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The present day relationship between botany and pharmacology

Marguerite. Bourgeois
University of Massachusetts Amherst

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THE PRESENT DAY RELATIONSHIP
BETWEEN BOTANY AND PHARMACOLOGY

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THE PRESENT DAY RELATIONSHIP
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BOTANY AND PHARMACOLOGY

By
Marguerite Bourgeois

Submitted in partial fulfillment of the requirements
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INTRODUCTION

Scope and Purpose of Thesis

This work makes no pretense at bringing forward a large mass of original research involving abstract questions, although it is believed that it contains a considerable number of practical remarks on the use of drugs, which are the result of the writer's personal observations. It aims, however, at bringing together in a moderate compass a more extensive series of facts concerning the action of drugs derived from plants. It aims at giving one an understanding of the present day uses of these drugs from a knowledge of their sources. By arranging these plant-sources in phylogenetic groups, the similarity in properties and actions of drugs extracted from closely related plants is emphasized.

In selecting the plants to be considered, "Useful Drugs", edited by the American Medical Association, was chosen as the most reliable guide, since it deals only with those therapeutic agents which are generally acceptable to the medical profession. Careful comparison of these drugs with the ones actually found in the medicine closets of the Massachusetts General Hospital and other recognized hospitals showed that, for the most part, they coincided. Pharmacopoeias and Materia Medicas were consulted for further information on these drugs. While in some cases the therapeutic uses have undergone only slight changes, if any, since the time of their initiation, in others, controversies are still being carried on in the most recent literature.

In these instances it was necessary to gather together all the available information, including that obtained from companies which manufactured the drug, and weigh it carefully to eliminate anything
which has not been proven valuable. The hospital resources, too, were utilized in making these investigations. The literature reviewed, substantiated by hospital findings, makes up the main body of this thesis and forms the basis for the writer’s conclusions.

**Historical Development of Use of Plants as Drugs**

Magic and medicine have a common heritage. Each is the expression of man’s desire to overcome his natural enemies. The magician, whether medicine man, priest—physician, witch doctor, faith healer, or soothsayer, invokes the help of the supernatural. The medicine man, however, decided to combine the supernatural with natural remedies. As these natural means proved more and more effective, the line of demarcation between magician and physician became sharper, but has never been entirely eradicated.

The Materia Medica of today, therefore, originated from cruelty and superstition—the superstition that disease was an invasion of the body by evil spirits and the use of cruelty to drive the invaders out. Among the means of cruelty employed were beating, bleeding, and noxious concoctions. No distinction was made as to the type of material used to make up these concoctions. Anything from roasted toads to bitter tasting plants was acceptable. Aloes, in use today, was one of the first plants employed in medicine, principally, perhaps, because of its extremely bitter taste. As time went on and the numbers of plant drugs increased, there were certain outstanding theories with regard to their uses. First of all, secrecy was of paramount importance. The preparation and employment of various remedies was handed down from generation to generation as a family secret not to be divulged. Unknown drugs were regarded to be most valuable. When Jean Nico introduced tobacco into France he even
persuaded the Queen, Catherine de Medici to chew and snuff it for her health. Next, herbs were employed in extremely large numbers. The European physicians put into their prescriptions as many ingredients as a patient's purse would stand, believing that the greater number of drugs fired at the disease the more chance they had of hitting it.

In 1665, three hundred doses were prescribed for the dying King Charles II of England. Finally, there was an empirical rather than a rational basis for judging the value of a drug. That is, drugs which were known to have cured certain diseases were prescribed again for the same use without an understanding of their actions. Although this method is effective in many cases, it is rather crude.

Before the changes which have taken place in the modern day methods for using plants as drugs are indicated, a more detailed account of these plants taken individually will be given.
**REVIEW OF INDIVIDUAL MEDICINAL PLANTS**

*Claviceps purpurea* (Fries) Tulasne is commonly called the *
*buck fungus.* The true nature of ergot was not known by early writers,
although it was mentioned by many. Lomicer, about the middle of the
sixteenth century, mentioned its specific use. Thalius applied the
name of "ad sistendum sanguineum." Bauhin used the name *Secale luxur-
ians.* DeCondolle called it *Sclerotium clavum.* Although other names
have been applied, the credit of working out the life history belongs
to Tulasne, one of the most eminent of French mycologists.

Epidemics of ergot poisoning have been recorded since the
days of Galen (130-200 A.D.) and of Caesar (B.C. 190-44). From the
ninth to the thirteenth centuries epidemics were frequent in France,
and in the twelfth in Spain. First they were called plagues and later
received special names. In 1596 Hesse and adjoining provinces were
visited by the plague attributed to the presence of ergot in grain.
In 1723 the King of Prussia ordered an exchange of sound rye for the
affected grain which caused an epidemic in Silesia. These epidemics
seemed to follow the rainy seasons. After heavy fogs and inundations
in Germany in 1906 many cattle and humans were affected. Parts of
this country, New York in 1849 and Kansas in 1884, had serious out-
breaks of this disease among their cattle. The hay was found to con-
tain considerable quantities of wild rye which, in turn, contained
ten to twelve per cent ergot in some cases.36

Ergot poisoning has been given the name of *ergotism.* Equines
are less susceptible than bovines, while man is not uncommonly afflicted
by eating bread of ergotized grain. In animals the poison is usually
acquired in small amounts and manifests itself in chronic form. Digestive tract symptoms, such as nausea, vomiting, colic, diarrhea or constipation are common. Abortion is a frequent occurrence in pregnant animals. In another form of ergotism the Central Nervous System is overstimulated and such symptoms as contraction of the flexor tendons of the limbs, anesthesia of the extremities, muscular trembling, general tetanic spasms, convulsions, and delirium occur. Death is usually a result of secondary causes. Gangrenous ergotism is attributed to degenerative changes in the vessel walls and formation of thrombi. Dry gangrene of feet, tips of ears, or tip of tail leads to shedding of hair, loss of teeth, and death from exhaustion. In these cases the cause should be removed and tannic acid given as a chemical antidote for neutralization of unabsorbed ergot. Chloral is the physiologic antidote.

