SCIENTIFIC DEPARTMENT.
FREDERICK STEARNS & CO.
Monograph No. 5. Illustrated.

KOLA.

PUBLISHED UNDER THE DIRECTION OF
F. E. STEWART, M. D., PH. G.
DIRECTOR SCIENTIFIC DEPARTMENT, F. STEARNS & CO.
Formerly Demonstrator and Lecturer on Materia Medica and Pharmacy, Jefferson Medical College, Etc.

PRESS OF
FREDERICK STEARNS & CO.
DETROIT, MICH.
1894.

AN ILLUSTRATED MONOGRAPH

—ON—

KOLA.

PART I.—PHARMACOGNOSY.
—SCHLOTTERBECK.
PART II.—PHYSIOLOGICAL AND THERAPEUTIC ACTIONS.—STEWART.
PART III.—A CLINICAL STUDY OF KOLA.—SHOEMAKER.
PART IV.—BIBLIOGRAPHY.

PUBLISHED UNDER THE DIRECTION OF
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DIRECTOR SCIENTIFIC DEPARTMENT, F. STEARNS & CO.
FORMERLY DEMONSTRATOR AND LECTURER ON MATERIA MEDICA AND PHARMACY, JEFFERSON MEDICAL COLLEGE, ETC.

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THERAPY—F. E. STEWART, M. D., PH. G.
PHARMACEUTICAL ASSAYING—
J. L. TEGARDEN, PH. C.
MICROSCOPY—S. C. STEARNS.

INTRODUCTION.

This is the first of a new series of scientific monographs, published by our Scientific Department, on drugs now attracting the favorable notice of the medical profession. These monographs will, in no sense of the term, be advertisements. By an advertisement we mean a notice that we have goods for sale. They are intended for no such purpose. On the contrary, they are scientific treatises on subjects relating to the Materia Medica and Pharmacy, carefully compiled by scientific and professional men for the purpose of conveying scientific information to the professions of medicine and pharmacy. They contain nothing unworthy a place in medical and pharmaceutical periodicals or text books. The high standing of the physicians and pharmacists engaged in the work is a sufficient guarantee of this statement. Furthermore, as we have no exclusive control of the manufacture and sale of any article mentioned in their pages, these publications conform in every respect to the altruistic ideal of the liberal professions, and the work is calculated in every way to promote progress in the science of medicine and the useful arts connected therewith.

Next, a few words about our Scientific Department. It is composed of graduates in medicine, pharmacy, and chemistry, in charge of the several departments of our laboratory—picked men, thoroughly familiar with their work and posted both in theory and practice. The department is under the direction of F. E. Stewart, M. D., Ph. G., well known as a teacher in medical and pharmaceutical colleges, as a physician, and as an author. The work of the Scientific Department is separated from the commercial interests of the house, and entirely free from trade influences. Its object is the free diffusion of knowledge; its aim is to publish the results of scientific investigation in the newer materia medica. But it is more than simply a publication department, for it offers to furnish material for original research, and to pay to have such work done either in the laboratory or at the bedside.

It will be naturally asked what motive we can have in devoting time and money to original investigation and a free diffusion of knowledge. Pharmacy is a branch of medical science and practice, and the pharmacist, like the physician, must be rated, not by the size of his business, but by his contributions to knowledge. Our object then is, first, to conserve and increase the reputation of our house. In the second place, by conducting this work we are constantly thrown into personal contact with the best men in medicine and pharmacy,

who naturally come to regard us in a friendly light, and finally become our patrons. And, finally, as we, in common with others, manufacture preparations of these newer drugs, the diffusion of knowledge concerning them greatly increases the general demand, and, therefore, adds indirectly to our business.

Now as to the monograph on Kola itself: The larger proportion of the work has been done for us by J. O. Schlotterbeck, Ph. C., B. S., Instructor of Pharmacognosy, and in charge of Materia Medica in the School of Pharmacy of the University of Michigan. To him belongs the credit for the original drawings, most of the compilation, and the bibliography. The artistic photography, which adds so much to the beauty of the work, was done for us by Professor A. B. Stevens, of the University of Michigan, Mr. A. C. Johnson, Ann Arbor, and by Mr. S. C. Stearns, the microscopist of our Scientific Department.

All of this has been done at our expense; and we are willing to pay for work of this nature, and also for clinical reports. The idea that it is unprofessional to accept pay foi scientific work, is an absurd relic of the past, more fit for the museum of the Antiquarian than for a place in the practical every day life of modern times.

We first offered Kola for sale in 1881 (see our journal, THE NEW IDEA, April, 1881). As we do not find that it was marketed previously in this country, we believe the claim that we introduced it to American commerce is justifiable. In fact, outside of two brief notices of Kola in the *American Journal of Pharmacy*, 1857, page 181, and 1880, page 617, we believe THE NEW IDEA was the first pharmaceutical journal in America to mention the drug. Since that time we have called frequent attention to it. We also are under the impression that we are the only importers of Kola nuts in their fresh, undried state. These we frequently exhibit before scientific bodies, and offer free to physicians who may desire to raise the plant from the seed.

An invitation is extended to physicians and pharmacists to inform us of any errors in the Monograph, and also to report their experience, pharmaceutically, physiologically and therapeutically, in regard to Kola or its preparations.

We have copyrighted these Monographs simply to prevent them from being used without proper credit, and not from any desire on our part to restrain them from general use. On the contrary, we court such usage by all who wish to employ the matter contained therein for scientific and literary purposes (not for trade purposes), but we do insist that we shall receive, in every case, proper credit, because it is certainly our due.

FREDERICK STEARNS & CO.

DETROIT, October 1, 1894.

TABLE OF CONTENTS.

Table of Contents Continued.

LIST OF ILLUSTRATIONS.

PART I.

Kola Pharmacognosy.

Comprising the Description, Names and Synonyms, Habitat, History, Botany, Cultivation, Collection and Transportation, Native Uses, Substitutions and Adulterations, and Chemistry of Kola.

BY J. O. SCHLOTTERBECK, PH. C., B. S.

Instructor of Pharmacognosy, and in charge of Materia Medica, School of Pharmacy, University of Michigan.

KOLA.

Origin.—Sterculia acuminata Pal. Beauv: (*Cola acuminata* R. Br., Schott & Endl.) (Cola heterophylla Mast., Cola ficifolia Mast., Cola Duparquetiana Baillon, Cola cordifolia R. Br., and perhaps St. tomentosa Hendelot)[1].

Natural Order.—Sterculiaceæ.

Botanical Synonyms.—Siphoniopsis monoica Karst., St. verticillata Shum. et Thonn., St. macrocarpa Don., St. nitida Vent., Bichea solitaria Stokes, Edwardia lurida Rafin., Colaria acuminata Rafin.

Names and Synonyms.

English.—Kola, Cola, Female Kola, (Soudan Coffee[2]).

German.—Kolanuss.

French.—Noix de Kola, Noix de Gourou, Noix du Soudan, (Café du Soudan[2]).

Spanish.—Cola de Africa, Cola de Soudan, Nuez de Kola.

African.—Guru, Gourou, Goora, Guro, Gooroo, Ombéné, Nangoué, Kokkoroku, Coles, Gola, Kollah, Makasso, Makatso, Kowda, Coorooah, Gonja, Biche, Bissai.

West Indian.—Bissy-Bissy, Bichy.

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1 Since the seeds of some of these species have not been obtained in quantities sufficient for extended chemical analysis, it is unknown as yet, whether they contain appreciable quantities of caffeine or not. It seems unlikely that they do, for in that case they would be sought as eagerly as the true Kola. Heckel has examined several other species of *Sterculia* and has found most of them free from caffeine. One, however, *Cola Ballayi* Cornu, yields caffeine, theobromine and kola red.

2 The name Soudan Coffee is properly applied to the seed of *Parkia biglobosa* Benth., which after being roasted has been used as a substitute for coffee, though it contains no caffeine or theobromine. It was thought for a long time to be a product of the Kola tree.

Derivation of the Botanical and Common Name.

The generic name *Sterculia*, indicating one of the sub orders of the Sterculiaceæ, is derived from the Latin *Sterculius*, the deity that presided over manuring, from *stercus*, dung. This name was probably applied because one of the original species possessed an unpleasant odor. The specific name *acuminata*, is descriptive of the apex of the leaf of this particular plant.

As to the derivation of the name Kola, we cannot speak with certainty. The Foulah traders, who occasionally visit Sierra Leone, affirm that it is simply a vernacular negro corruption of Guro or Goro, names common in Foulah and the Soudan. It is said that the tribes of the maritime regions were unable to articulate the letter "r" very clearly because of some defect of the vocal organs, and consequently were compelled to sound that of "l" instead. The words Guro, or Goro, soon became Gulo and Golo, which in turn, through careless pronunciation, was modified to Kola and this ultimately was universally adopted.

Habitat.

The Kola nut is the product of a tree whose distribution is somewhat restricted. It grows wild upon that portion of the western coast of Africa comprised between Sierra Leone and the Congo, or Lower Guinea (from 10° N. Lat. to 5° S. Lat.), and when topographical features are favorable reaches into the interior from five hundred to six hundred miles. Schweinfurth, in his travels, has found the Kola tree as far inland as seven or eight hundred miles, but it is more than probable that in these places it had been introduced and cultivated. Upon the eastern coast the Kola is apparently unknown in the wild state, none being found except those introduced by the English, who have also successfully transplanted them in the West Indies, Seychelles, Ceylon, Demerara, Sidney, Zanzibar, Brazil and other South American countries. It is plentifully distributed in the Jamaica Islands where it was unquestionably introduced by the slave ships trading at that point. More recently the French have succeeded in establishing it in their colonies, Gaudaloupe, Cayenne, Cochin China and the Gabon.

The plants have been propagated at Kew and generously distributed through the various botanical gardens, including those at Cambridge and Washington, D. C. The accompanying illustration was made from a photograph of two fresh leaves picked from the growing plants at Washington and kindly sent to the writer. As far as the writer knows, no substantial effort has been made to cul-

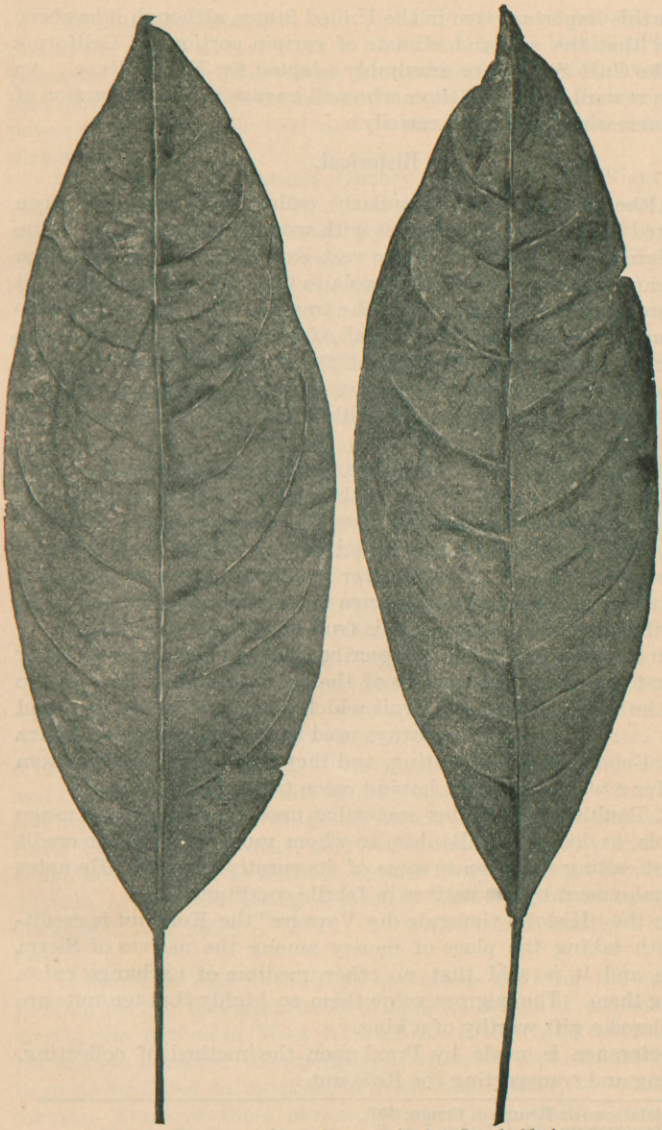

FIG. 1.—Leaves of *Sterculia acuminata*—One-half size.
Upper surface. Under surface.

tivate this important tree in the United States, although it has been stated that the soil and climate of certain portions of California and the Gulf States are admirably adapted for Kola culture. An ample reward is assured those who will engage in the production of this increasingly valuable remedy.

Historical.

Although Kola seed—popularly called Kola nut—has been credited from time immemorial with wonderful properties by the Aboriginal races populating the vast extent of territory between Senegambia to the north, and Angola to the south of the equator, it was probably first mentioned in the travels of Leo Africanus, who explored a large portion of Central Africa about the middle of the sixteenth century. In speaking of the country through which he passed, he merely says no trees of any kind were met save one variety of great size which bore bitter fruit, called by the inhabitants Goro, or Guro.

Phillipus Pigafetta[1] quotes the Portuguese traveler, E. Lopez, as follows: "If held in the mouth or chewed, the Kola nuts will quench thirst and improve the taste of drinking water. Furthermore, they comfort the stomach and are peculiarly beneficial in all diseases of the liver. Also the liver of a hen or any other bird that is putrified and stinketh will return to its original sound and fresh state if some of the matter of this fruit be sprinkled over it.'

In the year 1591, Clusius[2] described the seeds and was probably the first to furnish illustrations of them. Designating them as the fruit, he says: "Coles is a fruit which when dry is very hard and solid . . . . . and is always used by the inhabitants of Africa about Cape Verd when fasting, and they are able to abstain from food for a whole day after having eaten three or four."

C. Bauhin, 1623, dilates somewhat upon the history and usage of Kola, as does also J. Bauhin, to whom must be given the credit of first calling attention to some of its curative powers. He notes its employment by the natives in febrile conditions.

In the "Histoire Generale des Voyages" the Kola nut is credited with taking the place of money among the natives of Sierra Leone, and it is said that no other medium of exchange exists among them. The negroes value them so highly that ten nuts are considered a gift worthy of a king.

Reference is made by Prax[3] upon the method of collecting, packing and transporting the Kola nut.

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1 Relatione de Reame di Congo; 1591.
2 Exoticorum. lib. III. Cap. 7, p. 35.
3 Commerce de l'Agerie avec la Mecque et le Soudan, 1849.

The first comprehensive and probably most authentic description of the native uses of Kola is furnished by the botanist Palisot Beauvois[1]. Among other things, he says that his experience teaches him that the negroes of Oware eat the nuts because of their reputed power of giving to all food and drink, even brackish water, a pleasant taste.

Mr. Chas. Barter, Natural History Collector of the Niger Expedition, 1859, states that he found two kinds of Kola, one with four cotyledons, called "Fatak" by the Foulahs, and another with two cotyledons, called "Gonja" by the same people. The two cotyledon variety was, however, the more highly prized.

Dr. Daniell, who resided in West Africa for some time, prefaced a discourse which he delivered before the Pharmaceutical Society of Great Britain in 1865, by saying that it would be futile to attempt the discovery throughout the vegetable kingdom of tropical West Africa of any analogous product that occupies such an exalted position in the social or dietetic economy of the negro tribes or constitutes such an important article of commerce in Soudan as the seeds of the Kola tree.

From a dispatch transmitted by the Marquis of Salisbury from Her Majesty's Consul at Bahia in 1890, containing a report of the properties and uses of Kola, the following is extracted: "The West African carriers at this port who use Kola . . . . . are, as a whole, not, physically speaking, superior to the Brazilian negro, and yet the African through constantly masticating Kola can endure labor and fatigue which no Brazilian carrier can withstand, and where, for instance, it takes eight Brazilian negroes to carry a load with difficulty, four African porters carry it cheerfully, almost always, even though ascending a hill, singing and chanting the whole time as they trudge along." "I have myself had a bag of sugar weighing 80 kilos (179 pounds English) refused by a young, healthy, able-bodied native negro porter who could not so much as move it, carried away with ease by an aged African negro after biting a piece of Kola nut and transported a distance of four miles . . . . . without once taking it off the head."

