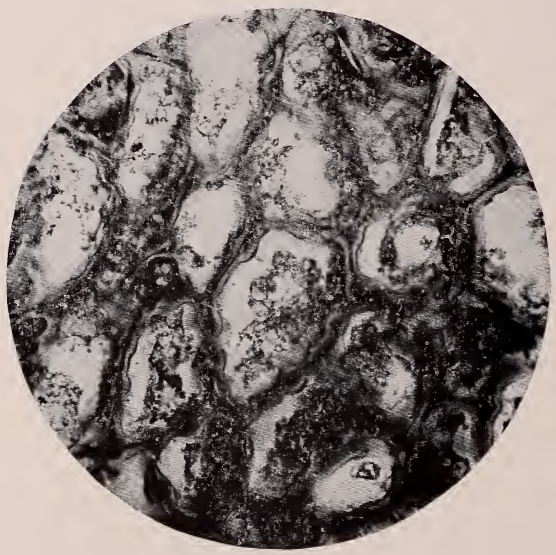

PLATE 54 B: *COFFEA ARABICA* L.

Endosperm { Polygonal cells. / Knotty cell walls. / Oil globules.

Transverse Section.

Magnification 500 ×.

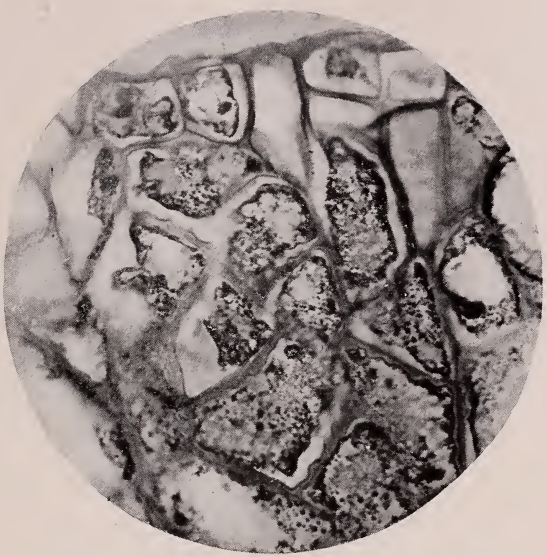

PLATE 55 A: *COFFEA LIBERICA* BULL

Epidermis and Outer Endosperm:—Transverse Section.

Magnification 500 ×.

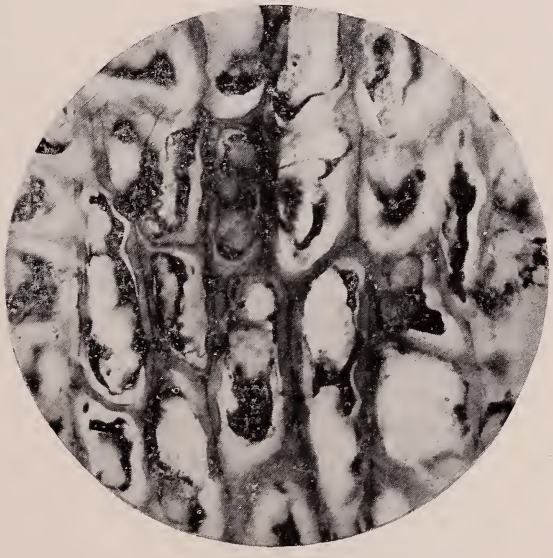

PLATE 55 B: *COFFEA LIBERICA* BULL

Inner Endosperm (oblong-rectangular cells).
Transverse Section.

Magnification 500 ×.

PLATE 56 A: *COFFEA LIBERICA* BULL

Seed:—Transverse Section.

Magnification 12 ×.

PLATE 56 B: *COFFEA LIBERICA* BULL

Germ:—Transverse Section.

Magnification 500 ×.

PLATE 57 A: *COFFEA LIBERICA* BULL

Seed:—Transverse Section.

Magnification 12 ×.

PLATE 57 B: *COFFEA LIBERICA* BULL

Longitudinal Section showing Position of the Germ.

Magnification 12 ×.

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CHAPTER VIII

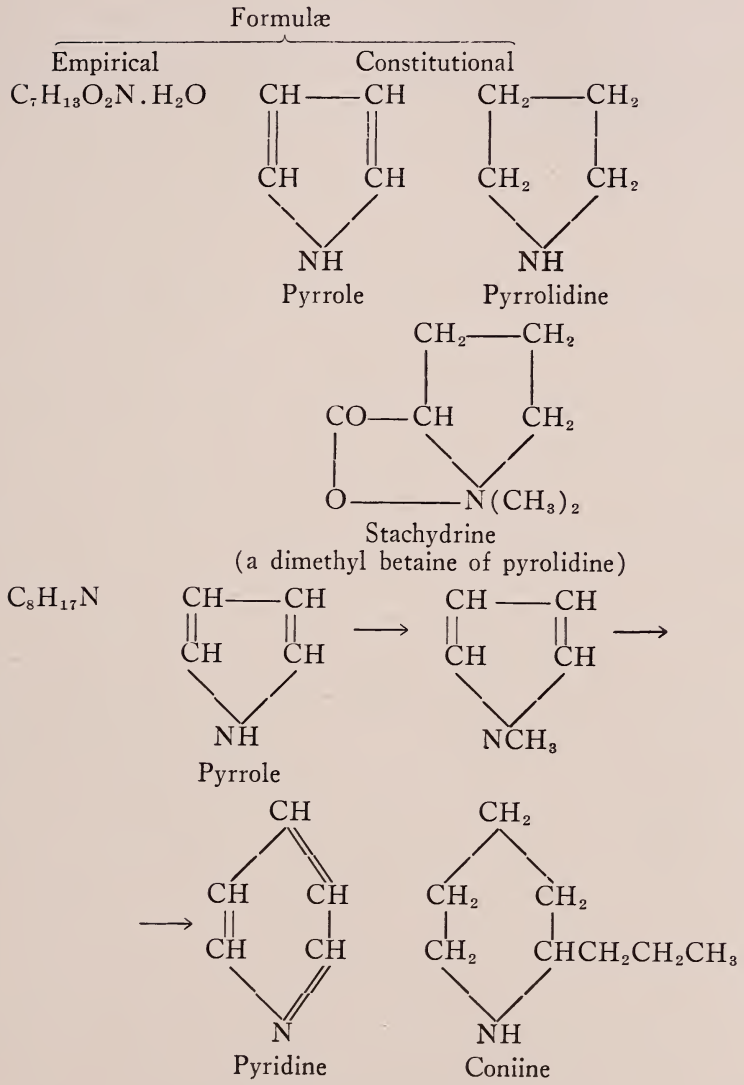
THE CHEMISTRY OF COFFEE

Primary attention has been given to the alkaloids of coffee in order to indicate the source, constitution, and method of extraction of those substances which are present in the coffee-bean and which have an appreciable effect on the animal organism. Special emphasis has been placed on caffeine, as it is the chief stimulative constituent of coffee.

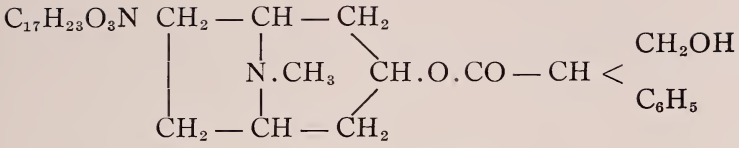
1817 dates the beginning of our chemical knowledge of plant alkaloids. In 1817, the crystalline, salt-forming, and physiologically active substance morphine was discovered by Sertürner in the opium poppy, *Papaver somniferum* L. In the same year Robiquet discovered narcotine; and in 1818, Pelletier and Caventon discovered strychnine. In 1820, Runge prepared caffeine from the seeds of *Coffea arabica* L.; and in 1827, Oudry isolated a similar principle in the leaves of *Thea sinensis* L. and called it theine. It has been established as identical with caffeine.

The molecular constitution of plant alkaloids has been investigated, and a large number of vegetable alkaloids have been synthesised. Caffeine was synthesised in 1895 by Fischer and Ach who published their results in Berichte 28 (1895) 3135. These molecular studies make possible the present classification of plant alkaloids based on their nuclear structure; and the following nine groups are arranged in accordance with the nature of the bases from which they are derived:

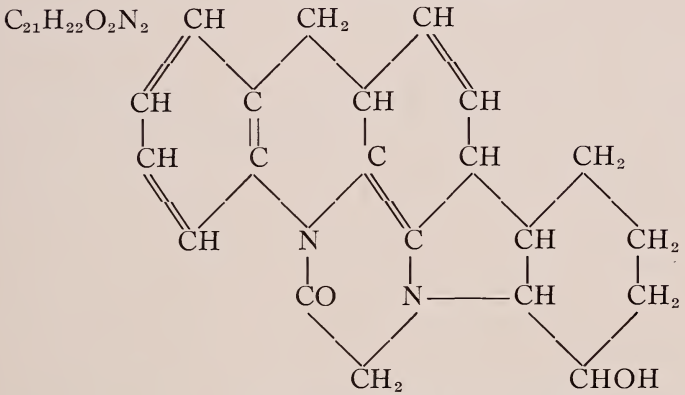
	Groups	Example	Usual Botanical Source
1.	Pyrrole	Stachydrine	Stachys Sieboldii Miq. (Tubers)
2.	Pyridine	Coniine	Conium maculatum L. (Poison Hemlock Fruit)


Formulæ
Empirical
Constitutional
$C_7H_{13}O_2N.H_2O$
Pyrrole
Pyrrolidine
Stachydrine
(a dimethyl betaine of pyrolidine)
$C_8H_{17}N$
Pyrrole
Pyridine
Coniine

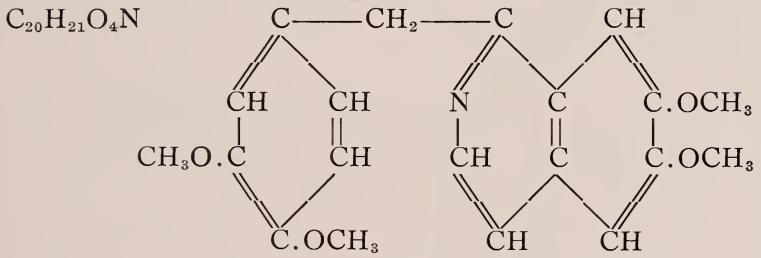
3.	Diheterocyclic (with a common nitrogen atom)	Atropine	Atropa Belladonna L. (Leaves and Roots)
4.	Quinoline	Strychnine	Strychnos Nux-vomica L.
5.	Iso-Quinoline	Papaverine	Papaver somniferum L. (Juice from unripe capsules of the Opium Poppy)



Atropine
(dl-tropyltropëine)



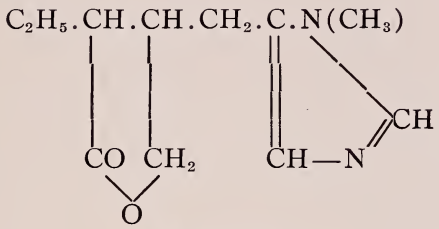
Strychnine (Perkin & Robinson)



Papaverine

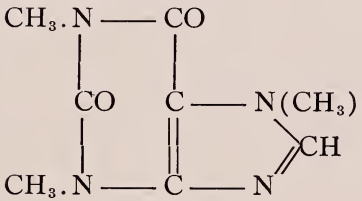
6.	Glyoxaline	Pilocarpine	Pilocarpus Selloanus Engler (Jaborandi Leaflets)
7.	Purine	Caffeine	Coffea arabica L. (Seeds)
8.	Cyclic or Acyclic (derivatives of aliphatic amines)	Choline	Amanita muscaria (L.) Pers. (Entire Plant)
9.	Alkaloids of Unknown Constitution.	Aconitine	Aconitum Napellus L. (rhizome)

$C_{11}H_{16}O_2N_2$



Pilocarpine

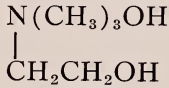
$C_8H_{10}O_2N_4$



Caffeine

(1 : 3 : 7 : trimethylxanthine or
1 : 3 : 7 : trimethyl — 2 : 6 : dioxypurine)

$C_5H_{15}O_2N$



Choline

$C_{34}H_{45}O_{11}N$
(acetylbenzoxyl-
aconine)

?

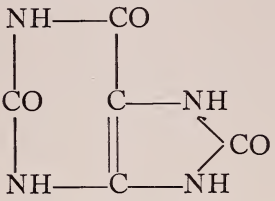
It is noteworthy that plant alkaloids seem to occur only in certain families of the vegetable kingdom. Although alkaloids occur in many other families in addition to the list given below, one finds them most frequently in dicotyledonous phanerogamous plants, less frequently in monocotyledons, and least frequently in cryptogams.

Families Rich in Alkaloids	*Families Poor in Alkaloids*	*Families Intermediate*
Ranunculaceæ	Gramineæ	Compositæ
Papaveraceæ	Orchidaceæ	
Fumariaceæ	Rosaceæ	
Leguminosæ	Labiatæ	
Apocynaceæ		
Solanaceæ		
Rubiaceæ		

It has been found not only that alkaloids are present mainly in few families but also that the alkaloids in any one family and especially in any particular genus are, as a rule, closely related. The purine group of alkaloids, however, to which caffeine belongs, are contrary to this generalization, as they are closely related and occur in several families.

The origin of alkaloids in plants is a debatable question. Pictet states that they are produced in two successive stages: (1) Decomposition of complex nitrogenous substances (ex. Protein or Chlorophyll) to simple basic substances. (2) Combination of these simple basic substances with compounds present in the plant, which results in the formation of the complex alkaloid molecules. Thus Drs. Haas and Hill [1] have stated, "The processes of metabolism within the plant would therefore be strictly analogous to those taking place in the animal body, in which waste products, such as phenol, glycerine, etc., are coupled up with other substances such as sulphuric or benzoic acid, before being eliminated." A well-known product of the metabolism occurring in animals is uric acid which is recognized systematically as 2:6:8 trioxypurine and may be represented by the constitutional formula:

[1] Haas & Hill Chem. Pl. Prod. ed. 3, 1 (1921) 271.



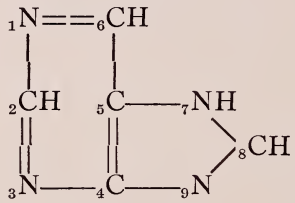
This acid does not occur in plants; yet its formula shows such a close relationship to other purine bases as to indicate that the formation of purine bases in plants may, as in animals, be waste products of metabolism. In fact, Foss, in Compt. Rend. 155 (1912) 851 and 156 (1913) 567, has observed urea traces in higher plants. It is, however, questionable whether or not they are a physiological product of the cell.

The function of alkaloids in plants is difficult to explain. It has been suggested that they are nutritive materials utilized in vegetable metabolism, and that they are protective materials against animal attack. It seems more probable that they are end-products of nitrogenous metabolism, which are rendered harmless to plants by conversion into alkaloids and merely happen to be stored up because of the inability of the plant to rid itself of them. Caffeine does not seem to be so intimately related to protein metabolism as are the other purine bases. Nevertheless, the purine bases, which are a part of the nucleic acids, form the major proportion of the nucleus which is the center of all cell-division. Thus it seems plausible that these purine bases play an essential part in the growth of both plants and animals.