The ergot fungus is commonly recognized on the young ovaries of grasses, especially rye, projecting as a dark violet or blackish, long, and often curved structure.

From the dried sclerotium of ergot have been extracted several active principles. Chief among these are the crystalline alkaloids ergotoxin, C₃₅ H₄₁ O₅ N₅ (hydroergotimine or ergotamine), paraoxyphenylethylamine or tyramine and histamine or imidazolylethylamine.²² Paraoxyphenylethylamine is closely related to epinephrine, both in composition and pharmacologic action.

It is the combined effect of the several active principles of ergot which produce the desired effect of the drug. The standardization of this drug is brought about by the "cox-comb" method. The combs of white leghorn cocks are darkened by doses of the extract corresponding to the same doses of standard fluid extract.⁵⁴
Powerful tonic, sometimes tetanic contractions of the uterus, are produced by ergot. Contractions of other involuntary muscles such as those of the blood vessels, bladder, stomach, and intestines are also produced. Extreme and long-continued contraction of the blood vessels, especially of those of the extremities, may cause gangrene. Ergot also tends to slow the pulse by stimulating the cardio-inhibiting center.

The chief use of ergot today is to prevent post-partum hemorrhage. A dose of 30 minims is administered intramuscularly after the third stage of labor. It is considered safe to give the drug after the placenta has been expelled, but its use during labor should be avoided, as it may cause rupture of the uterus or asphyxia of the child. Ergot is also used as a prophylactic for "after pains" or to prevent hemorrhage from the uterus in menorrhagia and metrorrhagia. In 1935 a new alkaloid was isolated in pure form by four different investigators, which they named ergometrine, ergotecin, ergobasine and ergostatrine. New and Non-Official Remedies adopted the name Ergonovine for this alkaloid. Some of the newest trade preparations of ergot are Ermutin, Erfundiin and Erzecolin.

The fern Dryopteris filix-mas (Linne) Schott has been variously known under the names of Lastrea, Naphrodium and Aspidium. Dryopteris itself comes from the Greek word meaning "oak"—probably called thus because it is a wood fern. Aspidium, on the other hand, means "small shield" and may refer to the shape of the indusium. Common names of this fern are Shield Fern, Wood Fern or Male Fern.
The male fern may be recognized by its lanceolate, tufted fronds with one to three linear-lanceolate pinnae and oblong, very obtuse pinnae, serrate at the apex and obscurely so at the sides. To distinguish it from Aspidium marginale, the sori are found nearer the midvein than the margin and usually confined to the lower half of each fertile pinna.17

In early autumn the fern is collected and the leaves cut off, leaving the stipes attached to the rhizomes. The dead portions of the rhizome and the chaff are removed. Usually the drug consists of the stipes only, which are separated from the rhizomes and from their periderm.32 The drug is carefully dried and preserved and should not be used after losing its green color. Filicic acid, not less than 1.5%, is contained in Aspidium. The drug also contains a light yellow, volatile oil with an intense odor and an aromatic, burning taste. It consists of free butyric acid and allied acids, hexyl and octyl esters of the fatty acid series. A green fixed oil is present which consists of glycerides of oleic, palmitic, cerotinic and filedonic acids. Tannin, resin, an uncrystallizable sugar, starch, and ash are the other constituents of Aspidium.54. This plant is rarely, if ever, used in crude form at present. The oleoresin is obtained by extracting with ether.

The oleoresin of Aspidium is a teniaicide. It is used against the common tapeworm. Before the drug is taken the alimentary tract is emptied by a light diet or a twenty-four hour fast and administration of a saline cathartic in the morning. This is done so that no food in the intestine may protect the worm from the action of the drug. The drug should be given early in the morning, in 5 grain capsules, at fifteen minute intervals until the full dose is taken. To dislodge the
worn while it is paralyzed and has lost its hold, the last dose should be followed by a calomel purge, a saline laxative and a saline enema. Castor oil or other fixed oils should not be given because they favor absorption of the active principle, filicin. Usually there are no untoward symptoms except some nausea. In case absorption occurs, violent symptoms of poisoning appear—vomiting and purging, weakness, spasms in the extremities, convulsions, stupor may be followed by collapse and coma. There may be disturbances of sight and hearing, or there may be jaundice and hemorrhagic nephritis. The form and manner of elimination of this drug is not known.

The Greek name used by Pliny for the horse-tail is Ephedra. Ephedra plants are curious looking low shrubs, usually with pale green, apparently leafless, branches much resembling those of the horsetail. They are often procumbent and sometimes climbing. The leaves are minute, scale-like, sheathing, in distinct pairs or whorls. The flowers are dioecious, in small aments, usually forming peduncled axillary clusters. The fruit is usually a nutlet, but in some species the bracts of the ament become fleshy and form a red berry-like syncarp.