It would be easy to multiply quotations showing the exalted position held by this remarkable drug as an article of consumption among the natives of West Africa. As a tonic and stimulant it has always attracted the attention of travelers and explorers, who have never failed to mention, at least incidentally, its wonderful virtues. Some of these notices, however, especially those from

[1] Flore d'Oware et de Benin.

FIG. 2.—Kola tree. (From *Les Kolas Africains.*)

early authorities, which refer mainly to its power of improving the taste of half putrid water and decaying meat, are manifestly extravagant; while such assertions as the one made by Jobson in 1620, that, after mastication of Kola, river water is rendered so sweet as to resemble white wine mixed with sugar, must be relegated to the realm of the fabulous. The origin of these fanciful notions may be accounted for in the following way: In tropical countries where the only available water is thick and muddy the seeds of various plants which contain much mucilaginous and astringent matters are rubbed around the inside of the vessel containing the water, and act as a clarifying agent. The principle of their action has never been scientifically investigated, but undoubtedly the purification is due to purely mechanical means. The Indian clearing nut, *Strychnos potatorum*, which contains abundant mucilage and tannin, is used for this purpose, and perhaps Kola acts in a similar manner to render water more palatable.

Among the botanists who have, one after the other, studied and described the history, habits and growth of this wonderful plant, the following may be mentioned:

Bosc[1], Stokes[2], Bory de Saint-Vincent[3], Schott and Endlicher[4], Mérat et de Lens[5], Virey[6], Thiébeaud de Berneaud[7], Baillon[8], Brown[9], Palisot de Beauvois[10].

Explorers of the "Dark Continent" from the middle of the sixteenth century to the present time have given vivid descriptions of the tree and its fruit and the remarkable properties attributed to it by the natives. Among the more eminent African explorers who have written upon this subject are René Caillié[11], Schweinfurth[12], and Griffon du Bellay[13].

No monograph upon this subject appeared in Europe until that furnished by Heckel and Schlagdenhauffen[14] in 1883. Up to that time, therefore, Kola had been known to Europeans mainly as a curiosity to the negro tribes. But such is no longer the case. From year to year the curative powers of the drug have become more

[1] Nouveau Dictionnaire d'histoire naturelle appliquée aux arts, à l'agriculture et à l'économie rurale et domestique, etc., 1803.
[2] Bot. Mat. Med., ii. 564, 1812.
[3] Dictionnaire classique d'histoire naturelle, 1823.
[4] Meletem, 33, 1832.
[5] Dictionnaire universel de matiere médicale, 1829.
[6] Journ. de Pharm. et de Chimie, 1827 and 1832.
[7] Dictionnaire pittoresque d'histoire naturelle et des phénoménes de la nature, 1839.
[8] Histoire de plantes, 1879.
[9] Botany of Congo.
[10] Flore d'Oware et Benin., XXIV.
[11] Journal d'un voyage à Tombouctou et à Jenné, 1825.
[12] Au coeur de l'Afrique, 1875.
[13] Au Gabon (in) Tour du monde, 1868.
[14] Sur les Kolas Africains.

widely known. It has been tested in the practice of eminent physicians; it has established itself to a considerable extent in the confidence of both practitioners and the public; so that at the present time it has come to be recognized as one of the most valuable therapeutic agents of our Materia Medica.

Botany.

Kola seeds are derived from several species of plants belonging to the natural order Sterculiacæ, but especially from *Sterculia acuminata*, Pal. Beauv. (*Cola acuminata* R. Br., Schott & Endl.) It is still an open question whether the different species of *Sterculia* mentioned at the beginning of this treatise and which are commonly known as Kola, contain all of the active principles found in the seeds of *Sterculia acuminata.* At least some of them are so poor in alkaloid as to warrant their designation—"Spurious Kola."

True Kola, or "Female Kola," is not to be confounded with false Kola, or "Male Kola," which is derived from a tree belonging to the Natural Order Guttiferæ, and whose seeds contain none of the characteristic constituents of true Kola.

The Kola tree resembles very much our chestnut and attains a height of from 40 to 60 feet or more. (See Fig. 2, p. 8.)

Stem erect, cylindrical, smooth.

Leaves numerous, alternate, 3—6 inches long, 1—2 inches broad, oblong-acuminate, smooth; margin entire, slightly revolute; petiole 1—3 inches long, slightly thickened at base of leaf; young leaves pubescent; veins beset with stellate hairs and sessile spherical glands.

Flowers numerous, polygamous, in terminal and axillary, cymose panicles; entire inflorescence covered with minute stellate hairs.

Flower buds subglobose, possessing faint odor resembling vanilla, apetalous.

Calyx petaloid, greenish-yellow or white, purple at edges; limb 5-cleft; lobes ovate-lanceolate.

Male Flower—Column slender, shorter than calyx, bearing a circle of 10 two-lobed anthers; anthers divergent.

Hermaphrodite Flowers—Anthers subsessile in a circle; ovary 5-lobed, 5-celled, stellate pilose; styles 5, linear, subulose, reflexed, superposed.

Ovules anatropous, attached in a double row to the ventral suture of each carpel.

Fruit usually five-follicles or fewer by abortion, sessile, oblong

FIG. 3.—*Sterculia Acuminata.*
A.—Flowering branch. (From *Les Kolas Africains.*)
B.—Flower.
C.—Staminal column of female flower.
D.—Transverse section of ovary.
E.—Ovary.
F.—Group of five follicles.

obtuse, rostrate; coriaceous to woody carpels, entirely smooth at maturity, slightly tuberculate, chocolate brown color; 3—6 inches long, 2—3 inches thick.

Seeds—1—10 in each follicle, subtetragonal, oblong, obtuse testa purplish, cartilaginous.

Cotyledons usually 2, sometimes 3—5, flatly ovate, or auriculate, thick, oppressed; red or yellow; radicle directed toward the hilum.

Cultivation, Collection and Transportation.

The Kola tree flourishes in moist, hot lands at or a little above the sea level, some beautiful specimens being found on the coast of Sierra Leone at an altitude of 200 to 300 metres. The trees are sometimes found in groups large enough to be called veritable forests. They are by no means difficult of cultivation as is sufficiently demonstrated by the success attending the endeavors of the English and French, who have introduced them in their colonies. The wood is light colored and porous, quite similar to the poplar, except that it is finer grained and less apt to be attacked by insects. It is said to be excellent for general carpenter work and is extensively employed by the natives in ship building, as well as in the manufacture of household utensils in general.

Mr. W. Fawcett, F. L. S.[1], speaking from his experience in Jamaica, states that "the Kola tree is propagated from seeds and will begin to bear fruit after five or six years. There are trees near the Botanical Garden, Castleton, which were planted over fifty years ago, still in perfect health and bearing fruit regularly. The trees should be planted about 20 feet apart, which would give about 108 trees to the acre. The trees grow about 40 feet in height. Those near Castleton produce from 500 to 800 pods each crop. If each pod contains, on a moderate calculation 4 seeds, and if we say 50 seeds to the quart, then a tree with 600 pods will give 50 quarts of nuts twice a year, or 100 quarts per tree per year. A quart of dry nuts will weigh a litttle over 1¼ pounds, or 125 pounds a tree. A tree in full bearing and under careful cultivation would probably produce 150 pounds of nuts a year."

As stated above, the tree begins to bear fruit in the fourth to the sixth year of its growth, but the maximum yield is not reached until the ninth or tenth year, when as much as 125 pounds of seeds are obtained from each tree. One peculiar feature of this tree is that it blossoms and bears fruit simultaneously, i. e., there are flowers and fruit during the entire year. It would naturally be sup-

[1] Kew Bulletin of Miscellaneous Information, 1890.

posed that the collection of the fruit might be continuous, but on the contrary there are only two gatherings a year. The chief one is made in October and November from the June flowering, while the second one is made in May and June from the November flowering.

When the pod is ripe it takes on a chocolate brown color, at which time dehiscence of the follicle commences along the ventral suture and exposes both red and white seeds in the same pod. It is at this time that the collections are made. As many as five carpels may result from a single flower, and they may contain from two to ten seeds each, while some are found with only one seed. When removed from their envelopes the seeds weigh from five to twenty-five grams each, according to their development and number.

Fresh, sound Kola seeds are either red or light yellow externally, but if bruised in any way they instantly turn to a brick red at the injured part and rapidly begin to decay and mold. Therefore, the collection and packing must be made with the greatest care. The gathering is usually made by native women who remove the seeds from the follicle and dextrously cut off the seed coat leaving the bare cotyledons. Extreme care is observed in selecting them, and when fresh nuts are desired for long distance transportation they are handled as carefully and tenderly in packing as are the finest apples in our American fruit belt. All are carefully sorted, the worm-eaten and otherwise damaged ones rejected, and the sound ones placed in peculiar baskets made either of bark, woven fibre, or strips of flexible wood. These baskets hold from fifty to three hundred pounds of seed.

A very common package for transporting the seeds is called "uagha" and is made as follows: Four strips of flexible wood placed crosswise and fastened at their centers, are made into a skeleton or framework by bending in the shape of a horseshoe and tying their free ends tightly together. The whole, covered with a tanned ox hide, is then filled with fresh Kola seeds and covered with a four-ply canvas bag called "gherara," which is securely fastened to the four strips of wood.

Some importations made by Frederick Stearns & Co., of Detroit, have been received in baskets, as shown in the accompanying illustration. (See Fig. 4, p. 14.) They are rudely woven of some fibrous material and supplied with a ring or handle made, it is said, from the bark of *Calamus Draco* (tai-tai by the natives). The lighter baskets can be supported on the heads of the native carriers, while a heavy one must be carried by two porters who suspend it between them upon a pole passed through the handle.

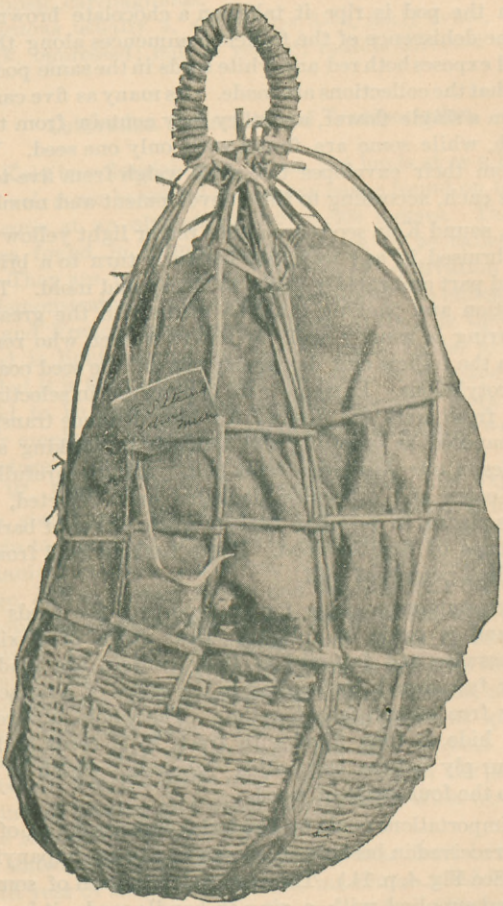


FIG. 4.—Basket of fresh Kola nuts ready for transportation.
[Photographed direct from original.]

The basket is first lined with coarse canvas, and then with large succulent leaves called "bal." These leaves, which are derived from various species of *Sterculia* and *Phrynium*, attain a length of twelve to eighteen or more inches and a width of six to ten inches. They retain their moisture for a long period, and for this reason are employed in packing the Kola seed for transportation. Protected in this way from the drying effect of the atmosphere they can be transported without injury for about thirty days. If it is desired to retain them longer in a fresh condition they must be unpacked, resorted, washed in clean running water and repacked in fresh, moist leaves, when it is claimed they can be preserved from eight to ten months.

The writer having been supplied with a liberal sample of both red and white seeds, sought for a method to preserve them in their natural condition. All the usual preservatives and antiseptics were tried without success. Alcohol soon caused the seeds to become almost black. Even aqueous solutions of benzoic, salicylic and boric acid caused a marked coloration, as did also the vapors of chloroform. Finally the following plan was adopted with excellent results: The seeds were wrapped in dry cotton, then packed in moist sawdust in an air-tight tin can. Seeds so packed retained their original color and freshness for over three months and none had been attacked by fungi.[1]

The principal markets for the seeds are Gambia and Goree, where the main traffic is carried on. They frequently arrive at Sokota and Kouka in the Soudan and Timbuctoo, where large sales are made. From the marts of Soudan it is carried by caravan to Tripoli, and from Timbuctoo to Morocco. From various ports on the Mediterranean and the west coast of Africa they are exported to Europe and the two Americas in constantly increasing quantities.

Acting Administrator Berkeley[2] reports from the Gambia upon the West Africa trade in this singular product as follows:

"The trade in Kola nuts is an attractive feature in the commerce of the Gambia. The Kola nut is the product of the Sierra Leone district, and the trade in it, both at Sierra Leone and the Gambia, is almost entirely in the hands of the women, to a large number of whom it affords the means of livelihood, and in many cases the acquisition of considerable wealth. The nut is largely consumed by the natives of the Gambia. It is of a bitter taste and produces no exhilarating effect, but is said to possess the power of

[1] A weak solution of formic aldehyde has proven to be a satisfactory preservative for retaining the bright colors of lower animals. The writer intends experimenting with this substance on vegetable tissues.

[2] Report on Progress and Condition of the Royal Gardens at Kew, 1880.

satisfying for a considerable time the cravings of hunger and of enabling those who eat them to endure long labor without fatigue. *Cola acuminata* in fact plays the same part in tropical Africa that *Erythroxylon Coca* does in South America."

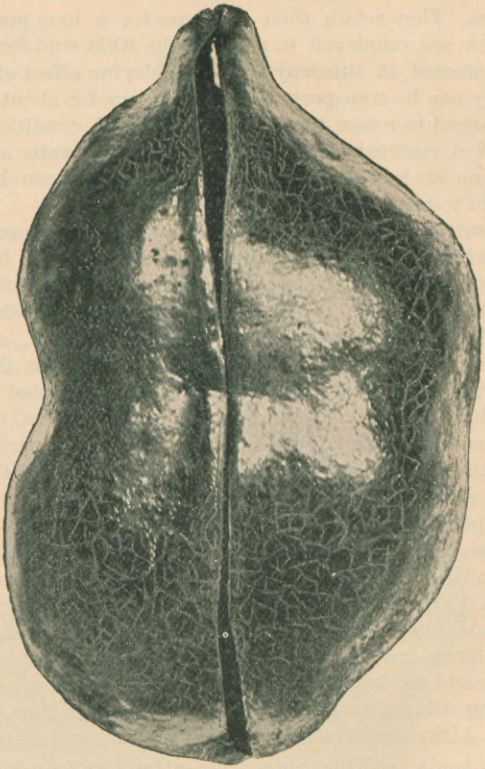


FIG 5.—Fruit of Kola (*Sterculia acuminata*)—Natural size.
[Photographed direct from original.]

Structural Features.

Fruit.—The fruit of the Kola tree is a follicle containing from one to ten seeds. When mature it is of a chocolate brown color, smooth externally, sometimes constricted at one or more places, very much like the depressions of the loment. Occasionally the follicle is somewhat elongated and slightly curved like the letter S. The pericarp is thick and a little fibrous and dehisces at the ventral suture. The cells of the outer layers are cubical and filled with a

brownish resinous coloring matter. Directly beneath this tissue the walls become thinner and more delicate, and enclosed in this tissue are large air spaces, which at an early period probably contained mucilage. Gradually the cells become larger, elongated and more compact. In this tissue the spiral vessels are embedded. Calcium

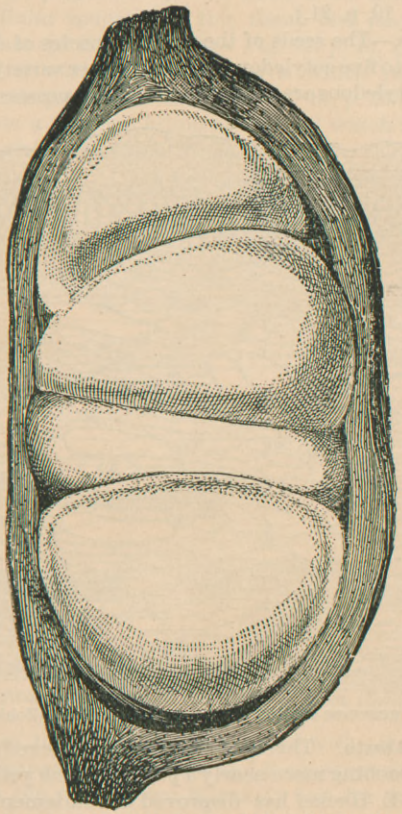


FIG. 6.—Mature fruit opened longitudinally.
[Original drawing direct from fruit.]

oxalate crystals are found scattered throughout the entire tissue. (See Figs. 7, p. 18, and Fig. 8, p. 19.)