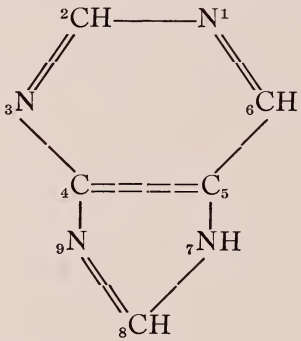
The purine bases to which the coffee alkaloid caffeine belongs, include caffeine which is found in *Thea sinensis* L. leaves; in *Cola acuminata* Schott & Endl. fruit; in *Ilex paraguariensis* St. Hil. leaves (maté); in *Paullinia Cupana* H.B.K. fruit (guarana); and in *Coffea arabica* L. seeds, which are of special interest in this treatise. The purine alkaloids also include theobromine which is present in the fruit of *Theobroma cacao* L.; theophylline in the leaves of *Thea sinensis* L.; xanthine in the leaves of *Thea sinensis* L.; in the root sap of *Beta vulgaris* L., and in a number of sprouting seedlings; hypoxanthine in the seeds of *Piper nigrum* L.; inosine, a pentoside of hypoxanthine, which is found in yeast and beet root; guanine, found

in Peruvian guano and leguminous seedlings; adenine, found in the leaves of *Thea sinensis* L., and in the root of *Beta vulgaris* L.; and vernine, a pentoside of adenine, found in *Vicia* seedlings. These substances are all derivatives of the same base, purine. Purine is also the mother substance of a number of compounds present in animals, such as uric acid, methyl- and dimethyl-xanthine, methyl-guanine, etc. The relationship of the members of this group to the mother substance and to each other is best noted from a consideration of their constitutional formulae.

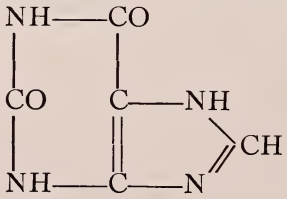
Purine.



or purine, written in the following form, shows clearly that it consists of two rings; the upper six-membered pyramidal ring; and the lower five-membered imidazol or gly-oxaline ring.



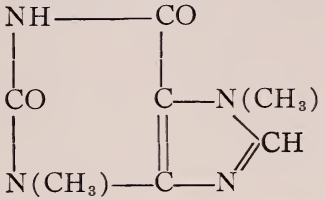
Xanthine or 2:6 dioxypurine.



This formula indicates that xanthine may be regarded as purine plus

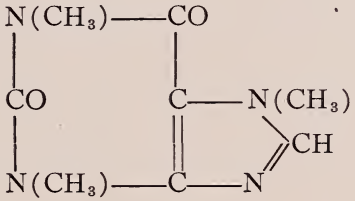
two oxygen atoms attached to the carbon atoms, numbers 2 and 6 respectively, and hence the term 2:6 dioxypurine.

Theobromine or 3:7 dimethyl-xanthine.



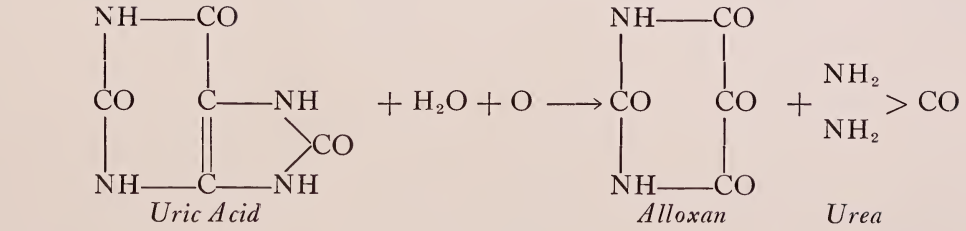
Formula demonstrates that theobromine is derived from xanthine by the replacement of two hydrogen atoms, at numbers 3 and 7 respectively, by methyl groups (CH_3).

Caffeine or 1:3:7 trimethyl-xanthine or 1:3:7 trimethyl 2:6 dioxypurine.

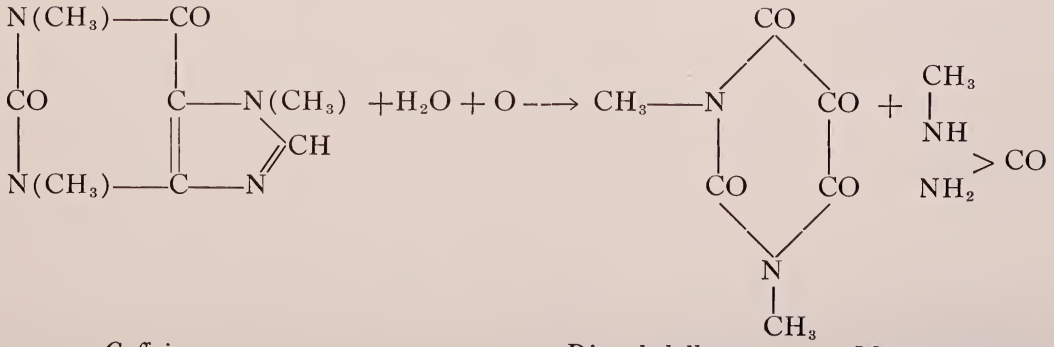


Formula indicates that caffeine is derived from xanthine by the replacement of three hydrogen atoms, at numbers 1, 3, and 7 respectively, by methyl groups (CH_3).

For further evidence to help substantiate this formula for caffeine, it will be noted that caffeine contains three nitrogen-methyl groups (i.e. 3 methyl-amino groups). Hence the caffeine formula may be written $C_5HNO_2(NCH_3)_3$. The relation of caffeine to uric acid is shown by the nature of its oxidation products Thus, as uric acid, when treated with potassium chlorate and hydrochloric acid, decomposes into alloxan and urea; so caffeine, when similarly treated, changes into dimethylalloxan and monomethylurea.

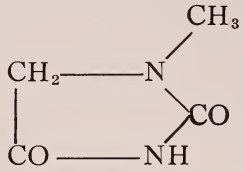


Uric Acid *Alloxan* *Urea*

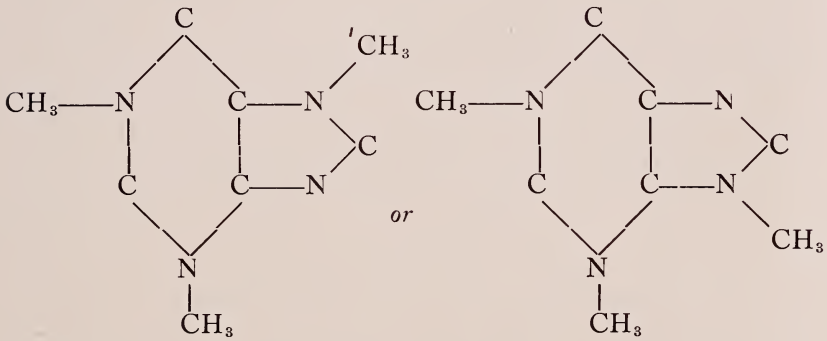


Caffeine *Dimethylalloxan* *Monomethylurea*

The decomposition products of caffeine include methylhydantoin.



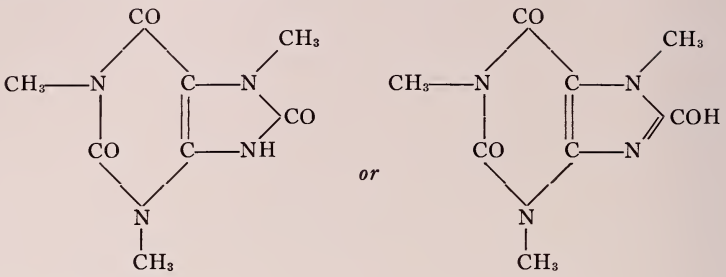
Comparison shows that the caffeine molecule and also the uric acid molecule are formed by the union of two nitrogenous rings. The one found in dimethylalloxan is a hexatomic ring and the one in methylhydantoin is a pentatomic ring. Thus there are two possible atomic groupings for caffeine; namely,



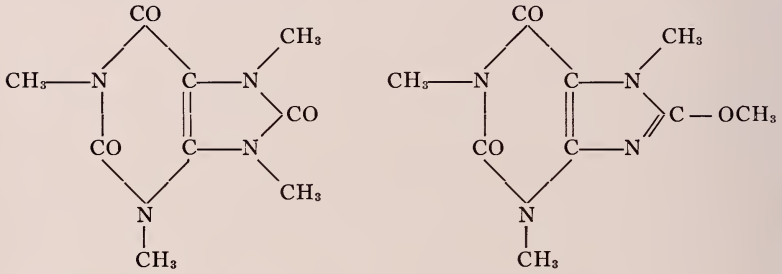
Fischer has shown that the first form is correct, as it alone possesses the atomic grouping which contains the chain of dimethylamide, CH_3-NH-CO-CO-NH-CH_3, which is another decomposition product obtained by him. This being the case, the position of the double bond, of the two oxygen atoms, and of the hydrogen atom was solved by Fischer from his research on oxycaffeine and hydroxycaffeine.

Caffeine reacts with halogens to form substitution products in which the substituted halogen atom readily exchanges for other radicles. Caffeine also forms unstable addition products with bromine. Chlorcaffeine, $C_8H_9ClN_4O_2$, is converted into methoxycaffeine, $C_8H_9N_4O_2(OCH_3)$, when treated with caustic soda in methyl alcohol. Methoxycaffeine, boiled with dilute hydrochloric acid, eliminates methyl chloride; and oxycaffeine, $C_8H_{10}N_4O_3$, is formed.

Oxycaffeine has been shown to be trimethyluric acid:



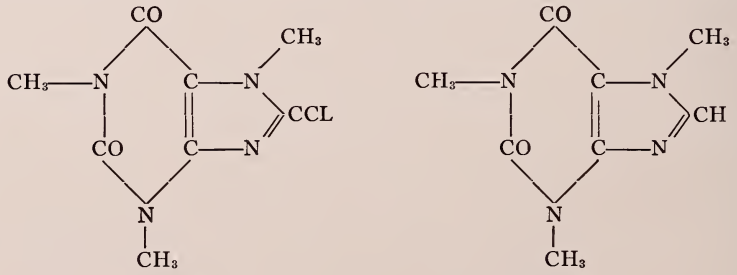
The heating of the silver salt of oxycaffeine with methyl iodide produces a mixture of tetramethyluric acid and methoxycaffeine.



Tetramethyluric Acid *Methoxycaffeine*

Formation of these two substances indicates that oxycaffeine may react in two tautomeric forms such as -NH-CO and -N=C(OH)-. Since these groups can occur only in the hydantoin nucleus, the methoxyl of methoxycaffeine must exist in this nucleus.

The following formulae are for chlorcaffeine and caffeine; namely,

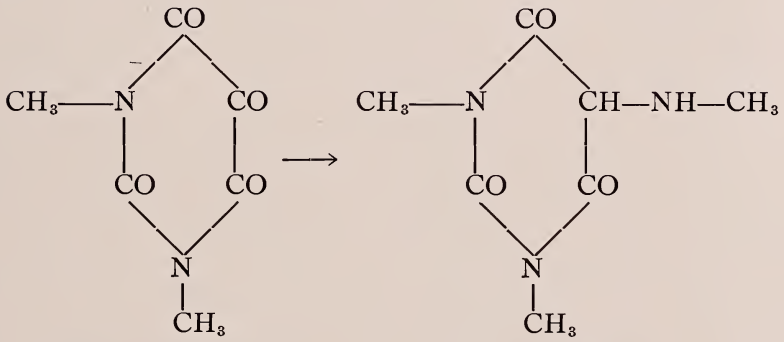


Chlorcaffeine *Caffeine*

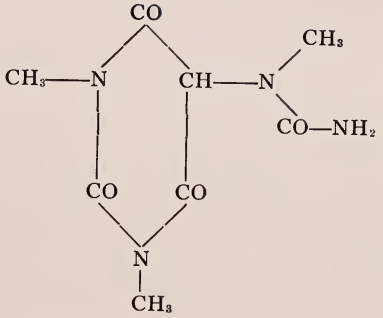
must be correct since a study of preceding formulae and reactions shows that methoxycaffeine is derived from chlorcaffeine which is derived from caffeine.

Complete synthesis of the alkaloid, caffeine, was obtained by Fischer from dimethylalloxan which, when treated with neutral methyl ammonium sulphite, forms an addition product which is converted by concentrated hydrochloric acid into trimethyluramil. This substance when heated with an aqueous solution of potassium cyanate yields tri-methyl-pseudo-uric acid which on being boiled with dilute hydrochloric acid condenses to 1 : 3 : 7 trimethyluric acid or hydroxycaffeine. Hydroxycaffeine crystallizes in needles which melt at 345°C. It is slightly soluble in cold water, alcohol, and ether. It possesses both basic and acid properties. Hydroxycaffeine is converted into chlorcaffeine by treatment with phosphorous pentachloride. Chlorcaffeine, when reduced with zinc and hydrochloric acid, yields caffeine.

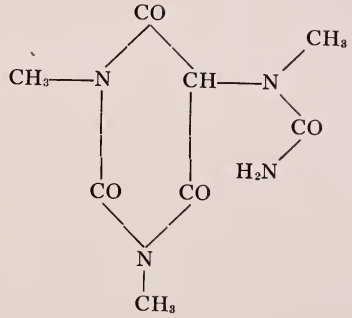
The complete synthesis of caffeine from dimethylalloxan as explained in the text is indicated by the following constitutional formulae:



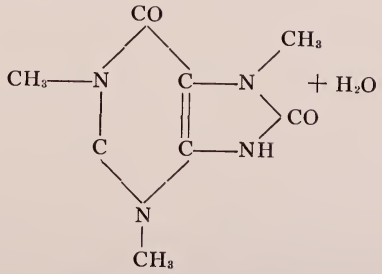
Dimethylalloxan *Trimethyluramil*



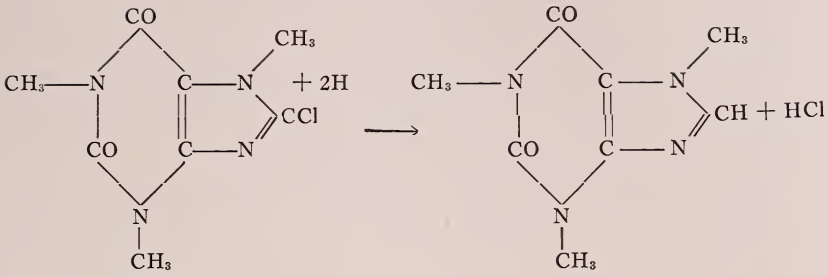
Trimethyl-pseudo-uric acid



Trimethyl-pseudo-uric acid. (After being condensed by boiling with dilute hydrochloric acid.)