An alkaloid derived from Ephedra Equisetina, closely related structurally to epinephrine and levoratory like epinephrine, but more stable, is ephedrine—(alpha - hydroxy - beta - methyl - amino - propyl-benzene). Ephedrine occurs as a viscous, almost colorless, solid that tends to crystallize as needles. The needles melt at 34-40° Centigrade and the liquefied alkaloid boils above 200° Centigrade. It is
soluble in alcohol, chloroform, ether and water. This solution is strongly alkaline to litmus. Ephedrine is used in the form of the salts Ephedrine Hydrochloride and Ephedrine Sulphate.54

The sympathetic nervous system is excited by ephedrine and effects similar to those of epinephrine are produced. Ephedrine also exerts a direct depressant action on smooth cardiac muscle. It produces a rather lasting rise in blood pressure, when injected either intravenously or intramuscularly, due mainly to vasoconstriction. Other effects are mydriasis and dilatation of the bronchi. On local application, it contracts the capillaries to a moderate degree and thus reduces swelling of the turbinate bodies and diminishes hyperemia of the mucous membranes.18

In therapeutics, ephedrine 1% in oil is applied locally to the mucous membranes in catarrhal conditions. A 4% solution is used in ophthalmic examinations. Some cases of asthma, especially asthma in children, are treated successfully with this drug. Although it acts more slowly than adrenalin, the effect is more lasting. Although it has been suggested for cases of shock, hypotension and hemorrhage,22 there are still conflicting opinions as to its real value in these cases.

Pinus palustris - Miller is commonly called the long-leaved, yellow, or Georgia pine. It rates next to Pinus Strobus, the white pine, in economic usefulness. The bulk of our naval stores, such as turpen-tine, tar, and pitch, are furnished by it; pine wool is made from its leaves, and essential oils for medicine are distilled from the leaves and young shoots. The name palustris is not an appropriate one for this
plant since it is seldom found in swamps or boggy places and does not grow favorably in such an environment. 4

*Pinus palustris* is a large tree with thin-scaled bark, bearing very long leaves in threes. Young specimens may have needles exceeding a foot in length, surrounding in dense, graceful tufts the big silvery buds at the tips of the branches. The flowers of pines are monoecious, the female flower being axillary and with simple strobili, while the male has compound strobili. The mature cones enclose winged seeds. A rhombic tip on the thickened apices of the scales is called the apophysis. The cones of *Pinus palustris* are large, with thick scales bearing short, recurved spines. 51 These pines are not adapted for planting north of 32°. They prefer the sandy soil of southern United States. 4

*Pinus palustris* is the most important source of turpentine. In this tree it amounts to 70-80% resin, 15-30% volatile oil, and pinene. Turpentine is an oleoresin which is secreted in the sapwood and obtained by making triangular incisions into the bark and wood in the spring. It flows into cavities made lower down on the trunk, from which it is dipped into barrels or other receptacles. The product of the first year's cutting is of superior quality and is known as "virgin turpentine." It yields about 15% oil of turpentine, while the product of the second or third year yields 10%. The turpentine is first in yellowish, opaque masses, brittle in the cold, sticky, and more or less shiny. Its most important constituent is the hydrocarbon, pinene, \( C_{10}H_{16} \). 32

After the distillation of the crude oleoresin (or turpentine) there is found a residue called resin, rosin, or colophony. The resin appears in amber-colored, sharp, angular fragments, usually covered with
a yellowish dust. It is hard, brittle, pulverizable. Resins are a class of substances which may be looked upon as final products of destructive metabolism. They result from oxidation of oils and allied products and usually accompany them; as oleoresin. Several kinds of resins are recognized, depending on the nature and constitution of their important constituents.54

A product obtained from the destructive distillation of wood of *Pinus palustris* is tar. The tarry liquid is separated from the aqueous mixture consisting of wood naphtha and crude acetic acid. Tar is a blackish-brown, viscid, semi fluid with a peculiar odor and aromatic pungent taste. Tar consists of a resinous substance with which are admixed a small quantity of turpentine, acetic acid, methyl alcohol and various volatile empyreumatic substances. On distillation, four distinct classes of products are obtained; the most important to medicine are an aqueous distillate, consisting chiefly of acetic acid, methyl alcohol and acetone, and a heavy volatile oil distillate, consisting of creosote oils, such as phenol, cresol, creosote, paraffin, and naphthalene.32

**Pine Tar** is an irritant to the skin. For this reason it is often employed as first remedy in changing from sedative to stimulating applications in dermatitis. Since it is also antiseptic and locally anesthetic, it is used to treat pruritus. Pine tar may be mixed with melted yellow wax and petrolatum to form a tar ointment. This is used in scaly eruptions of the skin, in psoriasis and in ringworm.

The oil of turpentine, or "Spirits of Turpentine" as it is sometimes called, is a volatile oil from oleoresin recently distilled from turpentine. This is used internally as an antiseptic and expecto-
rent in bronchitis, as an anthelmintic, or a diuretic. Externally, this drug is utilized for its counterirritant action. Tympanites may be relieved by the use of stupes containing turpentine applied over the abdomen. Care must be taken to test the urine after these stupes so as to guard against cumulative action of the drug.