Seeds.—The seeds resemble somewhat in appearance our common horsechestnut and are tightly nested in the follicle, assuming a rather triangular subtetragonal shape, due to mutual pressure ex-

erted on all sides. The seed coats are somewhat purplish and cartilaginous. It must not be forgotten that the seed coats are first removed before the Kola is shipped into market and that the Kola nut, so-called, is merely the cotyledons of the seed.

As there is nothing characteristic in the minute structure of the testa the illustrations given will answer all purposes. (See Fig. 9 p. 20, and Fig. 10, p. 21.)

Cotyledons.—The seeds of the various species of Kola may contain from two to five cotyledons, but the former variety is always preferred. The cotyledons are thick and fleshy and possess a bitter, some-

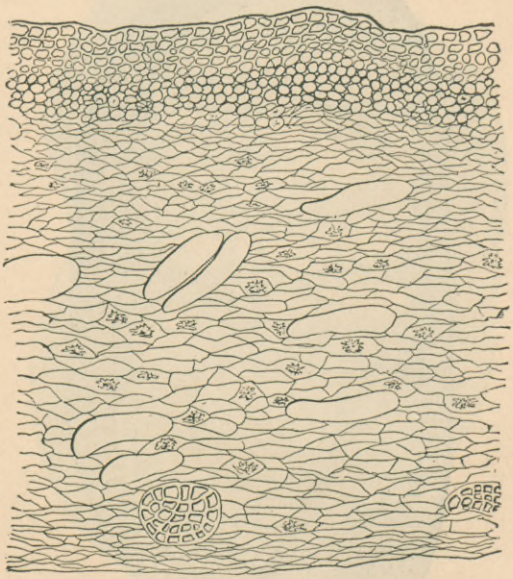


FIG. 7.—Transverse section of the carpel of Kola. (Zohlenhofer).

what astringent taste. There are two varieties, the red and the white, the latter approaching more nearly a pale, greenish yellow. (See Fig. 11, p. 22.) Mr. E. Heckel has disproved the statement of Hendelot that there existed two distinct varieties of Kola, one yielding exclusively red seeds, while the other produced only the white. He has demonstrated to a certainty that one and the same follicle may contain seeds of both colors. Neither does he agree with Griffon du Baillay that the white seed is a transitory state from the unripe condition to maturity, since he has repeatedly found both kinds in one and the same ripe fruit.

A transverse section of one of the cotyledons of the fresh seed shows an epidermal layer of very regular, thick-walled, empty cells. The outer surface is somewhat convex and amber brown in color. Immediately beneath the epidermal layer is the fundamental tissue which comprises the whole of the fleshy portion. This tissue is composed of large angular cells with thick walls and very plainly marked intercellular spaces. In this tissue one may find also an occasional delicate spiral vessel. (See Fig. 12, p. 23, and Fig. 13, p. 24.) Each cell is well filled with starch which resembles very much the common potato starch. (See Fig. 14, p. 25.) The grains are ovate, possess a distinct hilum at one end which is surrounded by very plainly visible eccentric rings.

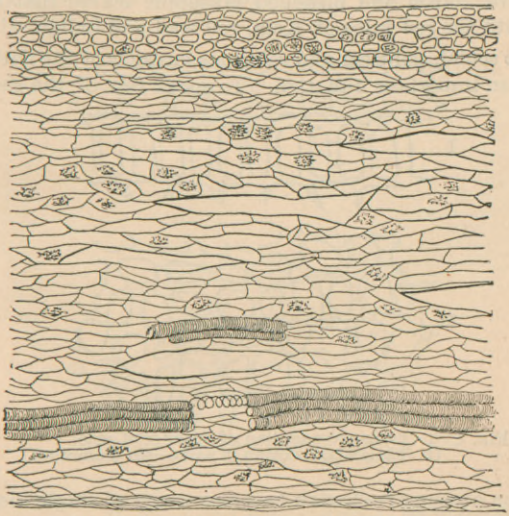


FIG. 8.—Longitudinal section of the carpel of Kola. (Zohlenhofer).

If a section of the cotyledon be warmed with potassium chlorate and hydrochloric acid to dryness and then exposed to the fumes of ammonia gas the well-known Murexoin test for caffeine is obtained.

Native Uses.

Among the inhabitants of a large portion of tropical and equatorial Africa, Kola is at once a necessity and a luxury. The fresh seed is generally employed as a masticatory to resist fatigue, hunger and thirst, while the dried seed is mainly used as an aliment. The

former is in greatest demand; nevertheless, those living far in the interior often give, even for dry Kola, weight for weight in gold dust. Tea and coffee, though containing the principle most abundant in the Kola nut, have no charms for the blacks, who constantly nibble at Kola while engaged in gathering coffee berries.

Carefully dried, reduced to an impalpable powder, and served with honey an milk, Kola makes and agreeable beverage which is said to be equal in flavor and much superior in nutriment to the finest cocoas.

Captain Binger, a prominent explorer, in speaking of *Bobodi oulossou*, says that he noticed women manufacturing various articles out of cotton and bleached pineapple leaves that had been colored with the red juice of Kola, red lead and indigo.

In the social, political and religious customs of the natives Kola performs an important function. To speak first of the social rela-

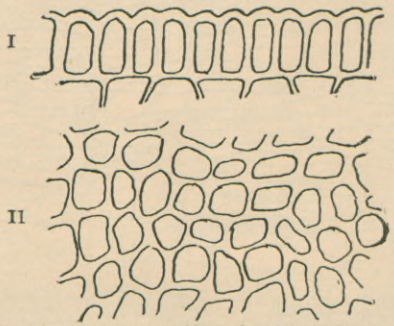


FIG. 9.—I—Transverse section of outer seed coat.
II—Tangential section of same—400 diameters.

tions, when a young barbarian becomes weary of single blessedness, he sends with his appeal to the chosen one's mother, one or more white Kola seeds, and with trembling and anxiety awaits the reply. If the white Kola be returned by the mother the youth knows that his suit has met with favor, and at once proceeds to prepare for the wedding ceremony. A red seed, on the other hand, tells him that he is rejected, and after passing a few days or several weeks in humiliation and melancholy he proceeds to select another. Formerly, no marriage gift of the bridegroom to the father would be deemed acceptable for the purchase of his daughter, if a goodly number of Kola seeds were not included.

The presentation of a few Kola seeds to a white trader or a native personage of rank visiting any chief, constitutes the highest

compliment that can be paid, as it conveys an assurance of friendly welcome and protection. In certain parts of this mysterious country no business of any import can be transacted between two parties, unless at least one of the nuts be previously eaten.

Again, on the departure of a guest, the host expresses his farewell by the gift of a few Kolas. To not a few of these visitors, actuated by commercial or political motives to travel great distances, no courtesy could be more acceptable, for experience has often demonstrated that the use of the Kola nut not only supports the strength, allays inordinate appetite, assuages thirst and assists digestion, but that it renders the traveler more capable of sustaining the fatigue of his homeward journey than any other product that can be obtained.

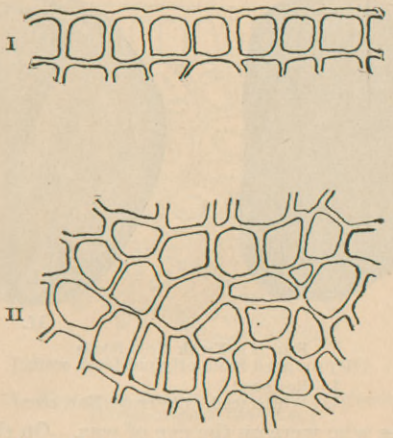


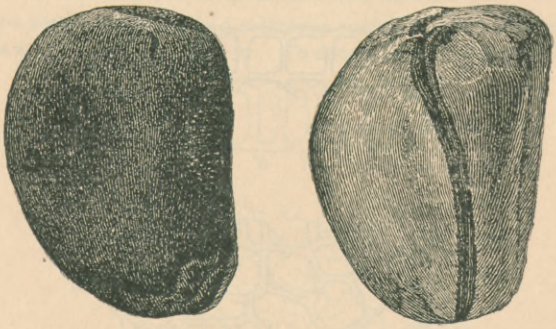
FIG. 10.—I—Transverse section of inner seed coat.
II—Tangential section of same—400 diameters.

At the death of a friend a quantity of Kola sufficient to nourish and strengthen the deceased on his long journey is placed in the grave.

Turning now to the religious uses of Kola, we note that the Mahommedans declare it to be a fruit of divine origin, introduced by the prophet himself and intended to drive out the evil spirit, expel disease and prevent plague. Dr. Rancon, the eminent explorer, says that the *Bambaras* and the *Malinkés*, swear upon the Kola, as is done upon the Bible in Christian countries. For instance, he says, suppose a dispute has arisen between two blacks. The accused, if he denies the statement of his accuser, must be summoned be-

fore the principal priest, who is generally a blacksmith, and take oath upon the Kola. Igniting a little straw fire, the priest takes a sound Kola and singes it slightly for the purpose of purifying it. Taking it then in the left hand he punctures it in many places with the point of a knife for the purpose of demonstrating its soundness. He now repeats this form of oath: "I swear that I am not guilty of the act of which I am accused; if I speak falsely, I hope that this one Kola which I am now going to eat will poison me in as many days." After repeating this oath, the offender immediately swallows the Kola whole. In order to prove that he is not feigning he is then given a gourd of water to drink.

In the political relations of the tribes in Western Africa, the Kola seed often performed the part of a mediator between two



I. II.

FIG. 11.—Fresh Kola Seeds.
[Reproduced from original fresh seeds.]
I.—Red seed.
II.—White seed. (Average Nat. size.)

beligerent tribes who were on the eve of war. On the centre of an elevated mound of earth some red and white Kola seeds were placed. If one of the red seeds was taken by either tribe, it was considered by the other a silent invitation to fight; while if a white one was removed, peace was at once declared.

Examples of this kind might be continued indefinitely, but enough have been given to show its value among the natives. Is it not remarkable that this drug and its wonderful properties should be unknown to the civilized world until recently?

Substitutions and Adulterations.

In addition to the true Kola there is another seed which unfortunately bears a similar name and is the cause of much confusion. It is called male or bitter Kola, and is employed for pur-

poses similar to those for which true Kola is eaten. It must be borne in mind that bitter Kola has properties and uses peculiarly its own. To make this statement clear, we may say that false Kola bears the same relation to true Kola that Blue Cohosh does to Black Cohosh. The two Kolas do not belong to the same natural order, neither do Black and Blue Cohosh. The principles are not alike in each, although they have some properties in common. This is one reason why false Kola is never used to adulterate the genuine article. It is rarely found with the true article, since their external features are so entirely different that a mixture of the two would be at once detected.

After inquiring of the leading jobbers in rare crude drugs in New York, Germany, England and Africa for a quantity of false

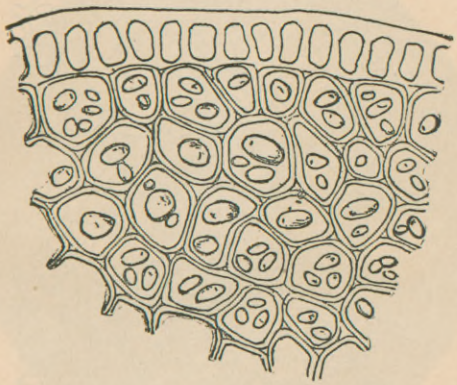


FIG. 12.—Tranverse section of cotyledon of fresh Kola.
[From original drawing.]

Kola, only two seeds carefully wrapped in cotton could be obtained. So it will be seen that the false Kola does not leave the localities where it grows.

A pound of a five-cotyledoned seed was purchased in New York for false Kola, but both chemical and microscopical examination proved it to be an inferior variety of *Sterculia*. It agreed in every particular with Heckel's description of *Cola Ballayi* Cornu, which is very small in size and weak in alkaloids. In 1875 Maxwell T. Masters described and figured in the Journal of Botany, bitter Kola, of which the illustration given is a reproduction. (See Fig. 15.) He at once determined it to be a product of the Guttiferæ, but not having at his disposal the parts necessary for exact identification, he described it as *Garcinia Kola* Mast.

Eight years later Heckel also made an analysis, but having experienced the same difficulty in obtaining the necessary material, he could add nothing new to the description of Masters.

Messrs. Heckel and Schlagdenhauffen[1] attempted to obtain from the various parts of the eastern coast specimens of the plant yielding bitter Kola, and although the flowers did not reach them, they received specimens of the branches, leaves and fruits, together with a sufficient quantity of the seed to allow of a complete analysis being made. All the specimens received from various

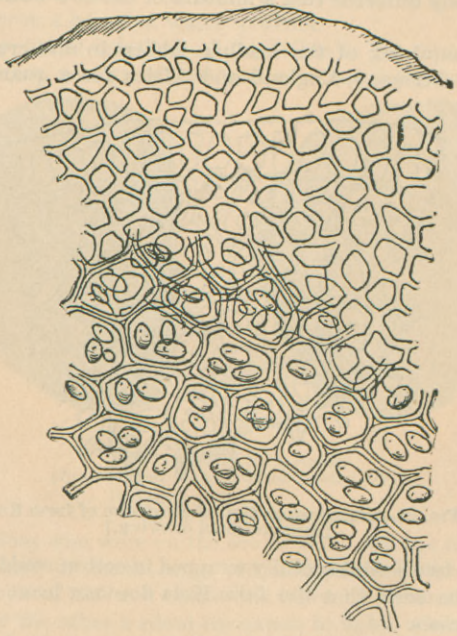


FIG. 13.—Tangential section of cotyledon of fresh Kola.
[From original drawing.]

places corresponded in their characters and showed that the bitter Kola is the product of a single Guttiferous species and not of several. From the material at their disposal the authors referred it to a new species, *Garcinia Kola*, Heckel. The plant is described as a tree of variable aspect, ten to twenty feet in height, bearing towards the base of the branches large opposite leaves (twelve inches long by seven inches broad), with short petioles, whilst at

[1] Journ. de Pharm. et de Chimie [5], vii., p. 553, viii., p. 81, 177.

the extremity of the branches the leaves are much smaller (five inches by two inches). The leaves are oval, slightly dilated at the base, mucronate at the apex, without stipules, full green on the upper surface and greyish underneath. The fruit is a berry about the size of an apple, with a rugose epiderm covered entirely with rough hairs. It presents three or four divisions, each containing a large oval cuneiform seed, rounded on the external and angular on the internal face; the seeds are covered with an abundant sourish yellowish pulp, constituting a true arillus. The fruit has at the base the persistent calyx still adherent to the peduncle, and sometimes the persistent corolla, and at the apex the persistent stigma. The

FIG. 14.—Kola Starch—450 diameters.
[From original drawing.]

plant is reported to occur all along the eastern coast of Africa and of Senegal, intermixed with the *Sterculia acuminata*, flourishing under the same conditions, but less widely distributed. In its known characters the plant appears to be closely allied with Garcinia Morella, which, however, is essentially an Asiatic species. The seeds present one convex and two plane surfaces, the former being towards the circumference of the fruit. They are covered by an apricot-yellow episperm, below which is a large yellowish white macropodous embryo devoid of cotyledons, with numerous depressions on its surface. The tissue is denser and closer than that

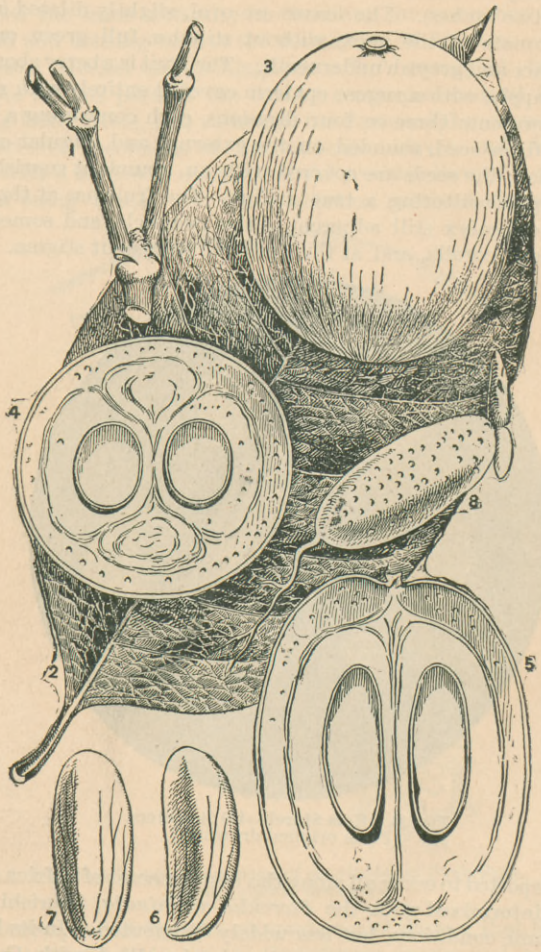


FIG. 15.—False Kola (*Garcinia Kola*)—One-half natural size.
[Redrawn from Journal of Botany, Vol. XIII.]