Hydroxycaffeine
(or Trimethyltrioxypurine)

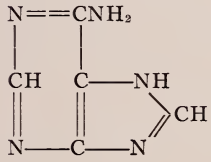


Chlorcaffeine
(or 1:3:7 trimethyl-8-chlordioxy-purine)

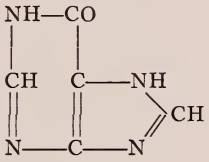
Caffeine
(or 1:3:7 dimethyl-2:6 dioxy-purine)

The constitutional formulae of the other principal members of the purine group are given below:

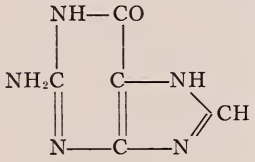
Adenine or
6 aminopurine



Hypoxanthine or
6 oxypurine



Guanine or
2 amino 6 oxypurine



The composition of coffee has been studied by a large number of investigators, but much remains to be accomplished. Subsequent statements refer to the seeds of *Coffea arabica* L. unless otherwise qualified. The chief alkaloid in coffee is caffeine, and varies in amount from 0.5% to 2.2% with an average content of about 1.3%. Gorter has shown that it occurs in coffee as potassium caffeine chlorogenate. Paladino isolated crystals of the base coffearine from coffee-extract by boiling with milk of lime. Coffearine, $C_{14}H_{16}O_4N_2$, occurs as colorless deliquescent needles, melting at 140°C. and giving a faint alkaline reaction. It forms a hydrochloride, $C_{14}H_{16}O_4N_2$ $HCl.H_2O$, melting at 180°C. Graf repeated and confirmed Paladino's experiment. Nitrogenous constituents of coffee other than caffeine are in need of research. The proteins, however, have been studied by some investigators, and have been found to consist of

legumin or vegetable casein. Polstorff obtained 0.25% of trigonelline.

The extraction and estimation of the total caffeine-content of coffee-beans is not a simple matter. The various proposed methods of procedure may be divided into four groups:

(1) Extraction of caffeine by means of boiling water and subsequent treatment of the infusion with lime, magnesium, litharge, or basic lead acetate to precipitate the tannin, etc.

(2) Treatment of the material with lime and magnesium or ammonia; and extraction with chloroform.

(3) Extraction of the caffeine in the material directly by means of aqueous sodium benzoate or salicylate with or without an alkali, and subsequent treatment of the alkaline liquid with chloroform.

(4) Gomberg's method whereby caffeine is extracted by means of water and the alkaloid is precipitated in acid solution as a periodide.

These methods are described in Allen's Comm. Org. Anal. ed. 4, 6 (1912) 607-614. The method I used with greatest success is a form of that described in group 1, and is known as 'Allen's Modification of Stahlschmidt's Method.' Outline as follows:

Take 12 grms. of coffee (finely powdered).

Boil with 500 c.c. of water for 6 hrs. under a reflux condenser.

Filter off extract (the residue being washed with hot water on the filter).

Dilute with water to 600 c.c.

Heat to boiling.

Add 4 grms. of powdered lead acetate; stir well to remove coloring matter.

Attach reflux condenser and boil for 10 minutes.

(If, on removing heat, the precipitate does not curdle and settle readily, leaving the liquid colorless, add more lead acetate and repeat the boiling.)

Pass through dry filter.

Collect 500 c.c. of filtrate and evaporate to 50 c.c.

Add a little sodium phosphate to precipitate the remaining lead.

Filter; wash precipitate; evaporate total filtrate to 40 c.c.

Extract caffeine by shaking with at least four portions of chloroform.

Collect the combined chloroform solutions in a tared flask; immerse in boiling water; distill.

Evaporate off the solvent (chloroform), while hot, by an air current.

Dry to constant weight; weigh residue as caffeine.

The weight represents the amount of caffeine present in 10 grms. of coffee.[2]

Crystalline Caffeine Properties

Caffeine forms long, white, silky, flexible needles, which readily adhere and mat together to form light fleecy masses. When deposited slowly, crystals present a characteristic appearance under a magnifying power of 100 to 300 diameters. Caffeine crystals heated to 100°C. become opaque and friable owing to the loss of water; and the residue is anhydrous caffeine which dissolves without turbidity in chloroform. Anhydrous crystals of caffeine can also be deposited from ether or alcohol.

Melting Point	(Strecker)	233° to 234°C.
	(Allen)	231.5°C.
	(German Pharmacopoeia)	230.5°C.
	(U. S. Pharmacopoeia)	236.8°C. after drying.
Sublimation Point	(German Pharm.)	180°C.
	(U. S. Pharm.)	178°C.

Crystalline caffeine: water content (British Pharm.) 8.49%; (Allen) 7.05% to 7.10%. Caffeine is odorless and gives a bitter taste. It forms an acid solution in ether and alkaline in chloroform. The presence of caffeine can be detected by evaporating a given liquid with nitric acid. The residue becomes crimson or purplish-red when ammonia is added.

The nature of caffetannic acid has been a matter of dispute. (For method of preparation, see Allen's Comm. Org. Anal. 6 (1912) 645.) Gorter has shown it to be a mixture of chlorogenic and caffalic

[2] Paul and Cownly noted that the caffeine obtained by the evaporation of chloroform is likely to contain small quantities of a brownish, waxy, or resinous impurity, and therefore should be purified by resolution in boiling water and recovered by evaporating the filtered solution and drying the residual alkaloid at 100°C. These investigators found that the proportion of caffeine in coffee varied but slightly, and is not materially affected by roasting excepting a loss in amount up to 21%. This fact recommends the estimation of the alkaloid in commercial coffee as a means of ascertaining the proportion of chicory or other adulterant present.

acids and other substances. He states that chlorogenic acid, $C_{32}H_{38}O_{19}$, can be purified through its calcium salt and crystallized as needles with melting point at 208°C. It acts as a dibasic acid; and, on hydrolysis with an alkali hydroxide, it yields caffeic or 3:4 dihydroxycinnamic and quinic acids. Chlorogenic acid gives a characteristic color reaction by means of which its presence has been detected in other seeds. Caffalic acid, $C_{34}H_{54}O_{15}$, is obtained in the form of prisms melting at 255°C. and possessing a sweet taste. Caffeine seems to exist in the seeds of *Coffea liberica* Bull in the form of potassium caffeine chlorogenate, $C_{32}H_{36}O_{19}K_2(C_8H_{10}O_2N_4)_2.2H_2O$. Gorter isolated it in colorless prisms. He states that the fact that caffeine can not be completely removed from coffee with anhydrous organic solvents is due to this association of caffeine with chlorogenic acid. Contrary to this, Lendrich and Nottbohn maintain that the retention of caffeine is due to adsorption by the tissue of the coffee-bean. According to Allen and lately repeated and confirmed by the author, it was noted that caffetannic acid, when it is dissolved in ammonia water and the solution exposed to the air, produces a bluish-green liquid owing to the formation of the oxidation-product, viridic or viridinic acid, which is an amorphous brown substance, very soluble in water and forms a solution which is turned green by alkalies. It also gives a bluish-green precipitate with barium hydroxide solution; and a blue precipitate with lead acetate. Nestler has used the production of this green coloration resulting from the addition of alkalies to detect the presence of coffee in mixtures and extracts.

The determination of the sugar content of coffee has been carefully studied by Ewell, who found 6% of sucrose in fat-free coffee, extracted by 70% alcohol. The insoluble matter after the completion of acid hydrolysis gives galactose. By distillation with hydrochloric acid, he obtained furfural equivalent to 90% of pentose. He has obtained a gummy substance which on hydrolysis gave rise to a reducing sugar, furfural; and mucic acid resulted on oxidation. Therefore, Ewell concluded that the gummy substance was a compound of pentose and galactose. Schultze and Maxwell found that raw coffee contained galactan, mannan, and pentosans, the latter present to the extent of 5% in raw and 3% in roasted coffee. Baker states that manno-arabinose or manno-xylose forms one of the im-

portant constituents of the coffee-cherry substance and that it yields mannose on hydrolysis.

The following table regarding the composition of the ash of coffee is compiled from information given in the U. S. Dept. Agric. Div. of Chem., Bull. 13 pt. 7 (1892) 904.

COFFEE ASH.

Constituents	*Mocha*	*Rio*	*Java*
Chlorine (Cl)	1.25	0.48	0.73
Ferric oxide (Fe_2O_3)	0.89	1.77	1.16
Lime (CaO)	7.18	4.94	4.84
Magnesia (MgO)	10.68	10.60	11.35
Phosphoric Acid (P_2O_5)	12.93	11.53	14.09
Potash (K_2O)	59.84	63.60	62.08
Sand	1.44	1.34	0.74
Silica (SiO_2)	0.88	0.69	0.91
Soda (Na_2O)	0.48	0.17	...
Sulphuric Acid (SO_3)	4.43	4.88	4.10
	100.00	100.00	100.00

Rochleder found the fat of coffee contained glycerides of palmitic acid and an acid of the composition $C_{12}H_{24}O_2$. Tretzel found that the glycerides of palmitic, stearic, and oleic acids, and free dihydroxystearic acid were present.

COFFEE FAT VALUES (according to Tatlock and Thompson).

Coffee	*Spec. Grav.*	*Iodine Value*	*Saponification Value*	*Unsaponifiable*
Raw	.....	99.0	179.5	5.26
Roasted	0.9354	99.0	179.5	5.51

Meyer and Eckert have separated a fatty oil and a wax from raw coffee. They give the following table:

Coffee	*Oil Saponification Value*	*Iodine Value*
Raw	160 to 182	90.1 to 91.2

Fatty acids present were mainly linoleic, palmitic, and carnaubic acids, together with traces of oleic, daturic, and caproic acids. The wax contained carnaubic acid in combination with a resin alcohol. The unsaponifiable matter of the coffee fat included Phytosteral.

Tatlock and Thompson state that tannin is not found in roasted coffee and that the lead precipitate contains the coloring matter. They report 4.5% of tannin as precipitable by gelatin in raw coffee.

In conclusion, the following table presents a general mean compilation of the chemical analysis of various investigators who used coffee-beans of *Coffea arabica* L. as their base:

Composition	*Per Cent in Raw Beans*	*Per Cent in Roasted Beans*
Ash	3 to 4	4 to 5
Albumin	10 to 11	11 to 13
Caffeine	1 +	1
Caffetannic Acid	8 to 10	4 to 5
Cellulose (crude fibre and non-nitrogenous matter)	38	48
Dextrin	1	1
Fat and Oil	11 to 13	13 to 14
Moisture	10 to 11	1
Nitrogenous Extract and Coloring Matter	4 to 7	12 to 14
Sugar	9 to 10	½

Effect of Roasting the Coffee-Bean

Roasting and pulverizing coffee-beans induces the changes to which the flavor and aroma are largely due. The toughness of the bean is destroyed, which facilitates the subsequent grinding. If not previously removed, the testa or so-called "silver skin" separates during the roasting-process, and is known as flights or fibre, and should be removed before grinding. The process should be carried on at a temperature of 200°-250° C. Torrefication causes the beans to swell and lose from 12 to 20% of their weight, of which 8% is removable water. If they are roasted to a yellowish-brown color, about 12.5% of their weight is lost, the product is difficult to grind, and the flavor is not well developed. If they are roasted to a chestnut-brown color, 18% is lost, and the beans are brittle and possess a pleasing aroma and flavor. If roasted until black, even although not entirely carbonized, the beans lose 23% of their weight, and the product has a nauseating and empyreumatic flavor. In general, 112 lbs. of raw berries yield 98 lbs. of roasted coffee or a loss of 12.5%. According to Hilger and Juckenack, if the coffee is glazed with sugar, the losses on roasting are much higher, owing to the

increased temperature required. The following are experimental results:

Losses for ordinary coffee	19.3%	total loss.
" of original fat	9.7%	
" " " caffeine	21.1%	
Losses for sugar-glazed coffee	15.3%	total loss.
" of original fat	18.3%	
" " " caffeine	44.3%	

Roasting is the most important operation in the preparation of coffee, and should be carried on in a closed vessel in which the beans are constantly in motion and under uniform temperature. For the best results, only beans of one size should be roasted at a time. The beans emit smoke, turn brown, and commence to sweat, which shows that the essential oil is being separated, and the beans become glossy.

By just the proper degree of roasting, the volatile oil is produced at the expense of some other constituents. Jaeckle found in 1898 that caffeine is volatilized slightly and certain other products are formed, such as acetone, furfural, ammonia, trimethylamine, formic and acetic acids. Moriari and Scoccianti, however, reported in 1895 that if the beans are heated to 260°C., no trimethylamine is formed, but he detected appreciable quantities of pyridine and its homologues. The fat is somewhat decomposed, which results in increased amounts of free fatty acids. The sugar-content of the beans becomes caramelized, and the caffetannic acids lose one-half of their weight. The volatile oily substance is termed "caffeone" or "caffeol," and has been held to be the chief factor responsible for the aroma of coffee. Bernheimer has suggested for caffeol the formula $C_8H_{10}O_2$ or $C_6H_4(OH).CH_2.OCH$. The chemistry of the formation of this substance is not well understood. It is the product of torrefication and the influence of heat on the other constituents which produces the materials for its composition. Its identity, however, has recently been disputed; and several authors have detected pyridine. Moreover, Erdmann has found that the aroma of coffee was produced when caffeine, sucrose, and caffetannic acids are heated together, and that the absence of any one results in the non-existence of the aroma. The dietetic property of coffee is due to caffeine, $C_8H_{10}N_4O_2$, and is not affected by torrefication beyond a slight loss

in amount. It may be well to state here that investigators who have detected caffeol suggest that coffee's dietetic value is due as much to the presence of caffeol as to caffeine.

Caffeine is identical with the alkaloid found in tea, where it is called theine. More coffee is necessary to produce a cup of coffee than the amount of tea to make a cup of tea; since, weight for weight, tea-leaves yield twice as much theine as coffee-beans do caffeine. Coffee-grounds contain 13% of nutritious gluten. Eastern natives drink these coffee grounds (as is also true of cacao) as well as the decoction, and thereby obtain the full nutrition derivable from the bean. Old ground coffee deteriorates so that it is best, when possible, to grind small quantities as needed by the consumer.

The table of the general composition of the coffee-bean indicates that nearly the entire saccharine-content of the bean disappears simultaneously with the roasting process. This is not true of chicory and other cane-sugar yielding plants. Hence, the coloration of water by a ground coffee clearly indicates adulteration as shown under the section on "Detection of Coffee Sophistications."

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CHAPTER IX

TABLE-COFFEES

§ a. EXPLANATION OF TERMS

(1') Café à la crème:—Café noir with the addition of plain or whipped cream.

(2) Café au lait:—Coffee with milk, or French Breakfast coffee, is a strong coffee served with boiling milk, usually about one-half coffee and one-half milk.

(3) Café noir, Black, or After-dinner Coffee:—These terms imply that the infusion has been prepared from a large proportion of coffee which was percolated until the liquid was black.

(4) Coffee Extract or Essence:—Coffee essence is deficient usually in its caffeine-content; and its color is dissimilar to the freshly prepared beverage. Strong alcohol, as a preservative, and caramel, as a color corrective, are commonly added. It is prepared commercially by distillation (i.e., the liquid is steamed and evaporated until reduced to the desired strength).

(5) Creole Coffee:—A slowly percolated coffee. Freshly roasted and ground coffee is pressed into the filter of the pot and boiling water poured over it at five minute intervals. A very strong and rich extract results. A tablespoonful per cup is sufficient. This extract may be preserved in an air tight vessel for future use.

(6) Demi-tasse de Café or Café demitasse:—Originally used to designate a half cup of coffee, but now signifies Café noir and is usually served in small cups.