*Cinnamomum Camphora* (Linné) Nees and Ebermaier comes from the islands of Formosa and Japan. Camphor imports into the United States usually exceed three million pounds annually, a large portion being used in the manufacture of celluloid and moving picture films; but artificial camphor is now also an article of commerce. *Cinnamomum* is an ancient Greek name. Because of the feeling of warmth produced in the stomach by this irritant and because of its exciting action on the Central Nervous System, camphor has long been used in the East as a stimulant and aphrodisiac.

*Cinnamomum Camphora* trees are stout, with base enlarged to forty feet. They have the attenuate leaves of the laurel family but these leaves are not large or very thick. They are ovate elliptic, acuminate, pinkish on the young growths, and a silvery blue color on the under surfaces of the older leaves, with a pair or more of strong side veins. The buds are scaly, the flowers small and yellow in axillary panicles, with a membranaceous perianth. These flowers are perfect, with nine, or less, perfect stamens in three unlike rows and a row of imperfect ones. The perianth is short-tubed with six nearly-equal segments. The fruit is a drupe the size of a large pea.

These trees yield camphor, which occurs as a crystalline deposit in clefts of the stem, but also it occurs in larger quantities.
dissolved in the volatile oil. The latter exists to the greatest extent in the roots, and the least in the leaves and twigs. Camphor arises as a product of the oxidation of the volatile oil. In the preparation of commercial camphor the tree is cut down and the roots and lower portion of the trunk subjected to distillation. This is usually accomplished in the winter time when the camphor is deposited in greatest amounts.

The product which is distilled consists of a granular and light-reddish mass containing about 80% camphor and 20% volatile oil. It is collected in bamboo canes or tubs and sent from Formosa to Europe and America, where it is refined by sublimation. Refined camphor occurs in commerce in large slabs weighing from one to five kilogrammes. It is composed of nearly-colorless, crystalline, shining granules, which are somewhat oily in appearance, brittle, and form a whitish powder, having a distinct penetrating odor and a pungent, bitter, cooling taste. It is

Chemically, camphor consists almost entirely of a dextrorotatory modification of a saturated ketone $C_6H_{15}CO$. Camphor water is an aromatic water which is a saturated solution of the volatile oily camphor in distilled water. It is clear and free from solid impurities. Its odor and taste is similar to that of camphor. It is made by placing the odoriferous portion of the plant in a still with sufficient distilled water. Most of the water is distilled; the excess of oil is separated, and the clear aqueous portion preserved and filtered when necessary.

Camphor is a Central Nervous System stimulant. Taken in large doses it produces epileptiform convulsions, preceded by vertigo, tinnitus and delirium. The pulse becomes rapid, feeble, and running; the skin livid, cold, and covered with sweat. In small doses camphor has the stimulant effect above mentioned, especially on the circulatory
and respiratory tracts, giving a feeling of warmth to the stomach and making the pulse rapid and strong. For this reason it is considered useful as a remedy in depression coming on in the course of acute and prolonged disease such as Pneumonia and Typhoid Fever. When given by hypodermic injection it is given in oil, which makes it too slow in effect to meet urgent symptoms. It is therefore more of a sustaining agent than an active stimulant. The solvent in this case is cottonseed oil and never liquid petrolatum, as the latter has often caused the development of fibrous tumors. Camphor is also useful in hiccoughs, old atonic cases of capillary bronchitis and catarrh of the air passages. In chronic nasal catarrh, spirits of camphor may be inhaled to stimulate secretions and tone up the parts. Camphor may be used as a carminative in dyspepsia and intestinal flatulence.

Externally, camphor is used to stimulate the healing process of indolent sores and is a useful addition, in small amount, to precipitated calcium carbonate as dusting powder in intertrigo. Since it is a mild local analgesic, rubefacient, and counterirritant, camphor is used in liniment for inflamed joints from sprains or rheumatism.

Various species of Cinnamomum trees indigenous to tropical Asia, where they are now extensively cultivated, are used as sources of commercial cinnamon. Sazion Cinnamon is obtained from C. loureirii-Nees (Cassia-Flower Tree) and other species cultivated in Cochin, China; Cassia Cinnamon, yielded by C. cassia-Blume (Cassia-Bark Tree) is cultivated in the southeastern provinces of the Chinese Empire and exported by way of Calcutta; and Ceylon Cinnamon, collected from C. zeylanicum i
Indigenous to and cultivated in Ceylon. Cassia and cinnamon were well known to the ancients, especially to the Israelites who used them for incense on their altars. The cultivation of *Cinnamomum zeylanicum* began about 1770. It was Heroditus who gave the name *Cinnamomum* to this plant, saying that it came from the Phoenicians.

Unlike the camphor trees of the cinnamon family, *Cinnamomum zeylanicum* is a small tree—only twenty to thirty feet high. Its leaves are very stiff, ovate, glossy, three-to-five nerved, obtuse or somewhat acute, and reticulate on the under side. The flowers, like those of the camphor trees, are small, yellow-white and in loose, silky clusters. The fruits, too, are small like those of the camphor plant.

The dried bark of the stem and the leaves of the various species of *Cinnamomum* furnish the cinnamon of commerce. The bark has an aromatic odor and aromatic, pungent taste. It is ground into a brownish powder. The most important constituent of cinnamon is the volatile oil, the Saigon being the most pungent and aromatic. The oil of cinnamon consists in large part of cinnamic aldehyde (not present in the oil of the root bark) and other compounds, such as camphor, which is present in the oil from the root bark; safrol, which is found in the leaves; and eugenol, which is found in both leaves and stem bark and which gives the characteristic odor to Ceylon cinnamon.