1. Portion of branch.
2. Leaf.
3. Fruit.
4. Transverse section of fruit.
5. Vertical section of fruit.
6, 7. Seeds.
8. Germinating embryo.

of true Kola and crackles under the teeth; it consists of a compact mass of very homogeneous cellular tissue interspersed here and there with laticiferous vessels of varying size containing resin, the cells constituting which are filled with starch granules larger than those occurring in true Kola."

"Upon chewing these seeds, a strongly bitter astringent, and yet aromatic taste is perceptible, which is quite different from that of true Kola and approaches in its aromatic flavor that of green coffee; it is this aromatic flavor that is esteemed by the negroes. It is worthy of remark that although the use of these seeds does not

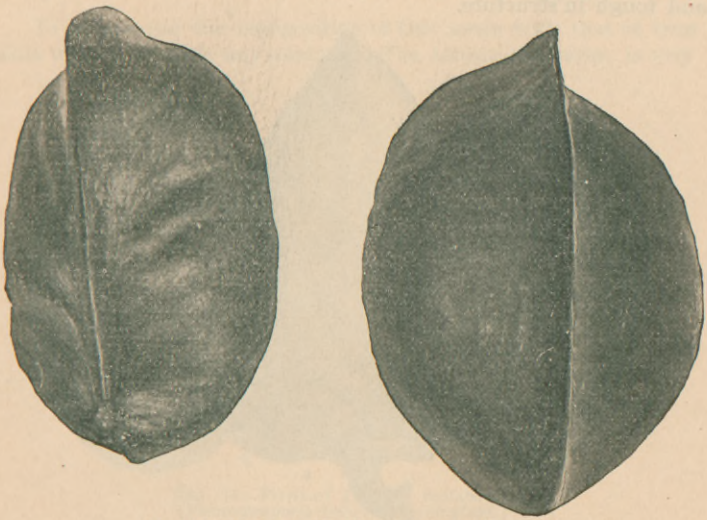


FIG. 16.—Fruit of *Heritiera littoralis* (Nat. size).
[Photographed direct from original.]
Dorsal side. Ventral side.

produce any notable stimulant effects or ward off fatigue, they are as much sought after and bring nearly as high a price on the Eastern coast as the true Kola. In the interior, however, they are unknown. The authors are of the opinion that these seeds owe their properties to the resin they contain, which is slightly stimulant. By the negroes they are thought to exercise an aphrodisiac action, which the authors consider doubtful, and as a masticatory they are said to be a valuable remedy for colds."

"An examination of fresh male Kola nuts for caffeine gave negative results, the chloroform, ether and alcoholic percolates, being all free from alkaloid. Besides coloring matter, tannin and

glucose, two resins were separated. One of these was brown, hygrometric and soluble in ether and melted at the temperature of the water bath; the other was yellowish white, soluble in ether, alcohol, acetone and acetic acid, insoluble in carbon bisulphide or petroleum spirit and had a high melting point."

Heritiera Littoralis, Aiton==Sterculiaceæ.

The fruit of this tree could not possibly be mistaken for that of Kola. (See Fig. 16.) It is smaller, lighter colored and indehiscent; the pericarp is proportionately thicker, lustrous and more woody and tough in structure.

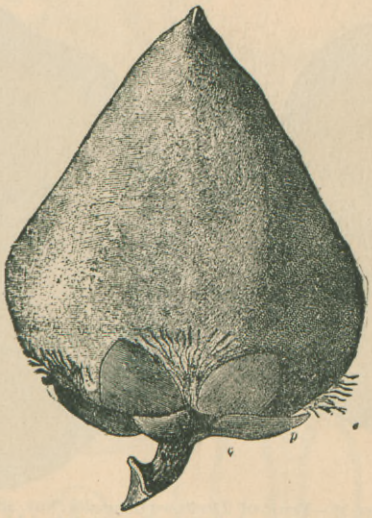


FIG. 17.—Fruit of *Pentadesma butyraceæ* (one-third nat. size).

The seed, which is the part employed as an admixture to true Kola, is loosely enclosed within a membranaceous irregularly striated testa. It is somewhat orbicular in shape, being flattened parallel to the shorter axis of the cotyledon, and is chocolate brown in color. It could be mixed with the smaller seeds of true Kola in moderate quantities as easily and with as little danger of detection as artificial coffee is added to the better qualities.

This drug is the product of a tree growing in eastern Africa, India, Phillipine Islands, and Australia. A careful examination of its external and microscopic features will at once distinguish it. One of the cotyledons is generally smaller and often partly em-

braced by the other. The analysis of Heckel and Schlagdenhauffen gave the following results:

Oil	4.366
Tannin and coloring matter	4.983
Sugar	5.738
Sodium chloride	.288
Cellulose and starch	55.987
Albuminous matter	13.537
Lignin	12.367
Fixed salts	2.645
Loss	.089
	100.000

In comparing the composition of this grain with that of true Kola we see scarcely any analogy. The tannin, however, is very

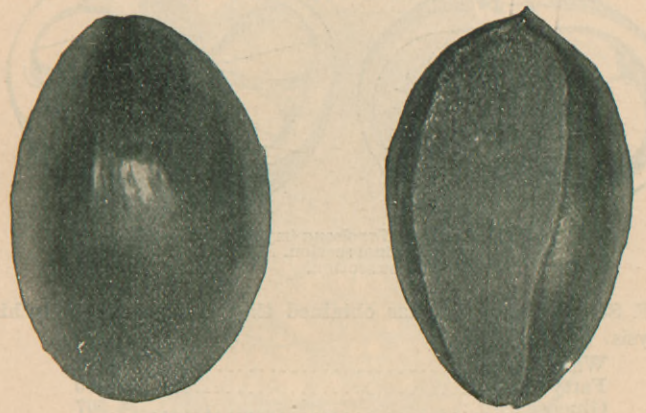


FIG. 18.—Fruit of *Lacuma mammosa*.
[Photographed direct from original.]

similar to Kola-tannic acid. Fat is present in ten times greater quantity. Although not dangerous, this substitution is reprehensible.

Pentadesma Butyraceæ, Don.—Clusiaceæ.

This seed, called "Kanya," seems to be found with Kola exported from certain countries only. Kola nut marketed in Sierra Leone has never been known to contain any "Kanya" seeds, but Messrs. Heckel and Schlagdenhauffen state that they have frequently found them as adulterants, and that they are difficult of identification.

The tree grows to a height of 30 to 35 feet upon the west coast

of Africa somewhat to the north. The bark contains a peculiar yellowish resin which, although odorless and tasteless, is said to be somewhat poisonous.

The fruit is a pyriform capsule, provided with a hard pericarp. (See Fig. 17,) Numerous resin canals penetrate the entire fruit coat which, when ruptured, exudes a reddish resin.

The seeds, of which there are three to five in each capsule, are particularly interesting, since they contain an abundance of a fatty matter called by the natives "Kanya butter." In color and appearance they resemble true Kola.

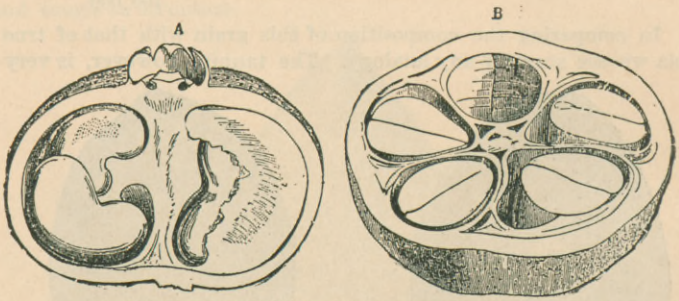


FIG. 19.—Fruit of *Napoleona imperialis* (Heckel).
A.—Longitudinal section.
B.—Transverse section.

F. Schlagdenhauffen has obtained the following results in his analysis.

Water	5.242
Fatty matter	32.500
Glucose	4.507
Tannin and phlobaphene	6.705
Tannin and coloring matter	8.869
Salts	1.700
Lignin, cellulose, etc	40.477
	100.000

Notice the entire absence of starch and alkaloids.

Lucuma Mammosa, Griesel--Sapotaceæ.

"Still more recently Helbing found seeds offered as Kola which were those of *Lucuma mammosa.* It is interesting that these nuts give off even in the dry state a very strong smell of prussic acid, a property which is not known to be possessed by any other fruit. The seeds contain a large amount of fatty oil and are used in the West Indies on account of their aroma as a condiment. They are

sometimes also termed Sapote, which indicates that they belong to the Sapotaceæ."[1]

Some of the fruit of which an illustration is given (See Fig. 18), was obtained from Dr. Schuchardt of Germany. There was no odor of prussic acid apparent, but instead a very decided odor of acetic acid, probably due to fermentation. As the seeds were somewhat altered in their condition no accurate description or illustration can be given. The writer does not believe that this seed will be used very much as an adulterant.

Coula Edulis, Baillon--Oleaceæ.

Because of the similarity in pronunciation of the names Kola

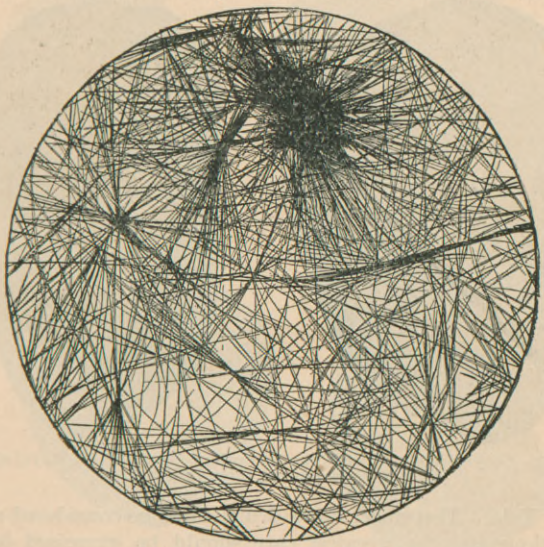


FIG. 20.—Crystals of Caffeine.

and Coula, it was thought worthy merely to mention the latter, although to our knowledge it has not been used with fraudulent intentions. If any further information is desired upon the subject an illustrated article may be found in Dingler's Polytechnic Journal, Vol. 238, p. 430.

Napoleona Imperialis, Beauv.

M. Autran, in a communication to E. Heckel, writes that there

[1] Notes on New Remedies, 1891, p, 11.

existed at Gabon a medicinal Kola differing in general features from those already known. This is a false Kola and is constituted by reddish, kidney-shaped beans, possessing a bitter taste somewhat resembling that of Kola. The illustration given is reproduced from the "*Traité général de botanique*," Le Maoût et Decaisne. (See Fig. 19).

Whether in the fresh or dry condition this seed is easily distinguished from genuine Kola by its external characteristics. A superficial examination by Heckel and Schlagdenhauffen revealed the presence of a large amount of saponine.

To recapitulate, it may be recalled that of all the sophistications above mentioned none contain the characteristic active prin-

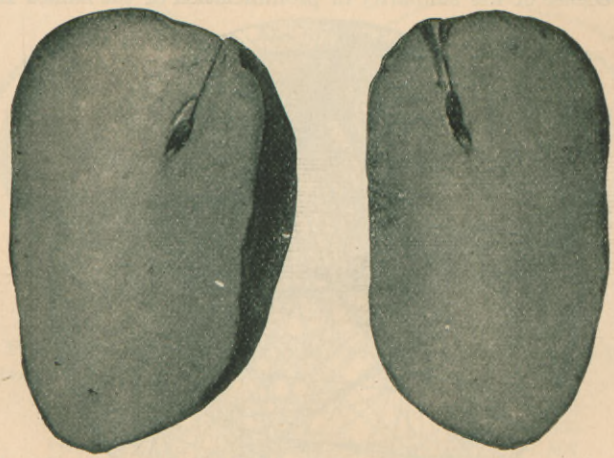


FIG. 21.—Cotyledons of fresh Kola (*Sterculia acuminata*)—Natural size. [Photographed direct from original.]

ciples of Kola. Therefore, these drugs must be considered as base adulterations and the greatest care should be exercised in purchasing and preparing Kola for use as a medicine and food.

Diseased Conditions of Kola.

Among the dangers to which fresh Kola in transit is exposed, is the development of a fungus which rapidly spreads from seed to seed, and, if not opportunely attended to, ultimately destroys the whole consignment. Even those seeds but slightly attacked possess a disagreeable odor and are devoid of the characteristic aroma and taste of the sound, fresh Kola. The quantity of the active principles also constantly diminishes as the growth of the fungus pro-

ceeds. When any mold is noticed those seeds affected should be removed, and if beyond recovery should be thrown away or burned. The others are then carefully washed and repacked in moist sawdust, clay, marl, or thick succulent leaves. In hot weather they should be sprinkled occasionally if it is desired to keep them perfectly fresh.

Chloroform vapor is often employed, as is well known, to check the growth of fungi. It was tried on a specimen of about two pounds of the white seeds which were placed in a glass jar

FIG. 22.—Dried Kola—Average natural size.
[Photographed direct from original.]

filled with an atmosphere of chloroform vapor. The fungus was killed and none other developed, but the original light yellowish green color of the seed was changed within a half hour to a brick red. As a specimen for a museum its usefulness was destroyed, but for practical purposes it remained unchanged.

Dr Nachtigall, in his book, "Sahara and Soudan," describes at length two forms of Kola disease. The first, called *Hillé*, transforms the seed little by little into a whitish, pulverulent mass. By cutting the diseased portion away, the remainder can be saved. If

the nut is completely attacked there is but one thing to do, and that is to throw it away. Messrs. Chodat et Chuit (*Étude sur les noix de Kola*) have determined that this disease is due to microorganisms that assume the form of excessively small, spherical micrococci and also of ordinary isolated bacteria or bacilli. These organisms destroy first the coloring matter and the tannin which impregnate the cell walls which consequently become white in color. If the bacterial action continues, the wall itself is destroyed and the starch set free, which later begins to be eroded, although it resists the action more strongly than does the cell wall.

A second disease named *Dasemséra*, is produced when the nuts are exposed to excessive moisture. The interior becomes hard and brittle, while the exterior peals off in dark scales.

Chemistry of Kola.

It was more than two centuries ago that Dapper, the traveler, remarked that Kola or Guru nut, "as experience teacheth, eaten in the evening hindereth sleep." [1] Yet not until 1865 did the knowledge of this and other equally important properties stimulate efforts to unravel the secret. In that year Dr. Daniell, having noticed the effect upon him of chewing the fresh seeds, and being struck by the close resemblance of the physiological action of Kola to that of tea and coffee, was led to suspect the presence of a substance in Kola analogous to theine. In order to verify his suspicions he decided to make a chemical examination. Accordingly, preparing a strong decoction of Kola, he precipitated the coloring matter with lead acetate, and removed the excess of lead from the filtrate by means of hydrogen sulphide. After filtering, he evaporated the nearly colorless liquid to a small volume and set it aside to cool, when long, silky, needle-shaped crystals separated. To all appearances this deposit was identical with a sample of theine which he possessed and which he knew to be pure. In addition to the effects he had experienced after chewing the fresh seeds, the discovery, by a rough chemical manipulation, of a crystalline principle similar in external features to theine, strengthened the belief of Dr. Daniell that Kola contained this latter principle. For the purpose of having his views substantiated he enlisted the services of a practical chemist, Dr. Attfield, at whose disposal he placed a sufficient quantity of the drug. The results of Dr. Attfield's examination and his conclusions as to the value of Kola as a food and medicine were published in Pharm. Jour. (2), VI., p. 456. The complete analysis is here given for the purpose of comparing it with the results obtained by modern investigators.