(7) Dutch Coffee:—A cold-water process involving the use of very finely ground coffee-beans which are held in a special filter possessing top and bottom reservoirs. Four hours are required for the water to percolate through. This process results in a high percentage of strength and flavor.

(8) French Coffee:—Addition of ten to thirty per cent of chicory,

very heavy roasting of the bean, and the occasional addition of a little butter and sugar during the roasting, all combine to give the coffee a special flavor. It is prepared in a percolator from finely ground coffee through which the liquid is passed several times to increase its strength.

(9) Russian Coffee:—Merely a strong, black coffee.

(10) Sultana Coffee:—Infusion of dried and roasted pulps without the beans. This mode of preparation is practised in certain regions of Turkey and Persia. Sultana coffee also refers to a decoction of the raw beans. Sometimes, in lieu of boiling raw coffee in water, a procedure similar to the preparation of a tincture of tea is followed. The decoction of green coffee is made by boiling one-eighth of a pound of coffee, powdered or uncrushed, in one pound of water for one-quarter of an hour. This resulting liquor is removed from the fire and allowed to set for some time in a closed receptacle, is sweetened with sugar, and drunk warm.

(11) Turkish Coffee:—The beans are ground to a powder which is put in cold water and brought *to* the boiling point but not allowed to boil. It is served at once without straining or settling of the grounds. The Turks, as is the common practise in many eastern countries and especially among the poorer classes, eat the grounds and seem to relish them as well as the infusion. In this way they obtain the entire value of the bean.

(12) Vienna Coffee:—Prepared in a special urn which continually passes the steam through finely ground coffee and thereby retains the full aroma. Whipped cream is added.

§ b. FORMULAS FOR PREPARATION

Coffee, raw or roasted, should be kept from strong odors as it absorbs them readily. Roasted coffee should never be exposed to the air, as it rapidly loses its flavor and aroma. Coarse ground coffee requires a long infusion to extract the full strength. Too much boiling spoils the aroma and flavor. One should use as pure coffee as can be obtained and of the desired flavor. Coffee should be freshly roasted, freshly ground to moderate fineness, and freshly made in a scrupulously clean coffee-pot. Sufficient coffee should be used. Two ounces of coffee per pint of water makes an excellent beverage.

Cold water, dashed into a boiling coffee decoction, checks the boiling and causes the grounds to settle, leaving the liquid clear. The addition of a small piece of charcoal accomplishes the same result. The grounds should never be allowed to remain in the coffee for any considerable period.

(1) Decoction or Boiling:—Place ground coffee in cold water and allow to boil for a few seconds. This method results in a strong and excellent liquid. The "Old Fashioned Boiling Method" involves the addition of the white of an egg to the ground coffee and boiling water which has boiled hard for ten minutes. The boiling water is poured over it, allowed to come to a boil, and stirred thoroughly once, after which it is placed on the back of the stove for ten minutes. This method results in an excellent coffee but requires great care.

(2) Filtration or Distilling:—A percolator is used. Boiling water is passed slowly through ground coffee which is held at the center of the percolator. This method is widely resorted to, as the results are uniform.

(3) Infusion or Drawing:—Ground coffee is placed in boiling water and kept hot without boiling for ten minutes. This method produces a very pleasing beverage but it does not bring out much of the stimulating property of the bean.

To assure the best results, regardless of the method of preparation, the water must be *strictly* fresh. The use of previously boiled water will alter an otherwise pleasing beverage into a drink which possesses a most unpalatable flavor. If the water used has been boiled until it is "flat" or if the water used is impregnated with lime, sulphur, or iron, the fine flavor of coffee will be destroyed. Since coffee is readily contaminated with odors, coffee should be stored in a closed glass container. If cream is used, it should be covered while in the refrigerator as it readily absorbs the odors of butter, vegetables, etc., which will cause the coffee to taste queer.

The household preparation of raw coffee is not difficult. Since the pleasing aroma developed during torrefication is rapidly dissipated from the time of roasting, it is necessary to have it freshly roasted in order to enjoy the best results. In Europe, in the well regulated homes, the daily supply is roasted every morning. This is not commonly practised in England and the United States. It may be

roasted in small frying pans and powdered without a coffee-mill. Any dish will serve the purpose. One is able to ascertain the critical roasting point by the color which should generally be more reddish than brown; by the odor which is extremely aromatic; and by the brittleness which is such that it can be crushed between the finger and the thumb. This freshly roasted coffee should be ground to a fine powder, and the beverage prepared immediately. If one is unable to roast his own coffee, it is very desirable to purchase freshly roasted coffee-beans in small quantities several times a week. The coffee should be stored in a closed glass jar, as this method of keeping it will preserve the aroma for some time. Eighty-five to ninety-five per cent of the caffeine is extracted by boiling water. A cup holding 150 c.c. of the infusion, contains about 1.5 grains of caffeine.

Excellent coffee is easily made in an ordinarily porcelain or granite-lined coffee-pot without any kind of filtering attachment. In preparing the beverage with this simple equipment, the following procedure applies:

(1) Maintain the proportion of *one* cup even full of dry ground coffee (fine as granulated sugar) to *six* cups of water. If pulverized coffee is used in an ordinary coffee-pot, it should be enclosed in a close-meshed bag, or the drink will be muddy.

(2) Place coffee in pot and add *fresh, boiling* water in the above proportions.

(3) Boil coffee and water together for *five* minutes *only,* as coffee should not be cooked. It has been previously roasted.

(4) Add a large tablespoonful of cold water to settle the grounds. If desired, the white of an egg may be added which will result in a wine-like clearness.

(5) Serve immediately.

Although coffee is not entirely tasteless, it is of primary importance, since the gustatory and olfactory senses are intimately associated, that the fragrance of the coffee-beverage should be preserved if full enjoyment is to be assured to the drinker.

It is noteworthy that the history of human experience and scientific experimentation shows beyond any reasonable doubt that the coffee-beverage, *properly prepared and rightly used,* gives comfort to man by safely stimulating his mental and physical activities. As Professor

Samuel C. Prescott reported in December, 1923, "Coffee, if properly prepared, has a remarkable stimulating and fatigue-relieving effect due to the action of caffein which acts on the central nervous system. It promotes heart action mildly, increases the power to do muscular work, and increases the power of concentration of mental effort, and therefore is an aid to sustained brain work. It has no depressive after-effect. It is not habit-forming, and does not require continually increasing quantities to give satisfactory stimulation."

Coffee is not injurious to the great mass of people. Coffee is taken as a stimulant, and of course can be abused. Large quantities of any stimulant are deleterious. It is necessary to find out how much coffee agrees with the individual, and to refrain from over-indulgence. Coffee is indeed a drug in the sense of being a stimulant, but it is the only stimulant which does not have a depressive after-effect. There are a few people who can not drink coffee with safety to their health. Such individuals suffer from an eccentricity in this regard just as certain persons should not eat spinach or certain fruits. The fact that such cases exist, does not detract from the value of the beverage to the masses of humanity. As a nation, our consumption of coffee has increased from 200,000,000 pounds per annum during the Civil War period to nearly 1,350,000,000 pounds at the present day. Or, stated in terms of per capita quantities, the United States consumption of 5 pounds per person in 1866, has increased to over 12 pounds a year or about 500 cups per individual. In other words, the United States consumes two billion cups yearly or nearly five and one-half million cups daily.

CHAPTER X

CAFFEINE-YIELDING PLANTS OF THE WORLD

Economic Plants Possessing the Alkaloid Caffeine: $C_8H_{10}N_4O_2$

SPECIES	FAMILY	PART	APPROXIMATE %
Coffea species	Rubiaceae	Seed	0.5 to 2.2%
		Leaf	1.3%

Geographical Distribution:—Africa. Now introduced throughout the tropics and subtropics of the world.

The caffeine-content varies greatly within the genus. For information regarding the various species of coffee, see the section devoted to the species in question. For extremes as regards the caffeine-content, see:

Coffea arabica L. var. *Humblotiana* (Baill.) Froehner.

Coffea arabica L. var. *amarella* Hort. ex Froehner.

Coussarea hydrangeaefolia Benth. & Hook. Rubiaceae Leaf used ——? %

Geographical Distribution:—Bolivia (Santa Cruz and Bellavista regions).

Thea sinensis L. Theaceae Leaf 1 to 4.8% (average 2 to 2.5%)

This species is the chief source of tea.

Geographical Distribution:—China.

Thea assamica Mart. Theaceae Leaf 1 to 4.8% (average 2 to 2.5%)

Geographical Distribution:—Upper Assam; Province of Cachar. For cultivated areas by introduction, see map.

Cola acuminata (Beauv.) Schott & Endl. Sterculiaceae Seed 2.3 to 3.6%

Synonymy:—*Cola vera* K. Schum. *Sterculia acuminata* Beauv.

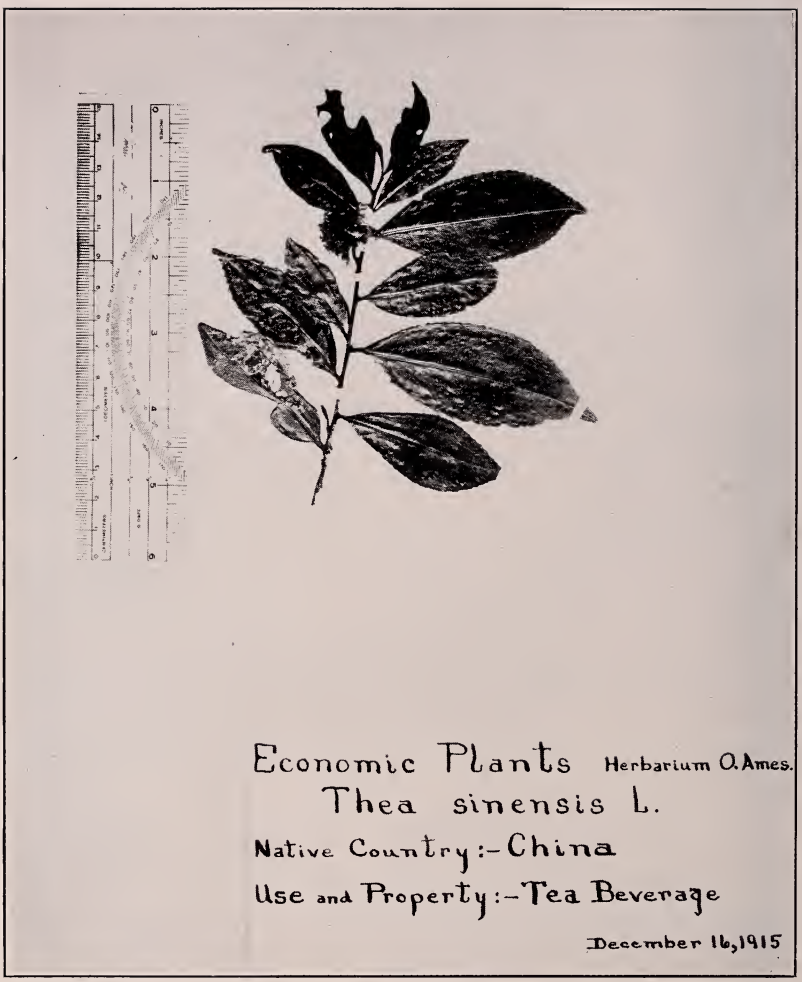

PLATE 58: *THEA SINENSIS* L.

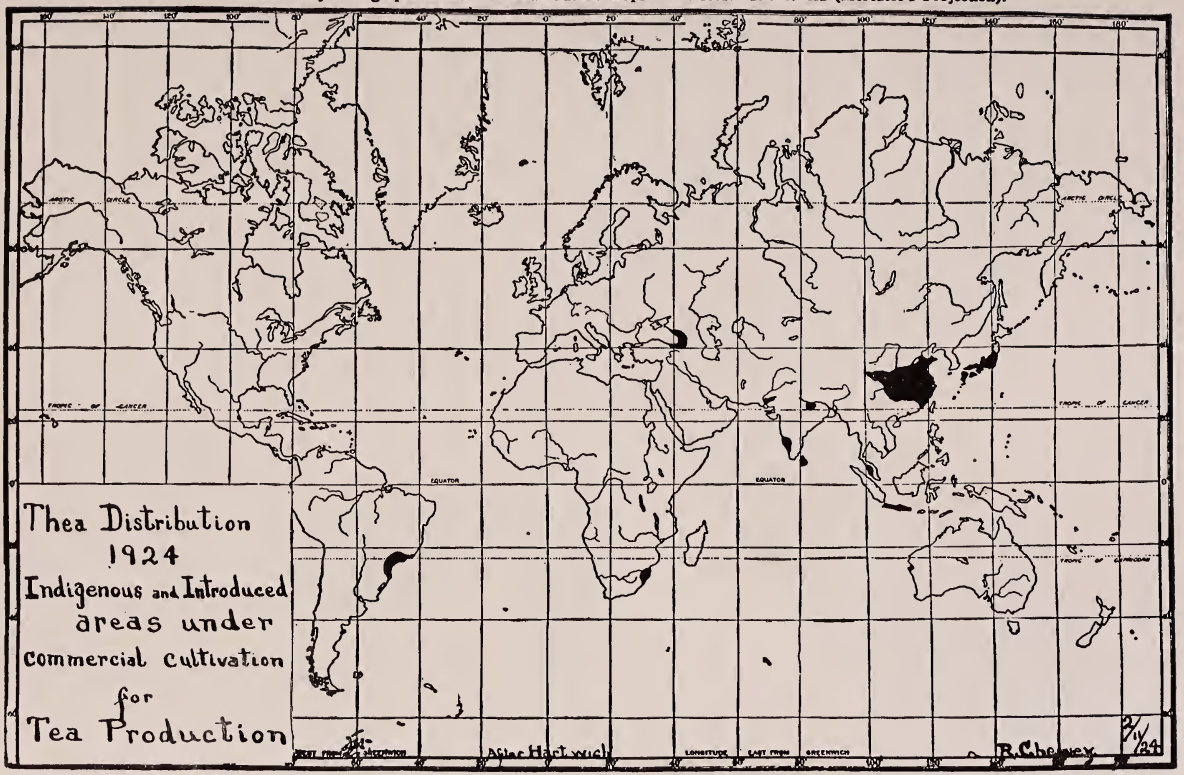

PLATE 59: *THEA SINENSIS* L.: DISTRIBUTION

PLATE 60: *COLA ACUMINATA* (BEAUV.) SCHOTT & ENDL.

This species is the principal source of the Cola Nut or Gourou, and contains, on the average, about 2.3% caffeine.

Geographical Distribution:—Indigenous in West Africa from Rio Nuñez south through the Congo. Cultivated in the West Indies and most tropical countries.

Cola astrophora Warb. Sterculiaceae Seed

Geographical Distribution:—Togo region, No. West Africa.

Cola anomala K. Schum.

Geographical Distribution:—Tropical West Africa.

Cola Ballayi Cornu

Geographical Distribution:—Tropical West Africa.

Cola digitata Masters

Geographical Distribution:—Kamerun; Gabon.

Only 0.26% caffeine.

Cola gabonensis Masters

Geographical Distribution:—Gabon.

Cola Johnsonii Stapf

Geographical Distribution:—Tropical West Africa.

Cola lepidota K. Schum.

Geographical Distribution:—Kamerun.

Cola pachycarpa K. Schum.