In medicine, the *Oil of Cinnamon*, or *Oil of Cassia* as it is sometimes called, a yellowish liquid with a characteristic odor and spicy, burning taste, is used as an aromatic or camminative. Cinnamon water, a saturated solution of oil of cinnamon in distilled water, is largely used as a vehicle.
Podophyllum peltatum—Linnaeus has a long list of common names, among which are the following: American Mandrake, May Apple, Indian Apple, Bog Apple, Wild Lemon, Wild Jalap, Peca, Raccoon-Berry and Buck's Foot. The name Podophyllum itself comes from anapodaphyllum or duck's-foot leaf because of the fanciful resemblance in the foliage.⁴ The medicinal virtues of Podophyllum were well known to the Indians of North America and an early writer, Catesby, remarked that the root was excellent emetic. Cases of poisoning have also been reported. ³⁷

Podophyllum peltatum is a perennial herb with long, creeping rootstock and thick, fibrous leaves. It grows one to one and a half feet high. The flower stem bears two five-to-three-lobed leaves, each lobe being two-cleft, and one white, sweet-scented, nodding flower. The flower has a calyx of six unequal sepals, a white corolla with six to nine petals, and twelve to eighteen short stamens inserted below the pistil. The many-seeded carpel ripens into a yellow, egg-shaped fruit about two inches long with rather a mawkish taste. ³⁶ This herb is commonly found in rich woods and copses throughout eastern United States.

For the drug trade, the rhizomes of Podophyllum are collected late in the summer and, after the removal of the rootlets, they are dried. Both the leaves and the fruit contain a purgative resin similar to that found in the rhizome. The berry is generally considered to be edible but several cases of poisoning from eating it have been recorded. The roots are externally dark brown, longitudinally wrinkled, or nearly smooth, with irregular scars of bud scales, stem scars, and root scars. They are lemon-yellow internally with a bark one millimeter in thickness and a large, white pith. A light brown powder with a pronounced and characteristic odor is made from them. The chemical constituents of
Podophyllum are: first of all, a resin, consisting of two poisonous principles—podophyllotoxin and picropodophyllin (an isomer); a yellow crystalline coloring principle; a green fixed oil; and podophyllic acid. The rhizome also contains a purgative resin—podophylloresin, considerable starch, and some gallic acid.

The resin of podophyllum, with a slight peculiar odor and faintly bitter taste, is very irritating to mucous membranes. It is used as a cathartic chiefly in the form of pills. The irritation stimulates peristalsis by reflex action. Chronic constipation yields to treatment with small doses. Since this drug acts only after twelve to twenty-four hours, it is given at bed time.

**Colchicum autumnale**—Linne derives its name from Colchis, a country in Asia Minor where the genus is most plentiful. Among its common names are Meadow-saffron and Autumn crocus. This plant was known to the ancients for its poisonous properties.

Colchicum autumnale is an autumn flowering, bulbous herb, with rosy-purple, sometimes pure white, crocus-like blossoms. The stem rises three to four feet high, the fairly large leaves are either all radical or some cauline, appearing in early spring and dying down by June. One to four or more flowers arise from each spathe. These are about four inches across, with veined, sic-parted perianth, six stamens inserted on the perianth, and a three-celled many-ovuled ovary. While Europe and North Africa are the native lands of this plant, it is commonly found in American horticultural trade.

The corn of Colchicum autumnale is collected in early summer.
before the flowering period, deprived of its scaly membranous coat, cut into transverse pieces, and dried at a temperature of 65° Centigrade. Tubers that are collected in the fall, either during the flowering season or later, are considered to be more active. They have a slight characteristic odor and a bitter acrid taste. They are composed mainly of starch-bearing parenchyma and yield a light brown or grayish-brown powder with numerous starch grains. About .4 per cent of this is a yellowish amorphous alkaloid, colchicine, the active principle of this drug.

The dried ripe seeds of this plant are used in medicine also. These are very hard when dry and tough when damp, nearly inodorous, with a feeble, bitter, somewhat acrid taste. The seeds contain about .6 per cent colchicine and a resinous principle, colchiresin.34

Colchicine, the alkaloid derived from the seeds and corms, produces marked irritation of the intestines, leading to looseness of bowels with much pain and watery stools. This may result in severe enteritis and collapse. It also produces irritation of the kidney which may lead to nephritis. It has narcotic properties, however, which account for its use in very small doses as an antineuralgic and analgesic. Some consider it as a specific for gout because it controls pain and cuts short the attack in many instances, but opinions differ on this point. The tincture of colchicum, an alcoholic solution, is employed for acute gout and given in small doses until nausea or slight purging is induced.21
Aloe Perryi-Baker was known to the Greeks in the Fourth Century B.C. It came from the island of Socotra and was called Socotrine Aloe or Zanzibar Aloe. All through the middle ages it was esteemed as a marvelous remedy, being one of the constituents of Venetian treacle. Aloe is the Latinized form of an Arabic name. Aloe vera—Linné gives us "Barbadoes Aloe." Aloe vera has stems one to one and a half feet high, suberect or spreading leaves, gradually narrowed from the base. They are large, pale, irregularly white-blotched and narrow when young. They have pale prickles on their repand margins. The inflorescences are two to three feet high, the yellow flowers an inch long with segments about equaling the oblong tube. Aloe Perryi has pale green, somewhat striate, but not mottled, leaves with rather close brown-tipped prickles on their margins.