[1] Ogilvy's Africa, p. 494.

Composition.

Water	13.65
Cell wall and coloring matter	20.00
Starch	42.50
Volatile oil	1.52
Fixed fat	6.33
Albuminoid substances, Gum, Sugar, Other organic matter	10.67
Ash	3.20
Theine	2.13
	100.00

It will be noticed that the total alkaloids are calculated as theine, the existence of theobromine in Kola not having been established at that time. It is rather remarkable that no tannin was found, since a watery decoction will at once give the characteristic color reaction upon the addition of a test solution of iron. Even when tested microchemically, the presence of tannin is readily detected.

Satisfied that the analytic methods employed by the English chemist were open to criticism, Messrs. Heckel and Schlagdenhauffen decided to study the chemistry of Kola according to the more modern methods of research. The details of their work fill many pages in their monograph, entitled *Sur les Kolas Africains.*

For the purpose of determining the best and most rapid solvent for the extraction of the alkaloids, the finely powdered Kola was percolated with water, alcohol, chloroform, carbon bisulphide, and ether. They found that chloroform was pre-eminently the proper menstruum, while cold water was the least satisfactory.

The following is the composition of Kola as determined by them:

Caffeine	2.348		
Theobromine	0.023	Soluble in chloroform	2.983
Tannin	0.027		
Fatty body	0.585		
Tannin	1.591		
Kola red	1.290		
Glucose	2.875	Soluble in alcohol	5.826
Fixed salts	0.070		
Starch	33.754		33.754
Gum	3.040		3.040
Coloring matter	2.561		2.561
Proteid matter	6.761		6.761
Ash	3.325		2.325
Water	11.916		11.919
Cellulose, by difference	29.831		29.831
	100.000		100.000

These results, since they agree on the whole with those obtained by other recent workers, may be accepted as the true composition of Kola. One point, however, is worthy of mention, namely, that the percentage of caffeine varies considerably with the locality from which the drug is obtained. This may explain in a measure why chemists sometimes obtain low percentages of caffeine from Kola purchased in open market.

During the process of roasting, coffee loses some of its caffeine. The same is true of Kola, hence the care which has been exercised in drying is an important factor in determining the value of the drug.

Reasoning by analogy, Heckel suspected the presence of caffeine in Kola leaves, but several carefully conducted analyses failed to reveal the slightest trace. The same was true with the bark and wood. In the case of the pericarp, however, an appreciable quantity of alkaloid was separated.

The following analysis of Kola in comparison with that of the tea leaf, coffee berry and cacao seed will be found instructive, in that it demonstrates the superiority of the former to the other nerve stimulants and tonics:

	Cacao.	Coffee.	Tea. Green.	Tea. Black.	Kola. Heckel & Schlagenhauffen.
Fat	53.00	13.00	0.28	.....	0.585
Proteid matters	13.00	13.00	3.00	2.80	6.761
Theobromine	1.50	.....	.....	.....	0.023
Caffeine	.....	1.01	2.16	2.00	2.348
Essential oil	0.40	0.003	0.79	0.60	Undet.
Resin	.....	.....	2.22	3.64	.....
Sugar	0.50	.....	.....	.....	2.875
Starch	.....	15.50	.....	.....	33.754
Gum	.....	.....	8.58	7.28	3.040
Cellulose	.....	34.00	17.08	26.18	29.831
Coloring matters	.....	.....	17.24	19.20	2.561
Coloring matters	5.001	.....	2.222	1.843	1.2904
Extractive	.....	.....	22.80	19.88	.....
Tannin	.....	.....	17.80	12.88	1.618
Ash	3.60	6.697	5.46	5.24	3.325
Water	6.00	12.00	.....	.....	11.919
	100.005	100.000	100.00	100.00	100.000

1 Cacao red.
2, 3 Chlorophyl.
4 Kolanin.
5 The total results do not foot up 100 but they have been placed here just as given in the original paper.

It will be observed from the above statistics that Kola far excels both tea and coffee in the quantity of the invigorating principle caffeine, which is practically the only valuable exhilarating constituent of these nerve excitants. More than this, it contains an

appreciable quantity of theobromine, which increases or intensifies the action of caffeine. This principle is also present in cacao but is entirely wanting in tea and coffee. Besides these stimulants, there is a glucosidal principle called kolanin, which is peculiar alone to Kola. Experiments have been made to prove that it is to this principle that the superior action of Kola is due; but whether this be so or not, there can be no question that Kola combines in itself the wonderful powers of the chief invigorants of the world, tea, coffee and cacao.

Caffeine—$C_8H_{10}N_4O_2 + H_2O$.

Tri-methyl-xanthine.

Synonyms.—Coffeine, Theine, Gauranine, Methyl-theobromine.

Caffeine is a proximate principle of feebly alkaloidal power. It exists in the fruit (pericarp and seeds) of Kola (*Sterculia acuminata*), in the fruit and leaves of the coffee tree (*Coffea arabica*), in the leaves and flowers of the tea plant (*Thea chinensis*), in the seed paste Gaurana (*Paulinia sorbilis*), and in the leaves and twigs of Paraguay tea (*Ilex paraguayensis*)[1].

Caffeine was discovered in 1820, almost simultaneously by Runge, Pelletier and Caventou, and Robiquet. In 1883 both Jobst and Mulder established the identity of Theine and Caffeine. A little later Martius found the alkaloid in Gaurana to be identical with Caffeine. Stenhause discovered Caffeine in Paraguay tea. In 1865 Dr. Daniell separated an alkaloid from Kola which he believed to be Theine. His result was substantiated later by Dr. Attfield.

Properties.—Fleecy masses of long, flexible, white crystals (See Fig. 20), possessing a silky lustre, without odor, having a bitter taste and permanent in the air.

Soluble at 15° C. (59° F.) in 80 parts of water, 33 parts of alcohol, 555 parts of ether, and 7 parts of chloroform. Also soluble in 9.5 parts of boiling water, and very soluble in boiling alcohol.

When heated to 100° C. (212° F.) Caffeine loses its water of crystallization, and at 229° C. (444° F.) it melts, forming a colorless liquid. When ignited, Caffeine is completely volatilized without charring or leaving a residue.

Caffeine is neutral to litmus paper.

Although Caffeine forms definite salts with many acids the Pharmacopœia recognizes but one—Caffeinæ Citras.

The salts of Caffeine are decomposed by water or dilute acids.

Tests for Identity.

1. A neutral or acid solution of Caffeine is not affected by

[1] Caffeine is also said to occur in the North American Apalachian tea and in the South American Bush tea, the former of which comes from various species of *Ilex*, and the latter from *Cyclopia*.

iodo-potassic iodide, Mayer's reagent, picric acid, or potassium ferrocyanide.

2. A distinct yellowish white precipitate is obtained with solution of phospho-molybdic acid.

3. Crystalline precipitates are immediately produced with Caffeine by a 5 per cent solution of mercuric chloride and a .5 per cent solution of mercuric bromide. After an hour or more a precipitate is obtained with a 15 per cent solution of mercuric cyanide.

4. An abundant white precipitate is produced with a fresh 5 per cent solution of tannic acid; the precipitate is soluble in excess of the reagent.

5. If a small quantity of Caffeine be dissolved in about 1 Cc. of hydrochloric acid, a little potassium chlorate added, the whole evaporated to dryness on a water bath, and the capsule then inverted over a vessel containing a few drops of ammonia water, the residue will acquire a rich purple color, which is destroyed by alkali.

6. Caffeine possesses a reducing power nearly equal to that of morphine. If a fragment of Caffeine be mixed with an equal quantity of chloride of gold on a porcelain dish and a few drops of caustic potash be added, the application of a moderate heat will cause a marked reduction of metallic gold.

7. To a mixture of ammoniacal silver nitrate and Caffeine add a little caustic potash and apply moderate heat. A rapid reduction of silver is noted.

A silver mirror can be made by boiling in a dry test tube a mixture of ammoniacal silver nitrate and acetate of Caffeine with a few drops of caustic soda solution.

8. The reduction test with iodic acid can be made at the temperature of the water bath.

9. A sulphuric acid solution of molybdic acid heated with a small quantity of Caffeine on the water bath produces in a few moments an intense blue coloration.

Estimation of Total Alkaloids in Kola.

Place ten grams of the drug, No. 80 powder, in a continuous extraction apparatus and percolate with chloroform for ten hours. Rapidly filter the straw colored liquid through a small dry filter into a beaker, and wash the flask and the filter with several portions of chloroform. Drive off the chloroform and treat the light yellow residue with several small portions of hot water. Filter through a small filter to separate waxy matter. Evaporate the filtrate in a tared beaker and dry at 100° C. Cool and weigh as total alkaloids

In case the alkaloids are not perfectly white, digest on the water bath for fifteen minutes with 25 Cc. of one per cent sulphuric acid. Filter into a separatory funnel and wash both beaker and filter with two portions of 10 Cc. of water. Make alkaline with strong ammonia and shake out three times with

chloroform, once with 25 Cc. and twice with 10 Cc. Evaporate, dry and weigh.

Theobromine—$C_7 H_8 N_4 O_2$.

Di=methyl=xanthine.

Theobromine exists in the cotyledons of Kola (*Sterculia acuminata*), and in the cotyledons and shells of Cacao (*Theobroma Cacao*).

It was discovered by M. Wosresensky in 1841. It is produced by heating the lead compound of xanthine with methyl iodide at 100° C. (E. Fischer). It can be made also by first converting guanine—a principle found in Peruvian guano—into xanthine and this then into Theobromine.

Theobromine occurs as a white crystalline powder possessing a bitter taste; permanent in the air. It is neutral to litmus.

It acts as a weak base uniting with acids to form definite salts.

Theobromine is soluble in 1600 parts of cold water; in 150 parts of hot water; in 4300 parts of cold alcohol; and in 430 parts of boiling alcohol. It is also soluble in 105 parts of hot chloroform and very easily soluble in a water solution of the fixed alkalies.

Tests for identity may be found in Prescott's *Organic Analysis* and Flückiger's *Reactions* (Nagelvoort).

Approximate separation of the Theobromine from Caffeine can be effected by means of benzol, which dissolves Caffeine and leaves Theobromine behind. A second more accurate method of separation is that given by E. Kunze.

It is based on the production of an insoluble silver compound of Theobromine, and estimation of the amount of metallic silver. The method is given in full in Fresenius *Zeitschrift*, 1894, p. 24.

Kolanin.

While the beneficial effects produced by the administration of Kola are largely due to the caffeine and theobromine which it contains, the decided neuro-muscular action, so peculiar to this drug, cannot be entirely ascribed to these principles. Heckel discovered that the residue of Kola left after completely exhausting it of its free alkaloid, still exerted marked activity upon the system. He concluded that of the remaining constituents found in Kola, only one could possibly be responsible for this action, namely, the red coloring matter which he called Kola red, [1] and which he supposed, though,

[1] Unfortunately the name Kola red is applied to two different substances and much confusion has resulted. Kolanin and the Kola red of Heckel are identical. Efforts should be made to discard the use of Kola red as a name for the glucoside.

as we shall see, wrongly, to be a simple compound. By subjecting this compound to a subliming heat, he obtained a crystalline sublimate of caffeine, which he believed must have been held mechanically in the resinous extractive of the coloring matter, and which thus resisted the solvent action of chloroform. Postponing the investigation into the chemistry of this substance for the time, Heckel confined his attention to its physiological action. Numerous experiments were made by him and later by Dr. Marie[1] upon the comparative action of Kola red, so-called, Kola and caffeine; the remarkably concordant results establishing beyond question the therapeutic power of what he called Kola red.

Inspired by the favorable reports of these investigators Dr. E. Knebel[2] carried on in the Pharmaceutical Institute at Erlangen an investigation into the chemical nature of this coloring matter. He proved that there existed in the Kola red of Heckel a glucoside, which on heating with water or dilute acids was converted into caffeine, glucose, and a coloring matter to which the name Kola red is properly applied. This glucoside he named Kolanin.

He does not believe that caffeine, glucose and Kola red exist as such in the green, or ripe fresh seed, but rather that they are chemically combined as Kolanin, which is partially decomposed during the process of drying by the action of a diastatic ferment which he has successfully isolated. Unfortunately the fresh seeds were not at his disposal at the time, so that he might verify his theory.[3] He calls attention. however, to the nearly molecular proportion in which caffeine and glucose existed in all the samples he had examined, as a strong argument in favor of his views. As further evidence, he cites the oft-repeated statement of African explorers that when fresh Kola is masticated it is at first very bitter, but is soon followed by a pleasant, sweet taste. This phenomenon is due, no doubt, to the glucose resulting from the decomposition of Kolanin. In the same way we may explain the secret of the reputed power which Kola possesses of making drinking water more palatable.

Kola suffers decomposition quite readily in weak mineral acids, or even in water alone, but not without some alteration of the Kola red, which, by the way, is a rather unstable body. The decomposition takes place very rapidly by means of acetyl chlorid. When the product obtained by the action of this substance upon Kolanin is thrown into water, glucose and caffeine at once go into solution, while the acetyl derivative of Kola red separates as a yellowish

[1] Thesis "Étude expérimentale et comparée de l'action du rouge de Kola, de la caféine et de la poudre Kola sur la contraction musculaire," 1892.
[2] Apotheker Zeitung, 1892, p. 112.
[3] The results of Dr. E. Knebel were confirmed six months later by A. Hilger and Dr. Kippenberger, and reported in the *Apotheker Zeitung*, 1892, p. 469.

precipitate. From this comparatively pure product Knebel was enabled to determine the following elementary composition of Kola red: $C_{14}H_{13}(OH)_5$.

He calls attention to the close relationship existing between Kola red and the tannins, since both have the same number of hydroxyl groups and in each case pyrocatechin, formic, acetic and isobutyric acids are formed when they are fused with caustic potash. He thinks it not at all improbable that Kola red is largely converted into tannic acid during the drying of the fresh seed, as shown by the following equation:

$$C_{14}H_{18}O_5+O_8=C_{14}H_{10}O_9+4H_2O.$$

The details of the method for detecting and separating the ferment above spoken of, having been omitted from Knebel's original paper, Heckel sought by indirect methods to prove its presence in Kola. Recalling the conditions necessary for the action of unorganized ferments and the precautions necessary to prevent their decomposition, it would seem but reasonable to assume that the ferment in Kola would respond in a similar manner. Accordingly, a sample of Kola was treated with chloroform in a continuous extraction apparatus for twelve days. Three portions of five grams of the dried exhausted powder were digested with cold water, water at 100° C., and 1 per cent hydrochloric acid respectively for six hours. The usual method of assay yielded the following percentages of alkaloid:

I.	II.	III.
.042 Gm.	.021 Gm.	.072 Gm.

That is to say, 100 Gm. of powdered Kola previously exhausted of its free alkaloid contained a sufficient quantity of Kolanin to yield by the action of the three manipulations respectively, .840 Gm., .420 Gm., and 1.440 Gm. additional alkaloid. It will be noticed that the action of hot water diminishes by one-half the yield of alkaloid, while with one per cent of hydrochloric acid the largest amount was developed.

These results were repeatedly verified by C. O. Topping[1] who recently worked upon the chemistry of Kola. He also found that when a specimen of previously exhausted Kola was plunged into boiling water, then boiled with a little water for five minutes, cooled, acidulated with hydrochloric acid and allowed to stand for twenty-four hours, the filtrate gave absolutely no test for caffeine. Although he did not separate the ferment, there is but one inter-

[1] Graduating thesis for Degree of Pharmaceutical Chemist, University of Michigan, 1894.

pretation that can be placed upon these results, namely, that there exists in Kola a glucoside, which under suitable conditions of heat and moisture, is acted upon by a ferment contained therein, to form caffeine, glucose, and Kola red.