Geographical Distribution:—Kamerun; Congo.

Cola spaerosperma Heckel

Geographical Distribution:—Gabon.

Cola sublobata Warb.

Geographical Distribution:—Aschanti region.

Cola verticillata Stapf

Geographical Distribution:—Tropical West Africa.

The fruits of some species are edible. The fruits of certain species, for example *Cola Supfiana* Busse of the Togo region and *Cola cordifolia* (Cav.)R.Br. of Senegambia and Togo regions, contain no caffeine. There are doubtless species additional to those listed above which are used as adulterants and as substitutes for *Cola acuminata* (Beauv.) Schott & Endl., and which are devoid of caffeine; but I am unable to obtain reliable information concerning them.

Theobroma Cacao L. Sterculiaceae Seed 0.05 to 0.36%.

This species is the principal commercial source of cocoa, chocolate, etc.

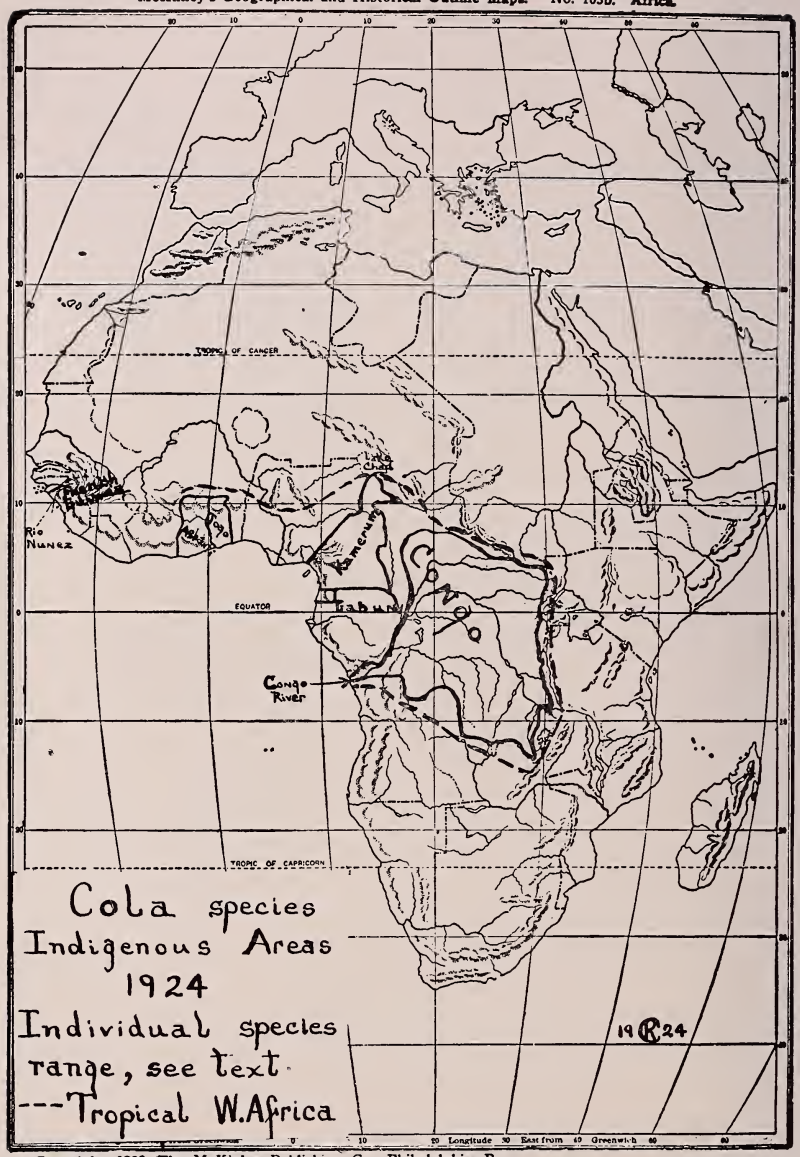

PLATE 61: COLA SPECIES: DISTRIBUTION

PLATE 62: *THEOBROMA CACAO* L.

McKinley's Geographical and Historical Outline Maps. No. 100b. The World (Mercator's Projection).

Geographical Distribution:—Indigenous in Mexico, West Indies, Central America, and South America from the Orinoco river to the Amazon basin in Brazil, especially in the Para and Bahia districts as regards Brazil. Also indigenous in Colombia, Ecuador, and Peru. For present distribution by introduction, see Map.

Theobroma bicolor Humb. & Bonpl.

Geographical Distribution:—Colombia (formerly New Granada).

Theobroma glauca Karsten

Geographical Distribution:—Colombia.

Theobroma leiocarpa Bernoulli

Geographical Distribution:—Central America.

Theobroma Martiana D. Dietr.

Geographical Distribution:—Brazil.

Theobroma pentagona Bernoulli

Geographical Distribution:—Central America.

Theobroma Saltzmanniana Bernoulli

Geographical Distribution:—Brazil.

Theobroma speciosa Willdenow

Geographical Distribution:—Brazil (Microcacao).

Theobroma subincana Martius

Geographical Distribution:—Brazil.

Paullinia Cupana H. B. & Kunth Sapindaceae Seed 3.1 to 5.0%.

Synonymy:—*Paullinia sorbilis* Martius

This plant is the source of a drink known as "Guarana" or "Brazilian Chocolate."

Geographical Distribution:—Amazon region, with the Eastern limit at Santarem at the mouth of the Tapajos river and the Western range to the Madeira river. Northward, in Venezuela between the Orinoco and the Rio Negro in Brazil. The principal region is between the Tapajos and Madeira rivers. It follows the Madeira river southward to Cochabamba and Santa Cruz de la Sierra in Bolivia.

Copernicia cerifera Mart. Palmae Seed ?%.

The seeds are described as being rich in caffeine and highly nutritious; but I have been unable to ascertain what percentage of caffeine they contain. The seeds are used as a substitute for coffee. This plant is known as the Carnauba or Wax Palm. It is valuable also as the source of a wax which is used in candle and phonograph record

PLATE 64: *PAULLINIA CUPANA* H. B. K.

From Bentley & Trimen Med. Pl. 1 (1880) No. 67.

A Leaf and a Flower Panicle.

1. Vertical Section of Flower. 2. Petal. 3. Vertical Section, Petal showing appendage. 4. Fruit. 5. Fruit with one Valve removed to show Seed.

PLATE 65: *PAULLINIA CUPANA* H. B. K

DISTRIBUTION

PLATE 66: *COPERNICIA CERIFERA* MART.

PLATE 67: *COPERNICIA CERIFERA* MART.

DISTRIBUTION

manufacture, shoe-maker's wax, etc. The fibres of the wax-freed leaves are made into sombreros, roofs, baskets, brooms, and mattings. Parts are used in medicine; and the trunk yields an alcoholic drink possessing a pleasant flavor. The fruit is edible, the upper part of young stems is eaten as food; and the slender branches serve as cattle forage. The root yields a starch which is prepared as a flour.

Geographical Distribution:—American tropics. Chiefly in the Pernambuco, Ceará, Rio Grande do Norte, and Bahia provinces of Brazil.

Ilex species (South American Group)

Aquifoliaceae Leaf 0.27 to 2.0%

The following South American species of the genus *Ilex* are the source plants of Paraguay Tea or Maté. The average caffeine-content of the leaves is 1.2%.

Ilex affinis Gardn.

Geographical Distribution:—Bahia, Minas Geraës, Goyaz, Matto Grosso, and São Paulo provinces of Brazil.

Common Name:—Congonha, Congonha do campo.

Ilex amara (Vell.) Loesener

Geographical Distribution:—Bahia, Espiritu Santo, Rio de Janeiro, Minas Geraës, São Paulo, Santa Catharina, and Rio Grande do Sul provinces of Brazil. Corrientes province of Argentina.

Common Name:—Cauna, Caurina, Congonha, Congonhinha, and Caachiri in Brazil.

Ilex chamaedryfolia Reiss.

Geographical Distribution:—Minas Geraës and Goyaz provinces of Brazil.

Common Name:—Congonhinha, Congonha do campo, and Congonha minda.

Ilex conocorpa Reiss.

Geographical Distribution:—Rio de Janeiro and Minas Geraës provinces of Brazil.

Common Name:—Congonha, Catuaba do mato.

Ilex Cuyabensis Reiss.

Geographical Distribution:—Matto Grosso province of Brazil.

Common Name:—Congonha.

Ilex diuretica Mart. ex Reiss.

Geographical Distribution:—Minas Geraës province of Brazil.

Common Name:—Congonha.

Ilex dumosa Reiss.

Geographical Distribution:—Minas Geraës province of Brazil. Uruguay. Paraguay.

Common Name:—Congonha minda in Brazil and Caa-Chiri in Paraguay.

Ilex glazioviana Loesener

Geographical Distribution:—Rio de Janeiro province of Brazil.

Common Name:—Congonhinha.

Ilex paltorioides Reiss.

Geographical Distribution:—Minas Geraës province of Brazil.

Common Name:—Congonhinha.

Ilex paraguariensis St.Hil.

This species is the source plant of most of the Maté or Paraguay Tea, which is a rival of coffee in Uruguay and some other regions of the interior of South America. The use of Maté and Herva (a Maté product) has spread into certain regions of the United States. Beverages under the terms Maté and Herva, which are described as exhilarating beverages, are sold (1922) by 'The Maté Industries, Inc.,' at 571-573 Centre Street, Jamaica Plain, Boston, Massachusetts.

Geographical Distribution:—Minas Geraës, São Paulo, Parana, Santa Catharina, and Rio Grande do Sul provinces of Brazil. Corrientes province of Argentina. It also occurs throughout Paraguay.

Common Name:—Maté, Matte, Herva Maté, Congonha, Herva de Congonha, and Congonhas in Brazil. Yerba Maté, Congonhi, Congoinfe in Argentina. Caaguagua in Paraguay.

This plant is called Brazilian Holly by the English-speaking population of South America; and the beverage is referred to as Brazilian Tea, Maté, Paraguay Tea, Jesuit's Tea, and St. Bartholomew's Tea.

In the Argentine alone more than 140,000,000 lbs. per annum, or about twenty pounds per capita, is used. All of this amount except about 3,000,000 lbs. is imported from Brazil and Paraguay.

Ilex Pseudothea Reiss.

Geographical Distribution:—Minas Geraës province of Brazil.

Ilex symplociformis Reiss.

PLATE 68: *ILEX PARAGUARIENSIS* ST. HIL.

Geographical Distribution:—Bahia province of Brazil.

Ilex theaezans Mart.

Geographical Distribution:—Bahia, Minas Geraës, Rio de Janeiro, São Paulo, Parana, and Rio do Sul provinces of Brazil. Corrientes province of Argentina.

Common Name:—Cauna, Cauna amarga, Cauna de folhas, and Pão d'aceite in Brazil. Yerba in Argentina.

Ilex Vitis-Idaea Loesener

Geographical Distribution:—Minas Geraës province of Brazil.

Ilex species (United States Group).

Two species of *Ilex* containing caffeine in the leaves to the average amount of 1% and tannin up to 7.4% occur in the southeastern region of the United States where they are known as the North American Tea Plants, Yaupon, Cassina, and as the Christmas Berry Tree. The Indians from Virginia to the Rio Grande and southward throughout Florida utilized the leaves of *Ilex Cassine* L. and *Ilex vomitoria* Ait., chiefly the latter, to prepare a drink similar in quality to Maté. These two species are indigenous along the Atlantic coast from the James River, Virginia, southward through Florida and extending westward through the Gulf States to the Rio Grande River. They are found inland for a distance of only twenty to thirty miles. They occur abundantly in dense thickets on the Sea Islands off the coast of South Carolina.

In Carolina and Virginia, these species were commonly used as substitutes for tea and coffee. They were called "Yaupon" or "Yopon" from "Yap" or "Yop," the Indian word of this region for the wood, stem, or tree (or bush) of these species. The beverage is also known as "Dahoon," and the plants, especially *Ilex Cassine* L., as Dahoon Holly.

In Florida, the Timucua Indians called the plant "Cassine" and "Cassena" from the Muscogee Indian term "ássie" meaning leaves. This drink called "Cassine" or "Cassena" was known to the Whites as the Black Drink or Black Draught. It was prepared by the early white population in one of three ways: (1) an infusion of the fresh leaves; (2) an infusion of the dried leaves; (3) an infusion of the leaves which was allowed to ferment and become intoxicating. Mastication of the herb referred to as "Cassiana" was long ago reported from Florida as effective in combating hunger and thirst for a period

PLATE 69: SOUTH AMERICAN *ILEX* SP., DISTRIBUTION

PLATE 70: *ILEX VOMITORIA* AIT.

of twenty-four hours. The use of *Ilex* species as the source-plant of a beverage made from its leaves has been known since 1650. In 1682, Thomas Ashe, an Englishman, writing his *Account of Carolina* said: "There grows in Carolina the famous Cassiny, whose admirable and incomparable Vertues are highly applauded and extolled by the French and Spanish Writers: It is the Leaves of a certain Tree, which boyl'd in Water (as we do *Thea*) wonderfully enliven and envigorate the Heart, with genuine easye Sweats and Transpirations, preserving the Mind free and serene, keeping the Body brisk, active and lively, not for an hour or two, but for as many days as those Authors report, without any other Nourishment or Subsistence, which, if true, is really admirable: they also add, that none amongst the Indians but their great Men and Captains, who have been famous for their great Exploits of War and Noble Actions, are admitted to the use of this noble Bevaridge."

During the Civil War, when tea and coffee could not be obtained, the people of the southern states used the cassina leaves to prepare a stimulating beverage. Cassina or Black Drink is still prepared (1924) by the natives and negroes along the coast wherever the source-plant is abundant. Cassina is a bush which grows usually to the height of a man's head. In the southern states, it is pruned carefully to obtain a hedge of nearly twenty-five feet in height. The tough branches and compact growth of the plant recommend it as an excellent windbrake. The cassina plant has been used for this purpose since 1893. This plant grows naturally and luxuriantly on poor, sandy soils over an area of about 40,000 square miles.

Several years ago, Congress voted an appropriation of $5,000 to investigate the possibilities of the cassina plant as the source of a national beverage. Dr. George Mitchell carried on research which produced very encouraging results. He found that the beverage is an efficient reliever of fatigue, and is followed by no ill after-effects. The fact that cassina contains only 1% caffeine, which is less than coffee and much less than the caffeine-content of tea, indicates that constant use of the beverage would not be as injurious as a similar use of coffee or tea. The low percentage of caffeine especially recommends it to individuals who find that the consumption of coffee or tea produces deleterious effects.

During the summer of 1922, there was established at Mt. Pleasant, South Carolina, in coöperation with Mr. Alfred Jouannet, an experimental commercial factory. Mr. Jouannet's plantation was selected because of the fact that he had growing on his place, large cassina hedges which afforded ample material easily accessible for the purpose. About 5,000 lbs. of cassina, of three different kinds, were produced by different methods of manufacture, namely Green Cassina, Black Cassina, and Cassina Maté. In December, 1922, Mr. W. G. Campbell, Acting Chief of the Department of Chemistry, reported to the Secretary of Agriculture at Washington, D. C., that an excellent beverage could be made from cassina leaves. Laboratory investigations have shown that a very delightful beverage, resembling tea in many respects, can be made from cassina when the leaves are treated by processes similar to those used in curing tea. Preliminary reports indicate that the laboratory results can be duplicated on a commercial scale, as cassina can be placed on the market at about one-fourth the cost of China tea.