The leaves of the Aloe plant are cut transversely and the juice which exudes is allowed to evaporate spontaneously, it being usually, however, concentrated by boiling and then poured into boxes or gourds, and occasionally it is found in commerce enclosed in monkey skins. When fresh, it has an unpleasant odor, but on keeping, develops an odor resembling myrrh and saffron. The powder is yellowish brown. Aloe contains a crystalline bitter principle, aloin, which is supposed to occur in largest amount in old Aloe; emodin, a pale yellow volatile oil which is not identical in the different varieties giving them characteristic odors; and resinous material which consists mainly of a resinotannal ester of cimamic acid. Aloin is a neutral principle which, on distillation with zinc dust, yields anthracene.

Aloes acts very slowly, requiring several hours for its influence to be manifested unless the dose is toxic in amount. Its
chief influence is on the lower bowel, producing watery stools if the dose is quite large—10 to 20 grains—but thick and pulpy ones otherwise.

Aloes should be used only when a somewhat slow stimulant to peristaltic movement is desired, and never when the object of the physician is to relieve congestion by depletion through the intestine. It is a favorite remedy in case of subacute or chronic constipation, but is distinctly harmful if continued for any length of time, as it seems to produce atony of the bowel. Owing to its bitter properties, it acts as a tonic to the stomach and is often given with iron. If given alone, aloes is very apt to produce griping, and it should always be combined with other drugs whose tendency is to prevent intestinal spasm—a favorite preparation being Aloes, Strychnine and Belladonna.

The Sanskrit name of the sugar cane was jakša, Ḗkṣa or iksava; but sugar itself was called sarka or ṣaktara and all its names in our European languages of Aryan origin, beginning with the ancient ones, are clearly derived from this. The Greek name was ἱκάρα, from which we derived Saccharum officinarum—Linné. This is an indication of Asiatic origin of the ancient use of sugar in the southern regions of Asia with which the Sanskrit-speaking nations may have had commercial dealings. The Chinese were not acquainted with the sugar-cane at a very remote period until they received it from the west. It appears to have been mentioned for the first time by authors of the Second Century B. C. The propagation of the sugar-
cane from India westward is well known. The Greco-Roman world had a vague idea of the reed *calamus* which the Indians delighted to chew. The Arabs in the middle ages introduced it into Egypt, Sicily, and the south of Spain, where it flourished until the abundance of sugar in the colonies caused it to be abandoned.14

*Saccharum officinarum* is a tall grass, eight to twenty feet, with a stout culm, one to two inches thick, and ample panicles. The branches are many-jointed and the spikelets small, slender, and one-flowered, surrounded by long, silky hairs. The spikes are awnless.51 Different cultured varieties are distinguished by the color and height system.

Sugar or Sucrose is distilled from the juice of this plant. It is white, dry, hard, in distinctly crystalline granules, and odorless, with a purely sweet taste. The chemical formula is $C_{12}H_{22}O_{11}$. Sucrose is very soluble in water and slightly soluble in alcohol.54

This drug is used mainly as a vehicle. Properly prepared, concentrated sugar solutions are fairly stable. Dilute solutions are prone to undergo fermentation. Because sucrose is a demulcent—that is, it forms a protective coating over parts of the body, especially mucous membranes, and prevents them from being irritated—we find it used in solutions for throat irrigations in cases of tonsillitis or septic sore throat. Simple sugars are given intravenously after operations to supply lacking fluid and provide nourishment. Sugar is used by Diabetic patients to counteract an overdose of insulin and thus prevent hypoglycemia or Insulin Shock.
Zea is an old Greek name for some common cereal. *Zea Mave- Linné* has been long cultivated by the Indians and white men of North America so that in the course of time many forms have arisen and it is difficult to trace the origin. It is said to have originated as a hybrid between teosinte, a native Mexican grass, and some unknown grass. North America produces about four times as much corn as the rest of the world.37

*Zea* is the most highly evolved of grasses. It has one fertile floret and one abortive one, showing that it was at one time a compound spikelet.51 This plant has unisexual spikelets but is monocious. The staminate spikelets are two-flowered. These flowers are arranged in the terminal branches of a terminal panicle in pairs, one sessile and the other pedicellate. The pistillate ones are one-flowered, sessile, and crowded in several rows along the much-thickened continuous axis arising from the lower leaf-axil and closely enveloped by numerous large foliaceous bracts. There are four awnless glumes; those of staminate spikelet acute, those of the pistillate very broad and obtuse or emarginate. The grain is hard and only partially enclosed by the fruiting glumes.37 This well-known, tall, striking annual grass has erect stems and broad leaves; the terminate, staminate inflorescence forms the "spindle", and the long, projecting styles of the pistillate flowers constitute the "silk." The cob is formed by the union of the axes of several female spikes into a much thickened body.