Hereafter as a result of the discoveries recently made, the actual value of Kola can be accurately determined. It no longer suffices to estimate the percentage of caffeine; it is of the highest importance to know the amount of Kolanin, the source of nascent caffeine, as well. The action of Kola on the organism, which has remained partially obscure for so long a time, can now be satisfactorily explained.

ADDENDUM.

Under "Tests for Identity" on page 37, the statement is made that a neutral or acid solution of Caffeine is not affected by iodopotassic iodide. Although this is repeated by the latest authorities on the subject, it has since been found to be only partially true.

While a neutral solution of Caffeine is not affected by iodopotassic iodide, a heavy, flocculent, deep brown precipitate is instantly produced in an acid solution.

An investigation into the nature of this iodine compound is now being made, and a report thereon will be published shortly.

PART II.

Physiological and Therapeutic Action of Kola.

Containing a Study of the Active Constituents of Kola, Physiological and Therapeutic Action of Kola; Kola as a Remedy in Neurasthenia, Nervous Affections, Cardiac Affections, Diarrhœa, Confinement, Alcoholism, and Seasickness.

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Physiological and Therapeutic Action.

Introduction.

As has been previously mentioned, under the head "Historical," the Kola nut has been credited from time immemorial with wonderful properties by the aboriginal races populating the vast extent of territory between Senegambia to the north, and Angola to the south of the equator. It is said that the Kola nut will quench thirst, improve the taste of drinking water, will comfort the stomach, is peculiarly beneficial in all diseases of the liver, will remove the sense of hunger for twenty-four hours while fasting, will greatly stimulate muscular energy; and as a tonic and stimulant, has always attracted the attention of travelers and explorers, who have never failed to mention its enormous consumption and its wonderful virtues. Whatever may be its therapeutic value, it is certainly true that the fresh seed is employed very largely at its native habitat as a masticatory, to arrest fatigue, hunger and thirst, and the dried seed is used extensively as an aliment. It is now important to investigate the claims made for this peculiar drug for the purpose of ascertaining its true value from a scientific standpoint.

Chemists have analyzed Kola and find that it contains caffein, theobromine and kolanin. The physiological action of the first two principles mentioned has been determined by careful physiological tests in the laboratories, and we know, therefore, to a certain extent, the therapeutic value of Kola as a compound. The combined physiological action of the collection of principles found in Kola has not yet been fully determined, however. Until such investigations have been made, I am not prepared to say what the true therapeutic value of the combination is. Therefore, I shall confine myself to the physiological and therapeutic action of caffein and theobromine, leaving it for other investigators to determine the true therapeutic value of Kola as a compound of these peculiar principles. Opium, cinchona, and nux vomica each possess characteristic therapeutic properties as compounds, differing from their contained alkaloids, morphine, quinine and strychnine, yet we are guided

somewhat in the use of these drugs by our knowledge of the properties of the alkaloids mentioned. In the same manner a study of the properties of the alkaloids of Kola taken separately will form a partial guide to determining the true nature of the drug itself as a therapeutic agent. To this has been added, however, the results of clinical work both in hospital and private practice.

Study of the Active Constituents of Kola.

Caffein.

Action on the Nervous System:—Caffein is a rapidly acting stimulant, producing a peculiar wakefulness, increased mental activity, rapidity of thought, and nervous restlessness, which is due, no doubt, to its influence on the brain and spinal cord. The increase of brain power, which is very frequently observed after taking caffein-bearing beverages, is undobtedly real and is due to a direct stimulation of the cerebrum.

According to H. C. Wood[1], the cerebral stimulation of caffein differs from that of opium in that it effects the reasoning faculties at least as profoundly as it does the imagination. Caffein, as well as tea, coffee, and Kola, prepares for both mental and physical work, while opium prepares for the reveries and dreams of the poet.

In man, after internal doses of 0.5–0.6 Gm. (8–9 grains), states of excitement resembling intoxication have been observed, consisting of giddiness, headache, buzzing in the ears, trembling, restlessness, sleeplessness, confusion of thought, delirium and at last drowsiness. In some cases these doses have almost no effect, and even a quantity of 1.5 Gm. (23 grains) did not cause any great degree of poisoning.[2]

Action on the Circulation.—Caffein is freely absorbed and produces no change in the blood. Experiments concerning its action on the heart are contradictory, but there appears to be no doubt that in man moderate doses increase the force of cardiac contractions and the duration of the systole, thus increasing the amount of work done. The diastolic period is shortened and consequently the blood pressure rises. Large doses on the contrary, have a paralyzing effect on the heart.

Caffein has been supposed to increase the pulse rate and blood pressure by stimulating the heart muscle, but from recent studies in this country and abroad it would seem probable that these changes are indirectly produced, and due solely to its stimulating action on the nervous system. Clinically, it certainly seems to

[1] Therapeutics: Its Principles and Practice.
[2] Schmiedeberg. Elements of Pharmacology.

raise the blood pressure in almost every instance where it is employed.[1]

Action on the Respiration and Temperature.—Though not markedly affected, the respiration is said to be excited by therapeutic doses of caffein, because of its stimulating action on the medulla. Large doses depress the respiratory function.

The temperature is not altered by small doses, but is somewhat increased by large doses.

Action on the Muscular System.—The importance of caffein and theobromine in the articles of luxury, coffee, tea, and chocolate, is to be referred to the changes in the muscular and nervous system already described. When, in consequence of weariness of the body, and of exhaustion, the stimulus of the will is being conducted by the nervous system only tardily to the muscles, and when the latter are in such a state that they can only with difficulty put what is left of their potential energy into action, then caffein, on the one hand, removes this increased resistance in the central nervous system, the irritability of which now increases, and, on the other hand, it makes the muscles disposed to pass from the relaxed into the contracted state more easily. The latter result will be lasting if the effect be too strong. While acting thus, the remedy does not necessarily increase either the irritability or the absolute working power of the normal muscle.[2]

Action on the Kidneys.—Upon the ingestion of caffein, the desire to micturate is very frequently experienced, so that the statement of Prof. Gubler[3] that the alkaloid is one of the most powerful and certain diuretics, is apparently confirmed. Both W. von Schröder and A. Langgard found that when a canula was inserted into the ureters of an animal whose vaso-motor system was paralyzed by chloral, injections of caffein into the circulation caused a marked increase in the urinary secretion. Therefore in dropsies, caffein does not act simply by regulating the circulation of the kidney, but it has also a distinct effect upon the renal organ itself. By means of Roy's oncometer, it has been shown that immediately after ingestion of a small dose of caffein the kidney suffers a decided contraction in volume, accompanied with lessening or even arrest of urinary secretion. But soon the organ expands beyond its original volume and the flow of urine increases and even becomes excessive. Thus it is seen that the action of caffein as a diuretic is entirely independent of its influence upon the general circulation. It increases diuresis by direct stimulation of the secretory cells of

[1] Hare. Practical Therapeutics.
[2] Schmiedeberg. Elements of Pharmacology.
[3] Bull. Therap., XC. i. 523.

the uriniferous tubules and therefore increases the amounts of solids as well as liquids in the urine.[1]

Metabolism.—The enormous use made by mankind of substances containing caffein indicates that in some way it is directly of service in the wear and tear of daily life. It is not probable that any of the caffein is assimilated, but it is thought by some authorities to check very greatly the elimination of nitrogen, or in other words to lessen the waste of tissue. This subject was laboriously investigated by Julius Lehmann in 1853, and by F. W. Böcker in 1854 and earlier. Dr. Lehmann found that the exhibition of six grains of caffein daily, the regulated diet being uniform, diminished the elimination of urea from 12 to 20 per cent.[2] Upon tissue waste the drug acts consequently as a depressant and is therefore a conservator of tissues.

Elimination.—According to the experiments of Richard Schneider, caffein when taken in therapeutic doses is entirely destroyed in the system and when taken in toxic amount, is partially destroyed and partially eliminated by the kidneys.[3]

Therapy.—In accordance with the physiological action, caffein is employed in practical medicine as a cerebral and cardiac stimulant. It is often taken to produce wakefulness, and increase the power of labor during excessive work. It is a valuable remedy for the relief of migraine and other forms of nervous headaches, in which its effects are sometimes marvelous, although more often it fails to accomplish good. To predic in any case what its influence will be, in the present state of our clinical knowledge, is impossible; but the remedy may always be tried in safety in a dose of five grains, taken when the paroxysm is coming on and repeated in half the quantity once in forty minutes if necessary. In opium poisoning, either in the form of unlimited quantities of a strong decoction of coffee or of the alkaloid itself, it is a standard remedy, but so far as I know Dr. J. H. Bennett has made the only attempt to establish by exact experiments the asserted antagonism of caffein and opium.

Caffein is very valuable as a cardiac stimulant in all forms of heart failure. When given to healthy men it decreases the rate and markedly increases the force of the pulse. The original statement of Prof. Gubler that it acts as a powerful diuretic is also undoubtedly correct. The indications for the employment are precisely those which call for digitalis. It differs, however, from that drug in the promptness and fugaciousness of its action and in being a more cer-

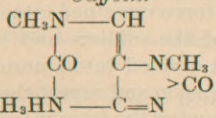
[1] Abstract from Therapeutics: Its Principals and Practice. H. C. Wood
[2] Ibid.
[3] Ibid.

tain diuretic. It is therefore especially useful when there are pronounced dropsical symptoms. In chronic Bright's disease it is often of service, especially in the later stages when there is marked cardiac failure. In acute Bright's disease it should be employed with caution, if at all. It is superior to digitalis in never disagreeing with the stomach and in having no distinct cumulative tendency. In some cases, however, it produces obstinate wakefulness and I have occasionally found it necessary to give it solely in the early part of the day.[1]

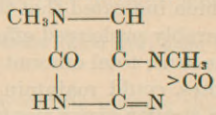
Theobromine.

Chemically theobromine is closely related to caffein and it differs in action from the latter only quantitatively. By removing a methyl group from caffein, theobromine or di-methyl-xanthine is obtained, thus:

Caffein.



Theobromine.



W. von Schröder performed many experiments to determine the relative value of caffein and theobromine as diuretics, and found that theobromine possessed the following advantages over caffein in that direction:

1. Theobromine causes no central disturbance and in moderate doses, without the aid of narcotics, calls forth marked diuresis.

2. It causes no symptoms of poisoning when excessive diuresis is produced.

3. Diuretic effects with theobromine are decidedly greater than those produced with caffein.

4. Theobromine diuresis is of longer duration than that of caffein. The theobromine diuresis lasts some twenty hours, while caffein diuresis is of only six hours duration.

Physiological Action of Kolanin (Kola Red).

Heckel[2] accords to Kolanin (Kola red) a distinctive muscular action which cannot be ascribed to caffein. "I am inclined to think" he says, "that the product called Kola red, which exists in the seed after it has been exhausted by chloroform, is a complex

[1] Abstract from Therapeutics: Its Principles and Practice. H. C. Wood.
[2] Academie de Medecine. April 8, 1890.

substance containing very active principles which we have not been able to isolate. It would not be surprising if this Kola red were the principle agent of the superior neuro-muscular irritability, although the caffein is itself unquestionably a neuro-muscular excitant."

"The African negroes march under the full glare of the sun as many as 80 kilometres a day by chewing a single fresh Kola seed. I have verified facts almost as surprising in France with dry Kola."

"The Colonel of the 60th regiment at Perpignan, accompanied by his Adjutant-general, who partook of the same diet, made the ascension of the Canigou in 1888, a mountain which has an altitude of 2302 metres. By taking a quantity of Kola, representing twelve centigrams of caffein, they were able to march without fatigue for twelve hours, resting in all from twenty to twenty-five minutes. In this experience the last six kilometres were passed over in one hour, which indicated that the muscular force remained intact after a considerably prolonged effort. Many of the soldiers and officers using the same total amount of Kola, but divided into a number of equal doses, could maintain muscular tension and repeat the same efforts in similar experiments without showing the fatigue resulting from similar muscular expenditure."

"As far as the disappearance of hard breathing during long marches is concerned, the daily experiments of the Alpine climbers with the use of Kola confirm in every particular the assertions of Germain Sée."

"At my instigation, the members of the French Alpine Club have adopted a food composed of Kola to resist the fatigue resulting from mountain climbing, and especially to the difficult breathing experienced during their ascensions. They derived the greatest benefit from this vegetable substance in mountain sickness and they even affirm that Kola regulates the circulation in high altitudes."

Comparative Action of Kola and Caffein.

BY MONAVON AND PERROUD.[1]

Some authors attribute the therapeutic properties of Kola exclusively to the caffein which it contains, while others, to the contrary, attribute it to the Kolanin (Kola red). In order to settle this question we have compared the results obtained after administering

1. A certain quantity of Kola.
2. A weight of caffein equal to that contained in the Kola given.

[1] Lyon Medical. 1891—68; A. J. Ph. 1892—367.

3. A weight of Kola red (Kolanin) equal to that contained in the Kola given.

4. A weight of extract of Kola representing the amount of Kola given.

The experiments were performed on dogs and the examinations made with the urine excreted. The following are the conclusions:

1. Kola is rather anuretic than diuretic.[1]

2. The elimination of nitrogenous matter and phosphates is diminished by the use of Kola. Kola acts as a conservator of the nervous, as well as of the muscular system.

3. The extract of Kola produced the same effect as Kola itself.

4. Kola red (Kolanin) has a slightly marked action upon the elimination of nitrogenous waste or of phosphates.

5. Caffein has an action analogous to that of powdered Kola, but is somewhat inferior.

6. Kola can be considered as a moderator of tissue waste.

Comparative Action of Caffein, Kola, and Kolanin (Kola Red) upon Muscular Contraction.

One of the first to determine in a scientific manner the physiological action of Kolanin (Kola red) was Prof. Dubois, an eminent physiologist of the "Faculté des Sciences" of Lyon. The results of his research were communicated to the French Association for the Advancement of Science, September, 1891. Employing the ergograph of Mosso he determined by the graphic method that Kola red in small doses is endowed with a neuro-muscular action comparable to, if not superior to that of powdered Kola. The tracings which he produced in support of his conclusion leave no doubt as to its certainty.

Prof. Dubois drew the following conclusions from his results:

1. The action of crystallized caffein is clearly noticed by comparing its tracings with the normal, but it is of short duration, the amplitude of contractions being very restricted.

2. With Kola, the duration of contractions is greater and their amplitude is at once large and sustained. The decrease follows a a very regular progression.

3. Under the influence of Kola red, the duration of contractions is the same, while their amplitude is preserved longer than with Kola. The decrease is produced more gradually, hence the conservation of muscular energy is longer.

The examination of these tracings confirms the statement of

[1] There seems to be a difference of opinion in this regard, many believing that large doses are anuretic and small doses diuretic, while others affirm that Kola is a general diuretic.

Heckel that Kola red has a peculiar activity which must not be confused with that of caffein or theobromine.

The valuable research which was so scientifically conducted by Prof. Dubois, inspired Dr. Marie[1] to undertake a series of experiments for the purpose of determining what position Kola shall occupy as a therapeutic agent. For rigorous comparison Kola and Kolanin were given in quantities representing the dose of caffein administered. A careful study of many tracings obtained before

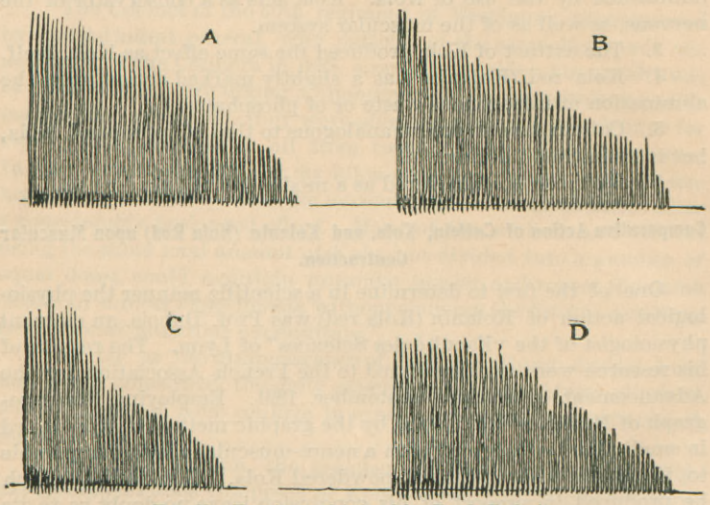


FIG. 23.—Tracings obtained by Prof. Dubois.
A.—Tracing obtained after the ingestion of Kolanin.
B.—Tracing obtained after the ingestion of Kola.
C.—Normal tracing.
D.—Tracing obtained after the ingestion of Caffeine.

and after the ingestion of caffein, Kola, and Kolanin enabled him to draw the following conclusions:

1. Kola exercises upon muscular fatigue a moderating action. It acts at once upon the frequency and intensity of the contractions and permits of sustained labor.