The process of manufacture is simple. The twigs are cut from the bushes and hauled to a barn where negro women and girls pick off the bulk of the leaves. These leaves are passed through a chopping machine and placed in trays for a day to dry. Final desiccation is accomplished by oven-treatment. This method of preparation results in Black Cassina. The twigs with the remaining leaves are placed in a sterilizer and subjected to steam for fifteen minutes. This treatment causes the leaves to drop off. The leaves are then ground, and the resulting product is Green Cassina. The remaining twigs are then utilized as fuel. The best cassina beverage, like the best tea, is a mixture of the leaves produced by the green and black processes.

The taste for cassina is easily acquired. Many inveterate tea- and coffee-drinkers, who have submitted themselves to the experiment, have found no inconvenience by substituting cassina in lieu of their customary beverage. Cassina is prepared by *boiling* the leaves. Merely passing hot water over the leaves does not produce a desirable drink. It may be drunk with or without cream, and sweetened according to the individual taste. Like coffee, it is more of a tonic when taken clear. The United States Government investigators have produced two delicious soft drinks from the cassina plant. One of these beverages is sweet; the other has a somewhat bitter undertone

like beer. These new cold drinks may be retailed for five cents per bottle; and present indications suggest their future popularity. About thirty gallons of hot cassina were served each day for fourteen days during the Charleston (South Carolina) County Fair in 1922. Judging from the demand, it is concluded that the beverage has very promising commercial possibilities. There were also served from 750 to 1500 glasses of the carbonated beverages made from cassina, which also indicates distinct commercial possibilities. It is reported by Mr. J. W. Sale of the U.S. Government Bureau of Chemistry, that cassina flavor blends well with other flavors, such as ginger, lemon, orange, spearmint, wild cherry, pineapple, caramel color, etc. A formula for cassina ice-cream has been developed. This ice-cream has a vanilla-like flavor. It was sold in Washington during a recent (1923) convention of about sixty thousand people by whom it was very favorably received.

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APPENDICES

ETHNOLOGICAL DISCUSSION OF COFFEE

APPENDIX A

A PHILOLOGICAL AND BOTANICAL TREATISE OF COFFEE

(Kaḍu ቡና Kaṛwa ቡና Coffee)

For coffee, the world is indebted to Africa. The various terms applied to this Abyssinian plant, its fruit, its seed, and the beverage prepared from these, are exceedingly interesting from the viewpoint of the derivation and the philological history of our word "Coffee." From the words بُنّ or *Bun,* the Arabic and Abyssinian name for the plant or its seed, and قهوة or *Qahwah,* sometimes written *Kahwah, K'hawah,* or *Kahwa,* which is the Arabic term for wine, most of the terms signifying coffee are derived. Thus we have *cahua, kawa, chaube, kapi, cavé, kava, café, caféier,* and *coffee;* and also *boun, bun, ban, ben, bunu, buncha* and innumerable derivatives from these terms, which I shall list on subsequent pages.

The literature of the past ages since the eleventh century, when coffee was first referred to, contains attempts to explain the use of *Kahwah* by the Arabians and Egyptians to signify this common beverage. *Kahwah* is assumed by some authors to have been a corruption of Kaffa, the name of an Abyssinian district where the coffee-plant is indigenous. If this supposition were true, then cavé, café, and coffee would be remarkably akin to the original name. Throughout the early literature, one finds *Kahwah* customarily applied to the beverage and *Bun* to the plant. In Yemen, Arabia, *Bun* designates the berry. Early Arabic writers used the term *Bun* by itself or in combination. Ancient authors considered it as an Abyssinian medicinal plant; and I infer that the appearance of the Arabic name *Kahwah* indicates the progress in the development of coffee as a beverage. No author has ever correctly explained the use of *Kahwah* for the coffee-beverage. Previous writers have suggested various reasons

and explained the association of this word meaning wine as indicative of one of two things: first, the abhorrence of religious persons of anything that savored of alcohol or that tended to exhilarate one's spirit; or secondly, it was considered by some authors as the direct expression of the circumstance that, when the Arabs first became familiar with the coffee-beverage, it was probably distinctly alcoholic and fully deserved the terminology *Kahwah*. Nevertheless, this was purely an assumption, as coffee is not described in any of the ancient literary works as being an alcoholic beverage.

By careful research in regard to the philology of *Kahwah,* I found that the term had been used by the Arabs and by the people of India in referring to an atrocious drink in the form of an exceedingly bitter and pungent wine which was commonly prepared from some species of pepper-plant. A large number of different plants were utilized in various localities. But throughout its history, the underlying meaning of *Kahwah* has been bitter or pungent.

A philological study of the term reveals its earliest form in the Dravidian languages of Southern India as Kaḍu (or Kadhu) meaning fierce, cutting, sharp, or pungent. Later, in Sanskrit one finds the form कटु, or Kaṭu meaning pungent, acrid, or sharp in respect to flavor; pungent, stimulating, ill-scented, or strongly-scented in respect to smell; bitter or caustic in respect to words; and also displeasing, disagreeable, fierce, impetuous, or hot in various connections. The term Kaṭu alone, in modification or in combination, refers to a large number of plants all possessing pungent or acrid properties. The subsequent list will give an idea of this term in its Sanskrit forms and botanical references:

Kaṭu refers to *Michelia Champaca* L.; *Trichosanthes dioica* Roxb.; and in a few instances, it refers to an improper action.

Kaṭu-rohinī refers to *Brassica ramosa* Roxb. ex Flem.; *Helleborus niger* L. (medicinal).

Kaṭu-kanda refers to *Zingiber* (fresh ginger root); *Allium* (garlic); *Hyperanthera Moringa* Vahl.

Kaṭu-Kurañja refers to *Caesalpinia Bonducella* L.

Kaṭu-kīta or Kaṭukītaka refers to a gnat or mosquito.

Kaṭu-kvāṇa refers to a species of chicken (*Parra Jacana* or *P. Goensis*) which makes a sharp or piercing noise.

Kaṭu-granthi refers to *Zingiber* (dried root); *Piper longum* L. (root).

Kaṭu-bhanga refers to *Zingiber* (dried root).

Kaṭu-bhadra refers to *Zingiber* (dried ginger or ginger in general).

Kaṭu-vījā refers to *Piper longum* L.

Kaṭu-cāturjātaka refers to an aggregate of four acid substances as of cardamoms; bark and leaves of *Cinnamomum zeylanicum* Nees; and of *Piper nigrum* L.

Kaṭu-cchada refers to a tree with pungent leaves.

Kaṭu-ja refers to a preparation of acid substances as a kind of drink.

Kaṭu-tiktíka refers to *Swertia Chirata* Buch-Ham. ex Wall.; *Cannabis sativa* L.

Kaṭu-tumbi refers to a kind of bitter gourd.

Kaṭu-traya refers to the aggregate of three black substances or spices: Ginger, black pepper, and long pepper.

Kaṭu-pattra refers to *Oldenlandia biflora* L. (medicinal).

Kaṭu-pākin refers to a substance producing acrid humors in digestion.

Kaṭu-vipāka refers to a substance producing acrid humors in digestion.

Kaṭu-phala refers to *Trichosanthes dioica* Roxb., a sort of cucumber.

Kaṭu-manjaríka refers to *Achyranthes aspera* L.

Kaṭu-moda refers to a certain pungent perfume.

Kaṭu-rava refers to a frog which makes an unpleasant sound.

Kaṭu-vārtākī refers to a variety of *Solanum*.

Kaṭu-sneha refers to *Brassica campestris* L. (the mustard seed plant).

Kaṭutkata refers to *Zingiber* (ginger as used).

Kaṭut-kataka refers to *Zingiber* (dry ginger).

Kaṭphala refers to a small tree in No. West. Hindustani; the bark and seeds are used in medicine and as aromatics; fruit edible and called *Kayaphal*.

Kaṭv-anga refers to the tree *Calosanthes indicum* Blume.

Kaṭuka refers to a combination meaning sharp, bitter, pungent, fierce, impetuous, and hot and refers to *Trichosanthes dioica* Roxb. (a fragrant plant); *Calotropis gigantea* Dryand. (the Giant-Swallow-wort whose bark and seeds are acrid and bitter and are used to dispel worms, for dysentery, etc.) also to indicate *Wrightia zeylandica* R. Br.; *Brassica campestris* L. and *Brassica ramosa* Roxb. ex Flem.

Kaṭvi refers to *Areca catechu* L.; *Hygrophila angustifolia* R. Br.

Dadhi-kaṭukan refers to a bad compound meaning sour, coagulated milk; a compound of pungent substances; in some cases, of black pepper, long pepper, and dry ginger.

Kaṭuka-phala refers to a perfume prepared from the berries of the plant *Kakkola.* The inner portion of the berry is waxy and aromatic. The scientific name of this plant is unknown.

Subsequently, in the Hindu languages, one finds the form *Kaṛwa* (or *Karhwa*) meaning bitter, acrid, sharp, or pungent. The term became the source of the various forms of *Kahwah* such as the Persian *cahewa;* the early Arabic *qahwah;* and the Turkish *kahveh* and *caheu;* all of which existed to the West of India. To the East, the innumerable variations of it occurred throughout Polynesia where one finds *Kawa* as the root form meaning bitter, sour, or unpalatable. Its many variations in form, meaning, and reference to specific plants, may be judged by a study of the following table:

FORMS OF KAWA OR KAWAKAWA OCCURRING IN POLYNESIA

LANGUAGE	FORM REFERENCE
Samoan	*'ava Piper methysticum* Forst.; an intoxicating drink made from 'ava; food; the beard.
	'a'ava pungent, sour, hot, scorching.
	'ava'ava to be oppressively hot.
	'avasia to be burnt by the sun; to be poisoned.
	'ava'avasitu Piper insectifugum C. DC. ex Sm.; *P. latifolium* Forst.
	'avapui Zingiber zerumbet Rosc. ex Sm. also *Zingiber officinale* Rosc.
	'avasa Tephrosia piscatoria Pers. (Used to poison fish.)
Tahitian	*ava* Plant and drink called *kava;* also for all kinds of intoxicating liquors.
	avaava sour, acrid, bitter.
	to-avaava sour, acrid.
Hawaiian	*awa* bitterness; name of a certain plant and the intoxicating beverage prepared therefrom.
	awaawa sour, bitter, sharp, pungent, harsh.
	ho-awaawa bitterness; sourness.
	auahia bitterness; sourness.

Tongan	*kava* name of a root; a beverage of intoxicating quality; any spirituous liquor; the beard.
	kakava perspiration.
Marquesan	*kava* or *kaava* a root which is chewed as an intoxicant; also used in modern times to refer to tobacco.
	kavahia bitter, sour, sharp.
Rarotongan	*kava* sour, sharp, pungent.
Mangarevan	*kava* acrid, bitter, a variety of taro, the edible root of *Colocasia antiquorum* Schott; also to any shrub yielding the liquor *kava*.
	kava-kava slightly acid taste.
	aka-kava bitter, harsh to taste.
Paumotan	*kava* disagreeable to take.
	kavakava acid, sharp, bitterness, grief.
Mangaian	*kava* or *cava* an intoxicating beverage prepared from the root of the *kava* plant. *Piper methysticum* Forst.

Throughout Polynesia, the term *Kawa* or *Kawakawa* frequently refers to the shrub *Piper excelsum* Forst. or to *Piper methysticum* Forst. These plants are sacred shrubs which are used in religious ceremonies. A branch is often used to strike a boat to remove evil spirits; to open a new building with priestly ceremonies; or to perform a sort of baptism. One of these shrubs is often planted by the native priest after naming a child.

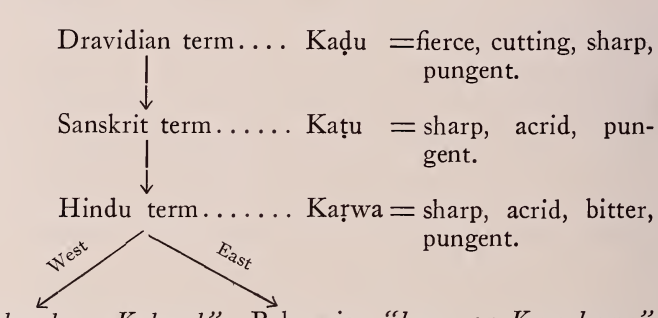
In the eastern dialect Motu, *kava* has the meaning 'to be crazed,' and *kava-kava* signifies folly or a foolish condition. In the dialect Aneityum, *kava* refers to *Piper methysticum* Forst., from which an intoxicating drink is made.

A survey of the foregoing pages clearly shows that authors since the eleventh century have misinterpreted the philology of *Kahwah* and its use to signify our coffee-beverage. The term arose from the Dravidian languages and, as seen below, it has maintained its underlying meaning throughout its evolution.

The term originally implied anything possessing bitter or pungent qualities, and came to refer to a very pungent wine which was prepared from various plants, usually a species of *Piper* (pepper). Finally it was used to signify a drink prepared from acid substances, then to a pungent intoxicating drink, and, in some localities, to *all*

intoxicating liquors. In *all* cases, the preparation was bitter or pungent in quality. It was without doubt in reference to these pungent wines that the Arabians became familiar with the term; and, upon acquiring a taste for coffee which was, and still is, prepared by them as a thick, black, and bitter beverage, they merely transferred to their new preparation the name of their formerly common and bitter drink.

It is significant that the original form Kaḍu, or any subsequent derivative, is fundamentally the term applied to a quality, not a specific plant or beverage. Hence, it is natural that it should keep pace with the migration of peoples and the tongues associated with or influenced by the Dravidian languages. One finds that the word *Kahwah* of Arabia and the term *Kava* of Polynesia are closely related, having been derived from the same root; and that both refer to a bitter or pungent beverage. To sum up:



The European languages derived the name "Coffee" from the Turkish form *Kahveh* or *Quahwe* about 1600. Originating from that term, one finds the Italian *caffe;* the Spanish, Portuguese, and French *café;* the early German *Koffee* and *Coffee* and the later German *Kaffee;* the Danish and Swedish *Kaffe;* the Dutch *Koffie;* and the Russian *Kophe, Kopheĭ,* or *Kofe,* and the Polish *Kawas.*

English literature of the sixteenth century, including the Early Modern or Tudor English, reveals the forms *caoua* and *chaoua.* The Middle Modern English variations of the next century were *coffa, caffa, capha, caphe, cauphe, cohpie, coffi, coffe, coffey, coffy,* and rarely *coffee.* The Current English of the eighteenth century

The following Catalogue, *containing ſuch* Druggs, *whoſe* Plants, *from whence they are taken*; *being* not at all, *or but* imperfectly *known*: *It is therefore moſt earneſtly deſired, that all* Practitioners in Phyſick, *or other* Curious Perſons, *who Travel into thoſe Parts, from whence theſe* Druggs *are brought, would be pleaſed* (*ſo far to oblidge the Ingenious of this Inquiſitive Age*) *as to procure what Account they can learn of them, with* Samples *of their* Leaves, Flowers *and* Fruit.

From the *Eaſt-Indies*.