Corn starch is made from the grains of the corn. In its preparation the grains are softened by being placed in running water and kept at a temperature of 60° Centigrade for several days, care being taken to prevent any fermentation. The grains are then crushed between brimstones and the paste carried by means of water to large
sieves, the strained magma then being reground and carried to sieves made of bolting cloth. The milky-fluid containing the starch is then run into settling vats, the starch separating out. The starch is then freed from oil, albuminoids, and other substances by treating it with a 15% solution of caustic soda. The supernatant liquid is removed and the starch washed with water to remove all traces of alkali. The starchy mixture is allowed to stand until the starch separates out, which is dried. Cornstarch occurs as a fine, somewhat cream colored, mobile powder, which is practically free from cohering particles.45

Amylum, as cornstarch is officially called, is used dry in dusting powders or drying powders or as a diluant for active substances. It may be boiled in water to form a thin paste which is used as a demulcent—that is, to form a protective coating over skin or mucous membrane surfaces by mechanically cohering to them. It is used thus in cases of colitis where the lower bowel is inflamed and may be soothed or protected by starch enemas. It is used in skin diseases in the form of starch baths to soothe the itching. Starch, too, is the antidote for iodine poisoning.

Elettaria Cardamomum—Maton is a South Indian plant. The seeds are aromatic and have been used from ancient times. In 1542 Valerius Cordus distilled cardamon oil. Bombay ships 100,000 kilograms of cardamon seed to London yearly.4

Elettaria Cardamomum grows five to ten feet high, bearing
a curving, jointed, closely-sheathed stem with oblong-lanceolate acuminate, entire, nearly sessile leaves, often two feet long. It has a horizontal rhizomatous rootstock. The flowers are purple-striped with slender tube-like perianths and filaments not prolonged beyond the anther. The fruits are oblong or nearly globular capsules with many thin, vertical ribs and are indehiscent. The seeds are small and angled. These plants are said to prefer the moist soil and the shade.

The true cardamoms of commerce are the dry capsules which are used in medicine. The fruit is gathered in autumn. Either the entire spike, when some of the fruits have matured, or the full-grown fruits are cut from the rachis in succession as they ripen. They are bleached by exposure to the sun, sometimes sulphurous acid or steam being also used. After this they are dried and freed from extraneous matter. Seeds which have been discharged from their capsules are inferior to those which have been retained. Cardamon seed contains a volatile oil with a penetrating but agreeable camphoraceous, burning taste, a fixed oil, starch, some calcium oxalate, and ash. The pericarp contains about 0.2% of a volatile oil. Cardamon is frequently prepared in the form of a tincture with cinnamon and caraway in diluted alcohol. 49

In the form of a composite tincture, cardamon is used as an aromatic vehicle. Because the volatile oils cause reflex stimulation of the muscles and glands of various organs by irritating their mucous membrane linings, cardamon makes a good stomachic and carminative. 12

Indigenous to the tropics of the eastern hemisphere, especially those countries bordering on the Indian Ocean and the Malay Islands, is another plant of the Zingiberaceae family—Zingiber
These plants are perennial herbs characterized by their long or tuberous rhizomes and strongly thickened roots. The leaves are lanceolate and ligulate at the basal portion of the petiole. They usually contain a volatile oil which is colored by a yellow coloring principle, curcumin, this being found in special secretion cells, which somewhat resemble surrounding parenchyma.32

The rhizomes of these plants are collected between December and March. They are cleaned by washing, peeled, again washed with water, sometimes containing the juice of the lime fruit, and dried in the sun. There are several kinds of drug, depending on the manner of treatment. That from Africa has the periderm removed from the vertical sides only and is known as "coated ginger"; in the Jamaican variety the periderm is completely removed and the product known as "peeled" ginger or "uncoated" or "scraped" ginger. The latter is sometimes steeped in milk of lime to protect it against attacks by insects. The Jamaican variety has a very delicate aroma.

A light yellow powder is made from these rhizomes containing a volatile oil consisting chiefly of a sesquiterpene, some dextrocamphene, and phellandrene, also a colorless, viscid principle, gingerol, which has the pungent taste of the drug.32

The Jamaica ginger is occasionally administered in powder form as a carminative in colic or as an aromatic and stimulating stomachic tonic. Its action is essentially the same as that of cardamom and other volatile oils.
Papaver somniferum—Linné is the old Latin name of the plant which constitutes the source of that group of drugs popularly known as "The Opiates." This includes the derivatives of opium, such as gum opium, morphine, codeine, heroin, etc. The opiates occupy a place all of their own in medicine. Sydenham says "without opium few could be callous enough to practice therapeutics." The old Egyptians knew the drug. Because of the fact that it was cultivated in Thebes, the name "Tinctura thebaica" still persists as the name of one of the opium derivatives. Asia Minor saw the evolution of the opium poppy. It was used in the east for thousands of years, then, following the migration of the races, it extended from Asia Minor to Persia and then India. Later on it was taken up by the Chinese. The chief markets of opium are Turkey, Asia Minor, India and Egypt. Smyrna opium is considered the best, although good opium has been grown in the United States. It was left to Friedrich Sertuerncr, a German pharmacist, to first isolate the chief active principle of opium—morphine. This he did in 1804 in his little store on Langebruecke Street in Germany.15

The Garden Poppy or Opium Poppy is an annual of tall, stately habit. Its flowers are the largest of practically any annual species. The petals are orbiculate, entire, undulate or cut, white through pink, red or purple. There are usually two fugacious sepals and four petals. There are many stamens and a many-carpeled superior ovary with a shield-shaped stigma. The fruit is a globose capsule which opens by pores at the top. This herb is recognized at once by the glaucous hue of its large, oblong, wavy, lobed or toothed, clasping leaves.37

The capsule of the opium poppy is full of sticky, milky juice resembling the liquid from common milk weed. The juice appears when
the petals are just beginning to expand. Incisions are made into the capsules and the juice comes out, spreads over the surface, and coagulates. It turns dark brown, is scraped off and collected into masses the size of a cannon ball. This is the crude opium or gum opium which is used in such common drug preparations as laudanum (deodorized tincture of opium) and paregoric (camphorated tincture of opium).