2. Caffein seems to act only upon the height and consequently upon the force of the contraction. Though it increases muscular contraction sensibly, its effects are of short duration and the muscle is fatigued as rapidly and often more decidedly than in the normal state.

[1] Etude expérimentale comparée de l'action du Rouge de Kola de la caféine et de la poudre de Kola sur la contraction musculaire. Thèse de la Faculté de Medecine de Lyon, 1892.

3. Kola red, even in small doses, augments in a very decided manner, the intensity and duration of muscular contraction. The action of Kola and Kola red present numerous analogous characters and the differences are only differences in degree.

4. The action of Kola is due in a great measure to the Kola red which it contains. Without doubt caffein augments the resistance to fatigue by toning the organism, regulating the circulatory and respiratory functions, but the Kola red exercises upon muscular contraction a characteristic action which is incontestable.

Physiological and Therapeutic Action of Kola.

A marvelous property of endowing its user with power to endure severe and long physical exertion without taking food and without feeling fatigued is the particular virtue which has attracted attention to Kola. The surprising accounts, by travelers and explorers, of the action of this drug induced the medical profession, especially of France to investigate its merits in a thoroughly scientific manner. Among the latest European investigators, who have devoted considerable time to the subject, E. Heckel, M. Schlagdenhauffen, Leon Monnet, Germain Sée and Dujardin-Beaumetz may be mentioned. E. Heckel was enabled to influence the government to afford it a trial in the French Colonial troops, while the German military authorities promptly instituted independent experiments with a view of verifying the physiological properties claimed for it. Prof. Heckel tells us that the negroes in tropical Africa easily walk over forty miles a day with nothing to eat but one fresh Kola nut, and that he himself has accomplished as surprising a feat upon a diet of dry Kola. He relates the experiment of two army officers, who, while ascending Mount Canigou, nearly 9,000 feet high, limited their nourishment to a quantity of Kola nuts representing about two grains of caffein. They rested twenty minutes, climbed twelve hours, and found themselves on top with scarcely any sense of fatigue, and with apparently no diminution of muscular power. At Prof. Heckel's suggestion the French Alpine Club adopted Kola as a diet during their mountain climbing feats, and they afterwards extended a hearty vote of thanks to him for having called their attention to this drug, which they declared had surprisingly kept them in breath and strength.

The superior neuro-muscular excitation produced by Kola is mainly due to Kolanin (Heckel), for after Kola had been completely exhausted of its caffein, it still possessed marked action upon muscular contraction.

Kola produces excitement of the cerebro-spinal system, hence its general tonic stimulating properties. It increases the force of

cardiac contraction and the duration of the systole, the period of diastole being shortened. In consequence of this action the blood pressure rises, and together with a direct stimulation of the renal epithelium, augments diuresis. This is contrary to the experiments on animals of Monavon and Perroud, who report that it is anuretic rather than diuretic. Conclusions drawn from observations on man are more trustworthy, however, and consequently warrant the statement that Kola is diuretic.

L. E. Monnet has shown that Kola diminishes the elimination of nitrogen, or in other words it lessens tissue waste resulting from decomposition of nitrogenous substances. Therefore, while not a food *per se*, it economizes the reserve forces, and by lessening fatigue, permits prolonged exertion.

The action of Kola is by no means least marked by its beneficial effect upon the digestion. Atony of the stomach, and dyspepsia indicated by sick headache, water brash, eructations and other symptoms of indigestion are speedily annihilated by its use, in appropriate doses, after meals, thereby creating a feeling of *bien-etre* to which the chronic dyspeptic is a stranger. It arrests vomiting, especially that of pregnancy, and generally exercises a most beneficial effect upon the whole of the digestive tract as well as upon the liver and kidneys.

Perhaps one of the most remarkable properties of the Kola seed is the inhibitive action it seems to exercise in alcoholism. Where ever tried, Kola has been found a most marked remedy in cases of confirmed dipsomania, absolute distaste for intoxicants following its use, while a habit is not created such as in the case where cocaine is used to cure morphinism.

Kola has been employed by the natives of Jamaica expressly to avert attacks of despondency to which Gold Coast negroes, who work the Jamaica plantations, are peculiarly liable.

We will now consider the reports of noted scientists as to their experiences with Kola from a physiological and therapeutical point of view.

It was at the instigation of Dujardin-Beaumetz, who has taken such an interest in this drug, that L. E. Monnet, a pupil, carried on this investigation. This important work entitled "De la Kola, Étude Physiologique et Thérapeutique" was presented as an inaugural thesis[1] for the degree Doctor of Medicine. As the details of the investigation are exhaustive and lengthy, the conclusions only are deemed of importance at this place.

1. Kola by the caffein and theobromine which it contains is a

[1] Thèse de la Faculté de Médicine de Paris, 1884.

heart tonic, accelerating the beats, increasing the dynamic power, and regulating the contractions.

2. A second phase of its action proves it to be similar to digitalis, namely, it is a regulator of the pulse, which revives under its influence, and becomes fuller and less frequent.

3. As a result of its action upon arterial tension, diuresis is augmented, consequently Kola may be employed to good advantage in cases of dropsy with cardiac lesion.

4. It would seem from observation that Kola, which causes energetic cardiac contractions and acts upon the contractibility of muscles of organic life, would have on the contrary a paralyzing effect upon striated muscles when toxic doses are taken.

5. It retards tissue metamorphosis and diminishes the excretion of urea resulting from decomposition of nitrogenous substances, very likely by exerting a special action upon the nervous system.

6. Because of the principles which it contains, Kola is a powerful tonic. Its use is indicated in anæmia, and in chronic affections of a debilitating character, also in convalescence from acute disorders.

7. It favors digestion by augmenting the secretion of gastric juice, or by acting upon the smooth fibres of the stomach, which it renders less atonic in cases of dyspepsia. Under its influence, rebellious anorexias disappear and the digestive functions become regular.

8. Finally, it is an excellent anti-diarrhœic. It has rendered excellent service in chronic diarrhœa or sporadic cholera, although its action could not be satisfactorily explained physiologically.

Kola as a Remedy in Neurasthenia.

Dr. Gihon, Medical Director of U. S. Navy, says[1]: "I had occasion to administer Kola in a case presenting the group of symptoms designated collectively as neurasthenia, in a lady, the equilibrium of whose nervous system had been seriously deranged and who suffered with excruciating headaches, attended with nausea, anorexia, insomnia, great despondency, palpitation, intercostal neuralgia, and perturbed secretion. Uuder the use of this remedy these symptoms, which had not been mitigated by previous exhibition of quinine, arsenic, iron, bitter tonics, guarana and diffusible stimulants, quickly disappeared. The headache which had been recurrent after temporary relief, did not return; the appetite was recovered, muscular vigor regained, and the mental dejection markedly relieved. The patient enjoyed refreshing sleep, and the secretions became normal. There was no gastric disturbance induced by the remedy, and no constipation as had followed the prior use of chocolate."

[1] Philadelphia Medical Times, 1886.

'The remarkably satisfactory results in this single case induced me to recommend the remedy as a nerve stimulant, and an invigorating and waste-preventing agent in other neurasthenic cases. It produces its effects without marked excitation of the circulation, consequently with no after effects of depression and exhaustion. It is a mental exhilarant, overcoming despondency, and brightening the intellect without resultant languor. It imparts tone to the muscular apparatus and secreting organs, and is probably a positive nutrient from the contained proteids, fat and sugar."

At a later date Dr. Gihon writes that he is able to add a second case confirming the opinion of the therapeutic value here expressed.

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Another most remarkable and interesting case of neurasthenia that was successfully treated by Kola is reported by M Levy, interne at the hospital of Sainte-Lazare of Paris. The complete report may be found in Heckel's monograph *Les Kolas Africains.* After several months treatment in which Kola was practically the only medicine employed, the patient, a woman of thirty-five years of age left the hospital completely restored to health. Her countenance regained its natural appearance, no longer indicating the suffering she was accustomed to. She increased in weight, the pallor, headaches, neuralgias, and lumbar and abdominal pains all disappeared. The lady now sleeps well, has no palpitations, or vasomotor troubles. Digestion is good and regular.

Kola in Nervous Affections.

L. E. Monnet[1] reports two interesting cases of cephalalgia, due to circulatory disturbances which had been most successfully treated by the use of Kola. One patient was a young, weakly man who had suffered severely from attacks of migraine which appeared quite regularly every two days. A continuous but moderate treatment with an elixir of Kola caused increased appetite, and a gradual decrease in the frequency of the attacks. The second case was very similar, though much more severe. The results, however, were as satisfactory as in the first case.

Kola is a valuable remedy in nervous disorders due to a want of proper circulation in the cerebral-spinal centers, or to troubles connected with a debilitating effect of certain cachexis. Caffein and the tonic principles of Kola, by their collective, as well as their individual actions, may serve as an excellent therapeutic agent in these nervous disorders. Even in nervous derangements due to disorder of the digestive tract, Kola possesses considerable efficacy.

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[1] Thèse de la Faculté de Médicine de Paris, 1884.

Huchard, who was among the first to experiment with Kola, has substantiated the opinion of many others that it is one of our best nerve, as well as cardiac tonics. It excites the cerebral function, favors intellectual work, rests the brain, and possesses an action not only excitant but tonic. It is certain that Kola can replace advantageously the preparation of quinine in adynamia; that it can be associated with alcohol in the treatment of infectious maladies; in short it is applicable in all cases of neurasthenia, characterized by extreme mental and physical lassitude, and by those morning fatigues, not only special to neurasthenia but also common in dilatation of the stomach. The indication for it is always found in overwork and in convalescences—in short, in all cases where one wishes to increase the forces.

The Use of Kola in Cardiac Affections.

Dr. N. Hudson,[1] Medical Inspector to the U. S. Navy, reports an interesting case as follows: "The patient, a lady of thirty-six, had suffered during childhood from rheumatism. Eighteen months since she was attacked with severe endocarditis, from which she recovered slowly and with a damage to the mitral valves (insufficiency). The action of the heart was feeble and irregular, and there was a good deal of dyspnœa, faintness and fatigue upon slight exertion. She had always been subject to occasional headaches and these now became periodic and severe, occurring at first at intervals of four or five weeks, and lasting two days. Latterly they had increased in frequency and intensity, coming on about twice a month, each attack causing three days of suffering, so severe as to fill the patient's mind with constant dread of recurrence. During the first nine weeks of the use of Kola, there was no recurrence of headache. The general condition was materially improved, the heart's action became much more regular, and the attacks of dyspnœa and faintness have nearly disappeared. The most characteristic effect seems to have been an immediate relief of the sense of fatigue, a sense of *bien-etre* and cheerfulness to which the patient had long been a stranger. The employment of the Kola seemed to be satisfying to the appetite, for whenever taken it appeared to serve as a substitute for the next following meal, but the nutritive processes were not impaired. On the contrary, the bodily weight increased from 98 to 105 pounds."

"As far as the experience in this single case goes, it would appear that Kola may be a valuable therapeutic agent. The considerable percentage of caffein, which it is said to contain, would

[1] Philadelphia Medical Times, June 26, 1886.

theoretically make it useful as a heart tonic, but caffein had been tried in this case without any marked results and the same experience had been had with convallaria. Digitalis had been the only agent which was found to be of any service, but its effects were only temporary and palliative, not being sustained even when given for long periods combined with iron. The improvement which was established with the employment of Kola was marked and immediate, and the gain in the well being and comfort of the patient has been most gratifying."

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In seven cases which came under L. E. Monnet's[1] personal observation, Kola proved of marked benefit in strengthening the weak heart, stimulating general circulation and arterial tension, and promoting diuresis. In some of these patients the urinary excretion was increased from a pint a day, to two and even three quarts. So gratifying, in fact, were the results, that we might say of Kola what Dr. Dujardin-Beaumetz says of caffein, that "in the last stages of cardiac affections, Kola sometimes works resurrections." We should bear in mind, that besides the caffein which it contains, Kola possesses nutritive and tonic properties which are carried to the badly-nourished tissues, thus revivifying the organism.

The Use of Kola in Diarrhœa.

From the physiological properties of Kola, the therapeutic application, to a great degree, can be anticipated. According to Dujardin-Beametz the service it renders in diarrhœa must be attributed to the large proportion of tannin which it contains. Drs. Durian and Cuneo have both reported cures in rebellious diarrhœas under its use. Combemale relates that Dr. Le Jollec ameliorated chronic diarrhœa by giving for six days two grams of the extract of Kola. Huchard used it with success in three cases of cholera, and Messrs. Héricourt and Durian have had recourse to it in the chronic diarrhœas of warm countries, whether infectious or not.

Employment of Kola in Confinement.

Chambard-Hénon[2] reports a case of a woman with three children, at the birth of each one of which the patient was in a very dangerous state of syncope. The heart sounds were feeble, rhythm light and irregular, pulse soft and fugitive. The patient's face would become black and the lips sombre red. The first and third were born apparently dead, but they were brought to consciousness by flagellation. The second child was still-born.

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1 Inaugeral Thesis, Paris, France, 1884.
2 Lyon Médical, March 15, 1891.

In the fourth confinement, besides taking the usual precautions, the patient was given some pastiles of Kola. The woman became cheerful and courageous, passed through the ordeal without the least indication of syncope, while the child uttered the characteristic cry at birth.

He attributes this happy result to the action of Kola, which acted as a heart tonic.

The Use of Kola in Alcoholism.[1]

A "freighter" who had long been in the service of Queen Victoria in Zululand, South Africa, gave me to drink an infusion of a nut called Kola. He said it was used there as we used coffee. He said it was used for debility and that it would sober a drunken man and prevent thirst. My informant's intelligence would enable him to give but little more data. He seemed to think he could not work without his Kola nut. Although he had plenty, I could only get a small number of the Kola nuts at any price I could offer. He had seen negroes in Jamaica cured of drunkenness by its use.

Mr. Christy, of Thos. Christy & Sons, London, England, has been informed by Mr. Espeut, a well-known sugar planter of Jamaica, that the negroes use the Kola as a remedy for drunkenness. They claim that swallowing a single nut, ground up and made into cream or paste with water or spirits, will cause all signs of intoxication to disappear in half an hour. Mr. Papefio, a surgeon, corroborates this. It has also been found to possess a beneficial action on the liver, its continued use preventing attacks of despondency to which negroes in certain localities are peculiarly liable. Dr. Daniell records a case of this kind in which Kola put a stop to an epidemic of suicide which threatened at one time tc depopulate the estate on which it occurred.

Use of Kola in Seasickness.

Dr. Chas. Hamilton[2] highly recommends the seeds of Kola as an excellent remedy for seasickness, depression, vomiting, vertigo, etc. He supposes that the efficacy of Kola is due to its tonic and stimulating action upon the central nervous system.

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[1] J. M. Barrickman, M, D., Physio-Medico Journal, 1884.
[2] British Medical Journal, 1890.

PART III.

A Clinical Study of Kola.

BY JOHN V. SHOEMAKER, A. M., M. D.,

Professor of Materia Medica, Pharmacology, Therapeutics and Clinical Medicine, and Clinical Professor of Diseases of the Skin in the Medico-Chirurgical College of Philadelphia; Physician to the Medico-Chirurgical Hospital; Member of the American Medical Association, of the Pennsylvania and Minnesota State Medical Societies, the American Academy of Medicine, the British Medical Association; Fellow of the Medical Society of London, etc.

A Clinical Study of Kola.

BY JOHN V. SHOEMAKER, A. M., M. D.[1]

Among the more recent additions to materia medica drawn from the vegetable world, Kola nut has proved itself to be possessed of excellent remedial properties.

It is properly speaking, rather a *seed* than a nut, and is the product of *Sterculia acuminata*, a tree belonging to the natural order of Sterculiaceæ, indigenous to the western coast of Africa, from which it spreads inland as far as 500 or 600 miles. The tree obtains the height of 30 to 60 feet, bears some resemblance to the horse-chestnut, and occurs in two varieties, one of which has broad and the other narrow leaves. The seeds are about the size of a pigeon's egg—some being red and others white; and from 5 to 15 are contained in a single capsule.