☞Ammoniacum.
☞*Aſa* Fœtida.
Balm of Gilead, *or* Opobalſamum.
☞Bdellium.
☞Benjamin.

☞Calambac, *or* Columbine-Wood.
Camphire.
Cardamoms.
Carpobalſamum.
China-Root.
Cinnamon-Tree.
Clove-Tree.
☞Clove-Bark-Tree.
☞Coffe.
Coſtus Dulcis.
Coſtus Amarus.
☞Cubebs.

☞Franckincenſe, *or* Thus.

Galangall.
Galbanum.
Gamboge.
Genſing-Root.
Gum Arabick.
Gum Lacca, *or* Lack.
☞Gum Sarcocoll.
☞Gum Sagapenum.

From the *Eaſt-Indies*.

☞Hermodactills.
☞Lignum Aloes, *or* Agallochum.
☞Lignum Aſpaltum.
☞Lignum Colubrinum.
☞Lignum Nephriticum.

Mirobalan. Bellericæ.
Mirobalan. Chebulæ.
☞Mirobalan. Citrinæ.
Mirobalan. Emblicæ.
Mirobalan. Indæ.
☞Myrrh.

Nutmeg-Tree.
Nux Vomica.

☞Olibanum.
☞Opopanax.

Black-Pepper.
Long-Pepper.
☞Rhubarb.
Sanguis Draconis.
☞Saunders, White and Yellow.
Schœnanth, *or* Sweet-Ruſh.
☞Spica Nardi Indicæ, *or* Spikenard.
Worm-Seed.
Zedoary.

From the *Weſt-Indies*.

Balſam Cœpevæ.
☞Balſam Peru, *or Natural* Balſam.
Balſam Tolu.

China-Root.
Contrayerva-Root.
☞Cortex Elatherii, *or* Sweet-Bark *to perfume* Tobacco.
☞Cort. Peru. *or* Jeſuits-Bark.

Ebony-Wood.
☞Fuſtick-Wood.

Gum Anime.
☞Gum Caranna.
☞Gum Copal.
Gum Elemi.
☞Gum Seneca.

☞Logwood.
Mechoacan.
Red Saunders.

Sarſaparilla.
Styrax Liquida.

Tacamahac.
☞Tramboon-Bark.
Vanilloes.

N. B. Specimens or Samples of any of theſe *Druggs* will be very Acceptable; but moſt Eſpecially thoſe, to whom there is this Mark [☞] prefixed, they being as yet altogether unknown; therefore Compleat Specimens of them, *viz. Samples* of their *Leaves*, *Flowers* and *Fruit*, are moſt Particularly Deſired.

London, Printed for *James Petiver*, Apothecary and Herbaliſt. 1693.

PLATE 72

The above photograph shows a seventeenth century form of the word coffee and also indicates that, at this period in England, it was known as a drug.

From a rare volume in the possession of Prof. Oakes Ames, F.L.S.

brought about its final spelling through *caufee* and *coffe* to our present form *coffee*. It is apparent that these European forms are adaptations of the Arabic term قهوة or *qahwah* which is the name of the infusion and in Turkish is pronounced *Kahveh*. The *"o"* of European derivatives of the word represents the earlier *"au"* from the Arabic *"ahw"* or *"ahv."* [1]

Philological Bibliography for قهوة or Qahwah:—D'Herbelot Bibliothèque Orientale 1 (1777) 461.—Thompson Eng. and Urdu (or Oordoo) School Dict. ed. 3 (1841) 22.—Forbes Dict. Hindustani-Eng. and Eng.-Hind. part 2 (1848) 25.—Calcutta School-Bk. Soc. Press. Romanized School Dict. Eng. Urdu ed. 7 (1867) 14.—Williams Sanskrit-Eng. Dict. (1872) 196.—Badger Eng.-Arab. Lexicon (1881) 146.—Tregear Maori-Polynesian Compar. Dict. (1891) 139, 140.—Clough Siṇhalese-Eng. Dict. (1892).—Murray Oxford Dict. 2 (1893) 589, 590.—Yule and Burnell Hobson-Jobson Glossary of Colloq. and Anglo-Ind. Words and Phrases and Kindred Terms. Etymological, Hist., Geograph. and Discursive (1903) 232.

Eastern Dialect Terms Synonymous with Coffee

(Native and foreign introductions)

Arabic:—Bun, buna, bon, ban, bunnu.

Kahwah, kahwa, kuehwa, cahve, cahué, cahu, cachua, caova, coava, coave, cauwa, coho, caoua, chaube, chaoua, choava, kaffeh, kaffe, kavee, kavhi, kahue, caffe, coffey, coffé, coffi, cafier, caffeyer, caffeyer d'Arabie, Caffayer arabique.

Egyptian:—Elkarie (or El Kari), elearco, and many of the Arabic terms.

African (various regions):—Koffij.

African (Golungo Alto region):—Murianbambe or Muria Nbambe.

Persian:—Bun, bunna, bunco, bunnu.

Qahva, kahwa, kahveh (also Turkish), tochém-keweh, cahwa, cahewa.

Hindustani:—Bun, bún. Kahwah, kawa, coffi.

[1] In addition to the subject in hand, it is interesting to note the influence of the Hindu language throughout Polynesia in the East, and Arabia to the West of India. It is curious that I am unable to find the term in any form in Malaya. I venture to suggest that this fact may be an additional unit of evidence to help substantiate the theory that the ancestors of the Malayan people did not make their appearance in that region of the world until a later period than the Polynesians.

Bengali:—Kápi, kava, kaoa, kuwa, caphee.
Gujerah:—Bund. Cappi.
Bombay Presidency:—Bun, búnd. Kawa, kahwa, caphi, caffi.
Marathi:—Bun, bund. Kaphi, kan.
Tamul:—Kapi-kottai, kapi, kopee, coppy-cottay, capie-cottay, capi.
Teloogoo:—Kapi-vittulu, capi.
Canarese:—Kaphi, kapi-bija, bonda-bija.
Burmese:—Kahpee, ka-pwot, kaphi-si.
Singhalese (or Cynghalese):—Kópi-atta, copi-cottá, kōpi.
Term common in Southern India:—Kuooa.
Javanese:—Koppi.
Malayan:—Kuppu, kapi.
Guam:—Kafé.
Philippine I. (Mindanao, Lolo):—Kahaua.

The majority of these terms are derived from one of two roots: *bun*, usually referring to the berry, and *kahwah*, referring to the roasted and ground fruit or the infusion prepared from it.[2]

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[2] Bun is used for *Phaseolus angustifolius* in Jameson Rep. Bot. Gard. Gov't. North-West. Prov. (1855) 117.

APPENDIX B

THE HISTORY OF COFFEE-HOUSES

Ever since the advent of the coffee-beverage, it has become increasingly the favorite drink of restricted districts and then of whole countries. Now its use has spread throughout the entire world. The introduction and expansion of its use has been greatly stimulated through the agencies of the public gathering places known as coffee-houses. Their development has been picturesque and of historical importance. Coffee-houses have been the subject of hostile attacks by the leaders of the Mahometan religion. These establishments have had a noteworthy influence on the literature of France. Excessive taxation and even the prohibition of coffee-houses was attempted by the English government during the latter half of the seventeenth century. The early American coffee-houses fostered the spirit of Yankee patriots. Present day coffee-houses are public gathering places where topics of general interest are discussed.

ARABIA:

In Arabia, coffee-houses were established in the fifteenth century when coffee, without sugar or milk, became the common beverage of all classes. Travelers have always held in their memories the "*kahwahs*," or "Coffee-Rooms," so intimately associated with Arabian hospitality. In these coffee-rooms, spread with mats and oriental luxuries, the Arabs gather to drink coffee and to find entertainment.

In serving coffee to a guest at the more pretentious coffee-houses, the ancient custom still prevails of washing and perfuming the hands after eating before indulging in coffee. At the present time, some coffee-houses are furnished with rugs, divans, and cushions. Others are devoid of display with the exception of the native costumes of the patrons. In all *kahwahs,* the coffee is always served black and frequently with the addition of some aromatic seed.

EGYPT:

In Egypt, coffee became the common beverage about 1500. About this time, public coffee-houses were established throughout the country. The beverage so captivated the people that they deserted the Mosques for the coffee-houses where the delicious drink and pleasant associations were enjoyed. The chief priests and rulers issued edicts prohibiting the use of coffee, but without avail. The coffee-houses still continue in a flourishing state.

PERSIA AND SYRIA:

In Persia and Syria, the coffee-houses were introduced during the sixteenth century. At the present time, they are characteristic establishments throughout this part of the world. They have always served as public gathering places for the idle, and as a retreat where merchants enjoyed relaxation. They provided an opportunity for politicians to express their views, a place for poets to recite their verses, and afforded Mollahs an audience for their sermons. Here, as in Egypt, festive gatherings such as characterized coffee-houses were incompatible with the Mahometan religion; and one finds that the coffee-houses were prohibited at various periods in the history of the country, but without avail.

TURKEY:

In Turkey, the type of coffee-house found in Aleppo, such as Russell described,[1] was characteristic of Mecca, Medina, Cairo, Damascus, and Constantinople. They were the most noticeable establishments of the city. They were large and beautifully furnished with matted platforms and benches. Many had a fountain in the center and a gallery for musicians. Large windows were situated so that pedestrians could readily observe everything that was happening within. The patrons sat about on small, low, wicker stools. In the summer months, they could be seen before the open door. This motley assembly in eastern garb and with eastern manners, variously placed in picturesque attitudes, composed a very amusing and interesting scene for a traveler. The early coffee-houses of Aleppo were frequented by all persons excepting those who belonged to the first rank of society.

[1] Russell Nat. Hist. Aleppo 1 (1794) 46-150.

Customers were entertained by musicians, a puppet show, or a story-teller. The frequenters, as they sat about drinking coffee, voluntarily contributed to defray expenses. The musical programme was often added to by some volunteer performer. The puppet shows involved a feeble attempt toward dramatic fable, but the dialogue was very frequently indecent. The Turks never gambled for money and were unacquainted with cards, as all gaming was prohibited by the Koran. They played, however, a game involving the use of coffee-cups of which a number were placed upon a large tray and a ring hidden under one of them. Whoever guessed the location of the ring had the right to blacken the faces of the losers, to expose them in fool-caps to the derision of the company, and to add any other insult which he might desire. They sometimes risked a cup of coffee to settle disputes.

Coffee-houses were opened in 1554 in Constantinople by Schems of Damascus and by Heken of Aleppo. At the present day, some are furnished with costly eastern divans, cushions of embroidered velvet, and prayer rugs of many patterns. During the reign of the Sultan Amuret III, the coffee-houses were closed on the pretext that they were places of distributing foods which were declared by Allah to be unfit for human diet; but in reality, it was because of the diminishing attendance at the Mosques in favor of the coffee-rooms. Various governors have levied excessive taxes on coffee-houses, but all prohibition has been in vain. Turkey to-day supports thousands of coffee-houses, some bedecked in splendor, others very small and plain, but all are permeated with the fragrance of their greatly-loved, bitter, and black beverage. With the appearance of Christians in Turkey, the use of sugar in coffee was introduced, but it is seldom indulged in by the Turks themselves.

Russia:

Coffee-houses have existed in the cities of Southern Russia since their original introduction about 1700; but they have never gained there the prominence attained in Turkey. Information, indicative of the demand for coffee in Russia, has recently (in 1922) come to me from Moscow, which says that even during this post-war scarcity of food and deplorable low value of Russian currency, which causes

bare necessities to be hardly purchasable, the people pay 1,250,000 Rubles for a cup of coffee.

GREECE:

Since the introduction of coffee-houses into Greece, they have been the common gathering places for men of all classes. These coffee-houses have always been associated with political discussions. The patrons of certain coffee-houses are decidedly in favor of conservative viewpoints; while the patrons of others maintain very radical ideas. It is possible to ascertain in a very short time what the sentiment of a coffee-house is; and, if one finds himself opposed to this sentiment, it may be well for him to change coffee-houses in order to secure greater peace and harmony.

The Greeks have imitated the customs of the Turkish coffee-house. One finds many of the Turkish terms used by the Greeks themselves. The patrons call for their *Solin* (σολυν σολυνες) or Turkish Water Pipe, which they own individually and in the ornamentation of which they often take great pride. Turkish pastry is obtainable in the Greek coffee-houses. In the modern coffee-houses, wines and beers are on sale, but they are much less frequently ordered than black coffee.

ITALY:

In Italy in 1625, liquid coffee was first sold in Rome. Coffee-houses have existed in the cities of Italy since the middle of the seventeenth century, but are not so typical and characteristic of the people and the country as throughout the countries bordering on the eastern part of the Mediterranean Sea.

FRANCE:

Although coffee was brought into France from Constantinople as early as 1664 by De la Haye, a Frenchman, and by Pietro della Valle, a Venetian, it was not until 1671 that coffee-houses were established. The first one was opened in Marseilles. It became a gathering place for merchants to smoke, and to discuss business and political conditions. In the following year, the first coffee-house in Paris was opened by an Armenian named Pascal. In 1675, a Frenchman, Éttienne d'Alep, opened an Oriental Coffee-House in the Rue des Italiennes. These coffee-houses, where black coffee and side dishes

of nougat and other oriental pastries were served, became the first Cafés in history. The word "Café" has been applied to restaurants, coffee-houses, and cabarets. These are modern applications of the term. Originally, it was distinctly and wholly a coffee-house where scientific and political men gathered with all other classes for discussion and where literary men read their compositions aloud. Cafés immediately flourished and were supported by the enthusiasm of the French for the new beverage. The Cafés soon became rivals of the cabarets. By 1690, over three hundred Cafés existed in Paris alone.

In 1689, François Procope established the Café Procope near the theatre of the Comédie Française. This café became the most famous of all Parisian coffee-houses. To the Café Procope, Voltaire came to sip his black coffee and to give utterance to his philosophy. Here, at the age of eighty-four, this master dramatist sought in his coffee a constant mental stimulant. In this Café Procope, the sinister figures of the French Revolution, such as Danton, Marat, and Robespierre, harangued the crowds and in passionate appeal urged them on to a period of bloodshed. Other striking personalities may be visualized in connection with the Café. Balzac, the great novelist, was an inveterate coffee-drinker. When he was poor and lived in an attic, he made coffee himself. When he could afford it, the best chef in Paris made it for him. M. Alfred de Musset, Hugo, Zola, Bernhardt, Clemenceau, great thinkers, many famous musicians, writers, and players, all found inspiration and solace in coffee as it cheered, soothed, and sustained them.

Holland:

In 1666, the first coffee-house opened in Amsterdam. Coffee-houses have existed since that period. The love of the people of Holland for coffee may be judged when one realizes that Holland has the greatest per capita consumption of coffee among the nations of the world.

Germany and Austria:

In Germany and Austria, although coffee-houses have existed since their establishment in 1686, they have never been so characteristic of the national life as the beer-gardens. The following list indicates the date of the establishment of the first coffee-house in the given city:

Nürnberg, Regensburg, and Prag	1686
Hamburg	1687
Leipzig	1694
Danzig and Wittenberg	1700
Stuttgart	1712
Augsburg	1713
Berlin	1721
Reutlingen	1760

ENGLAND:

In England, in 1651, a score and one years prior to the establishment of coffee-houses in Paris, liquid coffee was sold at Sultaness Head, a "Cophee" house in London. Soon afterward, Pasqua Rossie, the Greek servant of an English merchant named Daniel Edwards, opened a coffee-tent on St. Michael's Alley. By 1657, many coffee-houses existed in London and an excise tax of eight pence per gallon was levied. In 1660, coffee appeared on the statute books and a duty of four pence per gallon was levied. Three years later, a law was passed which required coffee-houses to be licensed.