According to chemical analysis, the Kola nut contains about 2.3 per cent of an alkaloid analogous to theine or caffeine: 0.023 per cent of theobromine; together with tannic acid, sugar, albumen, cellulose, starch, fat, and fixed salts.

The Kola tree has been successfully cultivated in the West Indies, South America, and the tropical parts of Asia.

The powdered seeds are of a bright brown color, and possess a slightly pungent and aromatic taste, which is by no means unpleasant. Kola increases the appetite and facilitates digestion.

The natives of Guinea are in the habit of sucking or chewing the seeds before eating or drinking; believing that this practice improves the flavor of the viands. It sustains the system under deprivation from food. It promotes the hepatic functions, augments the secretion of urine, stimulates the nervous system and the heart.

According to the experiments of Dr. Kotliar, Kola accelerates the assimilation and retards the metamorphosis of phosphorus and sulphur, both during rest and exertion. From the same experiments it appears that the assimilation of chlorine is accelerated during rest, but unaltered during work; while the metamorphosis of chlorine was retarded both during rest and work.

Dr. R. M. Wilcox has observed that night-doses of Kola, given

[1] American Medico-Surgical Bulletin, May, 1893.

during convalescence, will sometimes give rise to persistent wakefulness. This statement is readily comprehensible and should be borne in mind, in view of the caffeine which Kola contains. In administering the remedy *thrice daily*, as I have been in the habit of doing, I have not yet met with a case of insomnia resulting from the use of Kola. Kola may be given in doses ranging from 5 grains to 1 or even 2 drams. Its virtues are *not* exhausted by water, which is, therefore, a bad vehicle for its extraction. It may, however, be made up into a paste or an emulsion; or the powder may be enclosed in capsules or compressed into tablets or lozenges. French pharmacists have prepared a tincture, a wine, an elixir, a syrup, and an extract of Kola (the formulæ for which, from the *Revue Medico-Pharmaceutique* are published in the *Medical Bulletin* for June, 1891, p. 223).

I have made use of this remedy in a number of cases—especially in such as were characterized by debility; administering it, usually, in 5-grain doses;—and have found it *an excellent reconstituent tonic*. I select a few illustrative cases in which it proved of signal service:

Mrs. B., about 60 years of age, of melancholy temperament, has for many years suffered from attacks of neuralgia, induced by exposure to cold, or by errors of diet. She has always been of a weakly constitution, easily rendered ill, and not re-acting very speedily to treatment. Upon several occasions, also, she has had painful rheumatic seizures—generally of a muscular, but once of arthritic type.

When recently she came again under my care, for a distressing attack of migraine, I made a trial of Kola, with excellent result. The acute pain soon subsided; the vomiting was relieved; and she entered upon a convalescence, slow as usual,—but more rapid than I had expected, knowing the lady's general lack of tone and recalling the experience of her former illness.

In several cases of simple anæmia, Kola has acted very beneficially. In a girl of 16 years, whose condition was due to excessive application to her school tasks—making her spend a great part of the day in a hot, ill-ventilated room, with practically no out-door exercise—Kola brought about an entire change. Within two months the girl had gradually lost her appetite, had failed in flesh, and become pale. She had begun to feel weak; suffered from headache; and could not sleep well.

Under the use of Kola, and withdrawal from school, she soon regained a good appetite, began to improve in flesh; her headache left; and she became able to sleep at night. Her lips are now of

vermilion hue, and a little color has appeared in her cheeks. She now has also courage to pass a certain portion of every day in the open air.

Another case of migraine occurring in a middle-aged man, was attended with marked cerebral disorder, exhibited in the form of melancholia, with impulse toward self-destruction. Kola promptly mitigated the pain; the mental condition changed entirely, and the the patient's spirits resumed their normal tone.

I have witnessed the same good effects from this agent in a number of cases of neuralgia of different forms—frontal, cervico-occipital, intercostal, etc.

A case of ulnar neuritis was also benefited by Kola. The patient was a young lady, about 23 years of age, who had been subject for years to pain in the left arm and fore-arm. She often suffered from pain in the wrist over the position of the ulnar nerve. Sometimes the pain was of an aching, again of a sharp and shooting character. At intervals it darted through the arm so rapidly that the patient was unable to locate its point of origin. At times the manifestations would be absent for two or three weeks; when, again, it would become a daily visitor. The neuritis was always aggravated if her general condition was depressed.

Marked amelioration was produced in this troublesome and obstinate case by the administration of Kola. The pain in the fore-arm was assuaged, and has now remained absent for a longer period than has happened for many years. Her general strength has at the same time improved.

A case of vaso-motor neurosis following the menopause was treated by means of the same remedy, with the same happy results. The patient was about 48 years of age; the catamenia had begun to fail three years previously, and for the past year had been entirely absent. For two years after the menses became irregular, she was subject to frequent fits of giddiness. During the past year the vertigo disappeared and was replaced by sudden and transient attacks of cerebral congestion. Her face became flushed and was hot and burning to the touch. At the same time she experienced a sense of tension within the head. After an attack of this kind she feels languid, and occasionally has a sense of formication in the face. Sometimes she suffers from frontal headache.

Capsules containing Kola nut were prescribed thrice daily, and she was in a few weeks so decidedly improved that she ceased to take her medicine with regularity; but resumed it when she felt herself threatened with a recurrence of her old symptoms.

An extremely interesting case was that of a man who exhibited

the symptoms of locomotor ataxia. The patient had been addicted to the use of liquor for nine years, and would sometimes drink to excess. About 9 or 10 weeks before he came under my care—after a carouse of three or four days' duration, at the end of which he had had severe gastric irritation with great mental and physical prostration– he became conscious of a sensation of heat in the hands. This was succeeded in two or three days by numbness and tinging, with impaired tactile sensibility in the hands, gradually ascending the fore-arms and arms. Subsequently the circulation of both the upper and lower extremeties became impaired, the joint-ligaments were relaxed, and a condition almost amounting to subluxation was produced. The hands perspired very freely, particularly in moments of excitement. The feet, however, did not perspire. The thighs felt as if surrounded by iron bands. Sharp pains frequently shot up and down the arms and legs. The appetite was poor. He suffered from nausea after eating, but seldom vomited. He had lost strength. When he walked it seemed to him—as he expressed it—"as if he were walking on feathers or cushions." He could not walk firmly in the dark, could not stand erect with his eyes closed, or button his garments with ease. A history of syphilis was denied. I regarded the symptoms, though so suggestive of organic disease, as of a hysterical nature, due to alcoholism. The man had become so alarmed regarding his health, that he abandoned the use of liquor.

Kola nut in increasing doses was prescribed on account of its tonic influence upon the nervous system, its powers of allaying nausea, promoting appetite and digestion; and, last, but not least, because I have often found it of avail in lessening the craving for liquor. (In conditions of prostration depending upon fever, suppuration, or chronic visceral disease, in men who have drunk freely, Kola is an efficient drug.) In the case which I have described—assisted by abstinance—it brought about, in about a month, a very remarkable improvement. Nausea gradually vanished, the appetite improved; the man gained flesh and strength, his tongue became clean and his bowels regular. There was a return of tactile sensibility; he could walk better, the sensation of bands around the thighs had entirely disappeared. Amendment continued; and at the end of six months scarcely any manifestations of disordered nervous action were present.

In a case of gastro-intestinal irritability, attended with intestinal hæmorrhage, Kola exerted a peculiarly happy effect. Its stomachic properties and its astringency render it an excellent remedy in such a contingency. The patient, a man of 52, a steady beer-

drinker, was accustomed from time to time to break out in a spree and imbibe wine and spirits to excess. After a bout of this kind, he had lost his appetite, could eat no food, vomited frequently, and had a free intestinal hæmorrhage. He was weak, restless, and sleepless.

He was placed upon kumyss and Kola nut; beer, wine and spirits being prohibited. Upon the following day the discharge had ceased; his nervous system had tranquilized, he had obtained some sleep, his pulse was better; and in the course of a few days more he was able to leave the house and attend to business with his usual energy.

An irregular heart may be steadied by the use of Kola. A married woman, 23 years of age, was troubled, during the last five months of her first pregnancy, with shortness of breath, headache, and dizziness. In the latter part of gestation her feet had swelled moderately; but parturition had been attended by no difficulty, except that she lost an unusual quantity of blood. Instead of recovering sound health after the birth,—five months previous to my seeing her,—she had continued to suffer from dyspnœa. She had also been subject to palpitation. She had little or no appetite, complained of fugitive pains in both breasts, attacks of headache, and giddiness. The heart's action was rapid: but there was no murmur. She was thin, slept poorly, and was troubled by formication of the scalp.

The use of Kola rendered the action of the heart more slow, regular, and forcible; the appetite improved; digestion was strengthened; she gained flesh, and at the end of a few months was as well as she had ever been in her life.

The tonic effects of Kola are advantageous in pulmonary tuberculosis. This is particularly the case, of course, in the earlier stage of the disease.

A young man with consolidation at the left apex, who four months previously had moderate hæmoptysis, but whose general condition was fairly good, received marked benefit from this drug. His chest pains disappeared, his digestion became more vigorous, and he gained in weight and strength.

A more advanced case was even more decidedly improved. A man, 23 years of age, had suffered, six months previously, from measles; leaving the house too soon, he was exposed to cold, and had ever since been afflicted with a cough. He had lost 30 pounds in weight, was short of breath, had pain in the chest, was weak, had poor appetite and flatulent dyspepsia. He was troubled at times with diarrhœa, had fever in the afternoon and sweats at night. His finger-nails were very white. Consolidation was de-

tected in the left upper lobe, but there was no crackling. His heart was not enlarged, but was rapid and feeble; and there was a soft, systolic murmur present.

After taking Kola nut for a week, he felt stronger, had a better appetite, slept more soundly, and ceased sweating. He has remained for several months in an improved condition; and the physical signs do not show any advance of the disease. The affection evidently began as catarrhal pneumonia; and, under favorable circumstances, the arrest may be permanent. The action of the heart is stronger, but the murmur is still present.

Kola is a good remedy in tubercular diarrhœa. I have made use of it with success in several instances.

In a man, 45 years of age, with cavities in both lungs and a profuse diarrhœa, very much prostrated in strength, Kola nut proved effectual in restraining the exhausting discharges, and rendered his general condition more tolerable. His digestion, also, seemed to improve.

Another case which may be cited was that of a woman, 40 years of age, who had a cough for 18 months, had lost flesh, strength, and appetite. She had pains in the breast, night-sweats, and palpitation of the heart. The heart was rapid and excitable; there was consolidation, with beginning break-down, in the left apex. Latterly, diarrhœa had developed. The evacuations were promptly checked by the exhibition of Kola.

In *simple diarrhœa from indigestion* Kola nut is an efficacious remedy. It is said to have been of service in *dysentery*; but I have had no occasion to employ it in that disease. It has been suggested that Kola nut may prove of service in *cholera*.

This remedy is of decided efficacy in the treatment of dyspepsia; especially when the difficulty is of *nervous* origin, or dependent upon diminished functional activity of the *liver*. A thin, nervous woman, aged 40 years, had been afflicted for two weeks with palpitation of the heart, pain over the heart and in the breast, intercostal and frontal neuralgia, nervous dyspepsia, and depressed spirits. She cried without cause, and had a dread of dying or becoming insane. She had only menstruated once in three years, was sallow, and had dark circles under the eyes. There was no organic disease. Her spirits, as well as indigestion and nervous troubles, improved under the use of Kola nut.

I have in some cases witnessed a decided influence of this drug in dispelling *gloom of mind*. (One has already been referred to in this paper.) Another case which yielded readily to this drug was that of a woman, 49 years of age, who suffered much from flatulent

dyspepsia, and who, for the preceding three weeks, had had profuse diarrhœa, with frequent daily and nightly passages. She had lost appetite and strength, but was not tuberculous.

A very satisfactory result was also obtained in the case of a woman, 44 years of age, who suffered from *extreme flatulence*, with palpitation of the heart. She had become subject to fits of brooding melancholy.

A case of gastro-enteritis, lately under treatment, admirably exemplifies the virtues of Kola nut. A man, 32 years of age, of a highly nervous organization,—already so emaciated from the effect of a severe bronchitis from which he had suffered several months ago, and a chronic catarrhal laryngitis, that a suspicion of tuberculosis was aroused,—was attacked by acute catarrh of the stomach and bowels. There was chill, fever, nausea, vomiting, retching, pain in the abdomen, much flatulence, diarrhœa, and a very dirty tongue. After the violent symptoms had been subdued the tongue remained foul; there was no manifestation of appetite, milk was not well borne; the pulse was rapid and weak, and the prognosis appeared dubious.

At this juncture I began to employ the Kola nut, and the result was extremely gratifying. First, the disposition to diarrhœa was completely overcome; the discharges became regular and moulded; then some signs of appetite made their appearance; the more digestible forms of solid food were cautiously given and were properly digested. The flatulence, which had been so annoying, next disappeared; the patient began to sleep well and to regain his strength. The heart's action lessened in rapidity, and eventually the man made a satisfactory, though tardy, recovery.

In this connection I might allude to the work of Kola-nut in convalescence from severe ailments; such as typhoid fever, acute pneumonia or rheumatism, influenza, etc.

In *catarrhal jaundice*, I have also found this drug effective, in promoting the secretory function of the liver, and inducing a more abundant flow of bile, with removal of the mucous plugs which occupy the passages. It is no less useful in *bilious diarrhœa.*

Kola-nut supports the system during the course of *prolonged suppuration;* such as chronic abscesses, broken-down glands, inflammatory buboes, boils, carbuncles, sinuses, fistulæ, caries, suppurative inflammation of joints, empyema, etc.; and after accidental or surgical wounds.

A delicate, nervous woman, about 30 years of age, suffered from an abscess of the finger with cellulitis of the whole hand, in consequence of a slight accidental injury. She was weak, feverish,

her tongue was tremulous and heavily coated; and she was altogether quite ill. The abscess was freely opened, under antiseptic precautions and antiseptically dressed; and the pain and fever subsided. Kola-nut was then prescribed, and the general as well as the local condition rapidly improved.

In a case of pyelitis, due to the formation of renal concretions, the patient had suffered for 5 weeks from severe agony in the right lumbar region; nausea, vomiting, chills, fever, sleeplessness. He had lost a great deal of flesh. The pain was subdued by morphine; nitric acid was given as a solvent (the urine contained crystals of triple phosphates), and the pus soon began to disappear from the urine. In order to overcome *the nervo-muscular debility*, which persisted after the urgent symptoms had been alleviated, I gave Kola-nut. The effect was all that could be desired. The patient made an excellent recovery, and has had no return of symptoms indicative of renal irritation.

In several cases of boil or carbuncle, I have derived advantage, after evacuation of the pus, from the administration of Kola-nut. This remedy is particularly serviceable in carbuncle occurring *in aged persons*, in whom it is a dangerous disease; and in either furuncle or carbuncle *in persons of drinking habits*, irrespective of age. In both classes of patients, we need to avail ourselves of every tonic remedy within our power. Kola-nut is readily taken, and acceptable to the stomach; takes the place, to a certain extent, of alcoholic stimulant; and has a more permanent effect than alcohol.

PHILADELPHIA, PA.; 1519 WALNUT STREET.

PART IV.

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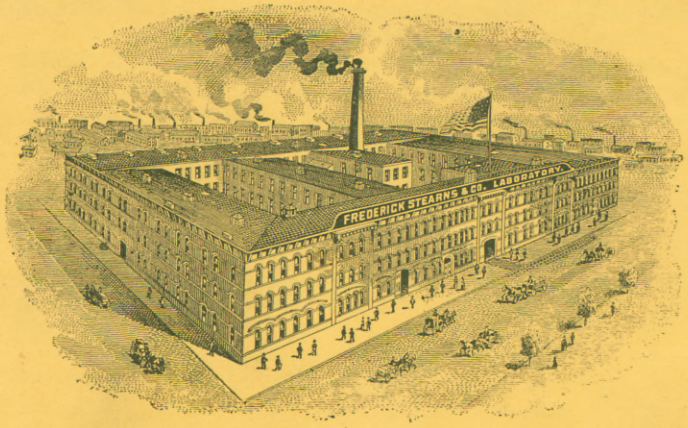
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