During the seventeenth and eighteenth centuries, the coffee-houses reached their height of popularity in England and were intimately associated with the English history of those periods. Here the geniuses of the time mingled and discussed art, science, literature, philosophy, and political conditions. Samuel Pepys, for example, wrote in his diary for February 3, 1663/4: "In Covent Garden tonight, going to fetch home my wife, I stopped at the great Coffee-house there [Will's Coffee-house], where I never was before: where [were] Dryden, the poet I knew at Cambridge, and all the wits of the town, and Harris the player, and Mr. Hoole of our college. And . . . it will be good coming thither, for there, I perceive, is very witty and pleasant discourse." A similar picture is presented in the play *Tarugo's Wiles* by St. Serfe, acted at the Lincoln's Inn Fields theatre, London, in 1668. Its scene is "a Coffee-House, where is presented a mixture of all kinds of people." In Act III, one throws "a dish of coffee" in another's face, "and so they fight." With the opening of the eighteenth century, coffee-houses had become firmly established as places of fashionable assemblage: Addison's *Spectator* for March 1, 1711, says: "There is no place of general resort wherein I do not often make my appearance: sometimes I am seen thrusting my head into a round of politicians at Will's. . . . Sometimes I

PLATE 73: THE CROWN COFFEE-HOUSE, BOSTON

THE EXCHANGE COFFEE HOUSE, 1808–1818 (Congress Square)

PLATE 74: THE EXCHANGE COFFEE-HOUSE, BOSTON

smoke a pipe at Child's. . . . I appear on Sunday nights at St. James's Coffee-House. . . . My face is likewise very well known at the Grecian [and] the Cocoa-Tree."

The welcome accorded, however, to coffee and to coffee-houses had not been universal. Cromwell had attempted to check the coffee-trade; but his attempt had resulted only in wide-spread smuggling. In 1675, Charles II temporarily suppressed three thousand coffee-houses by a royal proclamation against them as "Seminaries of Sedition." It was true that unrest and even treason were nurtured there by politicians who wished to overthrow the government. The proclamation resulted in such turmoil that annulment of the edict was necessary within a few days.

Gradually, however, the English coffee-houses changed in character. The Cheshire Cheese, one of the most famous English coffee-houses, emerged from a coffee-house of the true type to the inn-form of a public gathering place. The custom of serving drinks other than coffee, in these coffee-house-inn establishments, resulted in their loss of favor among temperate people. This was the course of evolution of the great majority of the early English coffee-houses. To-day, one finds but few typical coffee-houses in England.

United States:

Pre-revolutionary days saw the advent of coffee-houses in the United States. In New Orleans, the custom of coffee-houses was learned from Paris. New Orleans was the only American city where the true type of coffee-house existed. The coffee-houses of Virginia, New York, Massachusetts, and other sections of the original thirteen colonies, were naturally fashioned after the English prototype; and, as in England, these half-coffee-house half-tavern establishments were closely associated with the history of the period. The first coffee-house in New York was Burn's, which was northwest of Bowling Green. The place was a favorite haunt for the enemies of the oppression practised by the government of George the Third.

During the winter of 1923-1924, I visited a large number of coffee-houses in New York City. The so-called 'Coffee-houses' about Times Square are semi-lunch rooms. The Greenwich Village district, however, can boast of numerous coffee-houses of the pure type,

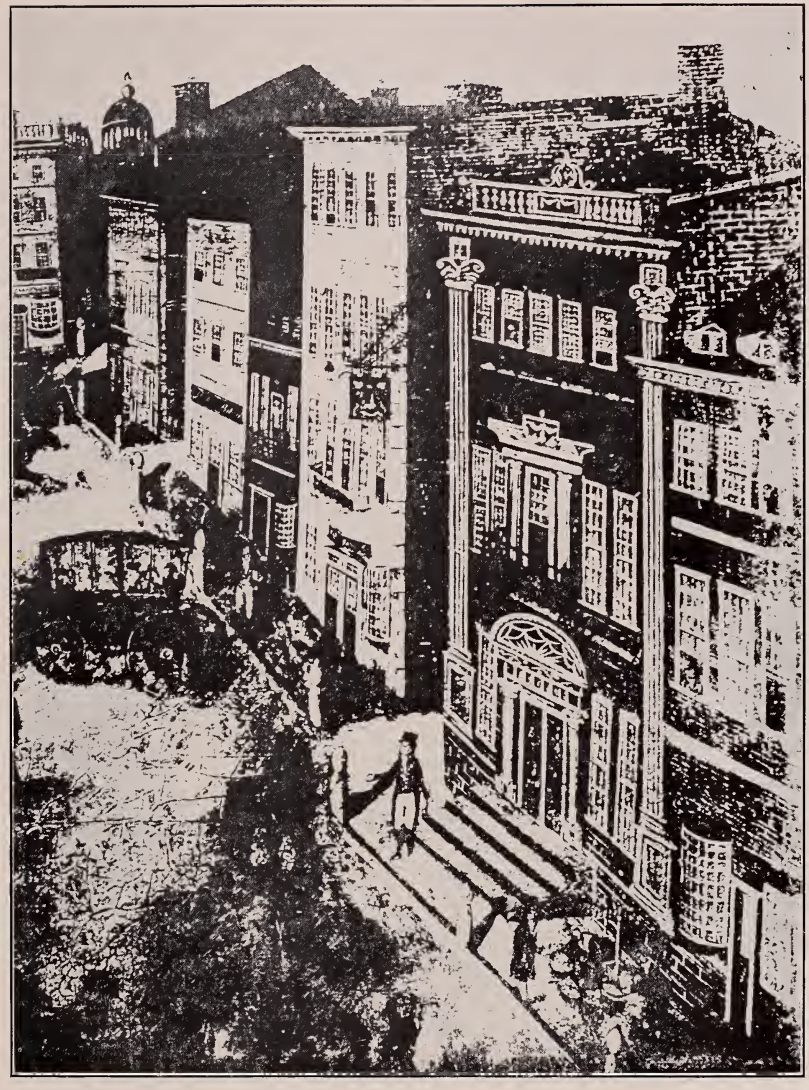
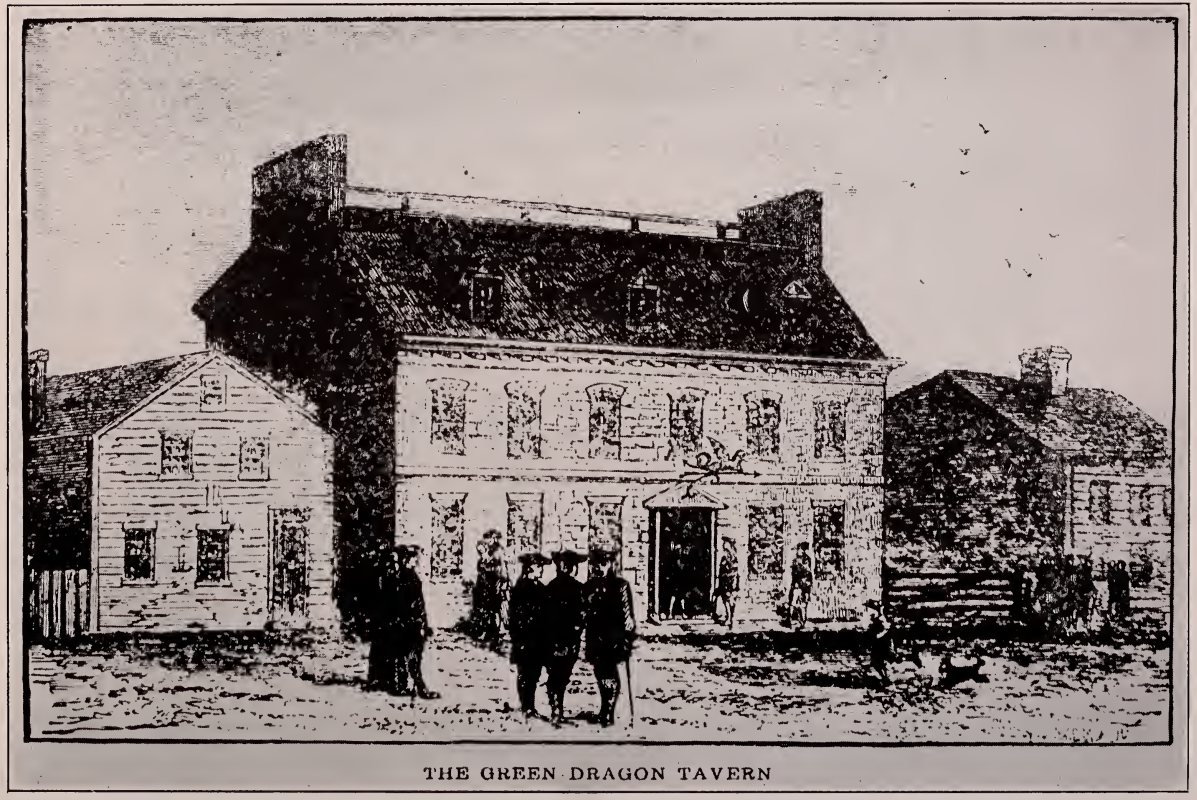


PLATE 75: THE ROYAL EXCHANGE TAVERN, BOSTON

(Merchants Bank site, State Street)

The tall white building, mail coach just leaving.



THE GREEN DRAGON TAVERN

PLATE 76: THE GREEN DRAGON, BOSTON

namely, places where only coffee (or tea) and cakes are served. These coffee-rooms are frequented by professional men, theatrical people, 'villagers,' students, and visitors. The patrons are served coffee in curiously-shaped coffee-pots. The frequenters of such coffee-rooms sit about playing cards, chatting, or reading before the fire-place. Indeed, they furnish a very pleasant gathering place to pass an hour or two in an inviting and home-like atmosphere where one may sit quietly and read or enter into the conversation which sometimes waxes warm in argument.

Boston had numerous coffee-houses during the days of the Revolution. Among the most famous was the British Coffee-house at 66 State Street, which served as headquarters for Loyalists; but later, owing to the growing political schism among its patrons, it became the American Coffee-house. The Bunch of Grapes, located at the southeast corner of State and Kilby Streets, was decidedly Whig in sympathies. It was here that Otis, in attempting to pull a Tory nose, received such a brutal beating as ultimately to cause the loss of his reason. The Crown Coffee-house at the head of Clark's Wharf on the north side of State Street (on the present site of the Fidelity Trust Co.), the North End Coffee-house opposite the head of Hancock's Wharf on the northwest side of North Street, the Exchange Coffee-house in Congress Square, and the Royal Exchange on State Street, were among the famous coffee-houses of Boston.[2] These coffee-houses were liberally patronized by both Whigs and Tories. In some of these Coffee-house-Tavern hostelries, the British sympathizers gathered and drank toasts to King George III. In others, Yankee rebels assembled. At the Green Dragon, which was also known as Freemason's Arm, such adventurous and ardent patriots as Otis, Joseph Warren, John Adams, Samuel Adams, Cushing, Pitts, Molyneux, and Paul Revere, met nightly to drink coffee and to discuss public affairs. An historical tablet at 80-86 Union Street, Boston, still marks the location of this famous coffee-house.

Not until comparatively recent years, however, did the pure type of coffee-house invade the cities of the eastern United States. Their establishment has been coincident with the Greek and Armenian

[2] The illustrations of early Coffee-houses presented here were photographed from Old Boston Taverns and Tavern Clubs by Samuel Adams Drake. Published in 1917 by W. A. Butterfield, Boston, Mass.

immigration. To-day, one finds coffee-houses flourishing in the Greek settlements of our metropolitan centers and in some of our smaller manufacturing cities. The main street of the Greek Quarter of Nashua, New Hampshire, has seven coffee-houses of the true type. Here, Greeks and a sprinkling of Americans spend the evenings sipping the black Turkish coffee, eating bits of pastry, and smoking the large and ornate water-pipes or *Solines* (σολυνες). During the summer of 1922, I visited numerous coffee-houses in Manchester and Nashua, New Hampshire; and in Haverhill, Cambridge, and Boston, Massachusetts. Those in Nashua seem to be of the best type. I found them to be very informal places where men of all classes sit about—usually with their hats on—to drink coffee, to smoke, to play cards, and to discuss the present-day topics of the world.

It is of considerable interest to one who is foreign to the environment of a coffee-house, to see men industriously drawing (inhaling) on their water-pipes without producing the slightest smoke. One soon discovers that the color of the smoke is removed during its passage through the water, owing to the precipitation of the dispersed phase by water, so that only a delightfully cool and colorless gas reaches the mouth. After the water becomes saturated with smoke, as it does in the course of two to three hours, some normal smoke is emitted.

Although non-alcoholic beverages are purchasable, they are rarely served. I found the pastry menu of the coffee-houses to consist mainly of Τριγονον, which is a preparation of honey and almonds; Χουραμπιες, which tastes like a very dry cooky covered with powdered sugar; Λουκουμ, which is Turkish paste, usually red, covered with powdered sugar, in size a one-inch cube, and in taste and appearance similar to a bit of compressed jelly; and Μπακλαβα, which is a very palatable although excessively sweet concoction of layer pastry and almonds. The entire preparation is thoroughly permeated with honey by a process of soaking in honey when made. One inserts a fork (oyster-fork type) in the center of this lozenge-shaped pastry, which is about one-half inch on each side; and, holding it in this manner, one bites off portions at intervals during the conversation.

The Greek coffee-houses are as distinctly Royal or Republican in regard to the modern Greek government as the early American

PLATE 77

Coffee Urn, Used in the Green Dragon Tavern, now in the possession of the Bostonian Society.

coffee-houses were Whig or Tory. In coffee-houses with Royal sympathies, one finds the photographs of the Royal family. On the walls of coffee-houses with Republican sympathies, one finds the pictures of eminent Republicans. In all Greek coffee-houses, one sees pictures of Greek battle-ships, usually in the process of sinking a Turkish warship, and copies of paintings which depict the historical and intellectual attainments of the Golden Age of Greece.

There are several coffee-houses in the Central Square region of Cambridge, Massachusetts, not of the true type but existing in combination with public pool-rooms. Consequently, they have a less desirable trade and environment than those of Nashua, New Hampshire, and some other manufacturing centers. I have visited the following Cambridge establishments: Ελλενικον Καρρενειον Και Αριστεριον το Ενοσις at 792 Main Street; Καρρενειον Σενενσις at 769 Main Street; and Ελλενικον Χενοδοχειον το Καρρενειον Ελλας at 502 Massachusetts Avenue. I found them less popular than the pool-rooms notwithstanding the fact that they provided a place for discussion as in coffee-houses of the pure type.

In Boston, one still finds coffee-houses of the pure type. At 36 Kneeland Street, one sees the sign:

Ελλενικον Καρρενειον
Η Κωνσταντινουπολις.

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