Crude opium is made up of a large number of alkaloids. The principle ones of these and their approximate amounts are:

- Morphine 10%
- Papaverin 1%
- Codeine .5%
- Narco tin 8%
- Thebaine .3%

The narcotic action of these drugs is most striking in the first and becomes progressively less until it is scarcely observed in thebaine, which acts more like the drug, strychnine, in stimulating reflexes. Opium also contains acids such as meconic, lactic, and sulphuric; gums, sugars, albumins and wax. Morphine and codeine are extracted from opium by the chemist. Crude morphine has a grayish brown color. After being dissolved in dilute sulphuric acid and treated with decolorizing agents, fluffy white crystals of morphine sulphate are obtained. These are prepared for market in little cubes the size of a lump of sugar. Later tablets are prepared; these for hypodermic use, and triturates, the excipient usually lactose. The composition of morphine is $\text{C}_{17}\text{H}_{19}\text{NO}_3 \cdot \text{H}_2\text{O}$. The crystals are colorless with no odor but a bitter taste. They are practically insoluble in alcohol. Morphine has an advantage over opium in that its composition does not vary.18

Morphine exerts its chief actions on the Central Nervous
System, the respiratory center, and the gastro-intestinal tract. In
the Central Nervous System the higher cortical centers are depressed—
especially the powers of concentration, coordination, and summation.
After this the receptive faculties are lowered, especially the appreci-
ation of pain; and finally the entire system is depressed, but spinal
activity is slightly augmented. On the respiratory center in the
medulla morphine has a depressant effect, making breathing slower and
shallower. Morphine slows peristalsis, induces constipation, decreases
intestinal secretion, and lessens the sensation of hunger in the
gastro-intestinal tract, but opium has a more marked effect on perist-
alsis. Morphine is absorbed by the blood vessels and excreted for the
most part into the stomach, where it is sometimes reabsorbed, and out
through the intestines. While a therapeutic dose of morphine causes
slightly contracted pupils, slowed respirations, lessened voluntary
movements, lack of attention, drowsiness, and a more or less deep sleep,
with toxic doses the pupils become "pin-point," the respirations ex-
tremely slow, the face cyanosed, and the patient goes into a deep,
torpor-like sleep. This condition should be treated at once by caffeine
and other respiratory stimulants and a lavage. If it is not relieved,
the patient dies of respiratory failure.12

Because of those actions of morphine described above, it is
used to relieve severe pain which is not chronic, since in that case
morphine is habit forming. If it is used for insomnia, but only when the
sleeplessness is due to pain. Morphine has a peculiar usefulness in
treating inflammation of serous membranes which is not thoroughly
understood. In these cases the patient should receive only enough to
take the edge off the pain but not enough to make him unable to answer
questions.18 Opium is used to check peristalsis in certain cases
where it is desirable to keep the perineum aseptic or the lower bowel undisturbed. Codeine is used in preparations of cough syrups to lessen coughing. Before operations, morphine is commonly used to precede the other anaesthetic. Finally, morphine is permissible in old age and advanced phthisis to smooth out the remaining years of life.

Besides the morphine, codeine, and opium preparations mentioned, there is the drug apomorphine, an artificial derivative of morphine made by removing a molecule of water with certain dehydrating agents. This changes the physiologic action of the drug, giving it a stimulating effect on the medulla, especially the vomiting center. Hence, it may be used to produce quick vomiting in case of emergency. Diamorphine or Heroin is a derivative of morphine obtained by introducing acetic acid into the morphine molecule to make diacetyl morphine. It is used in cough mixtures, in asthma cures, and for diseases of the nasal and bronchial tracts.

**Brassica juncea** (Linné) Gossen is known by the common names Indian Mustard or Chinese Mustard. **Brassica Negra** (Linné) Koch is the Black Mustard. The name Brassica comes from the Latin word meaning cabbage. The ancients knew B. Negra as a medicinal agent but it was not used as a condiment until somewhat more modern times. These plants are natives of Europe and Asia.36

**Brassica juncea** is a rank and coarse grower, in the common forms making great tufts of root leaves if sown early. It is nearly glabrous and somewhat glaucous. The pedicels are slender and spread-
ing, the pod long, slender, and tapering to a seedless beak. *Brassica nigra*, the black mustard, is hirsute. Its pods are short on short, erect pedicels which are oppressed. The four-cornered pods are tipped with a slender beak. This plant is a tall (two to five feet high), coarse, much-branched annual.17

The ground, dried, ripe, black or reddish-brown seeds of *Brassica nigra* constitute commercial mustard, though oil is extracted from the seeds of many species. The endosperm and embryo contain fixed oil and oleurone grains and make up most of the drug. Ground Black Mustard or Black Mustard Flour is usually prepared from the cake which has been deprived of the hulls and part of the oil. It is customary to mix some white mustard with black mustard, it being supposed that the excess of the ferment in *B. alba* will change the unconverted glucoside into volatile oil of mustard. It is likely, however, that the enhanced quality of the product is due to the pungent and non-volatile character of the oil in white mustard. **Mustard paste** is sometimes adulterated with starches.

Black mustard contains 30 to 35% fixed oil, a ferment, myrosin, and a glucoside, sinigrin (potassium myronate) which is present to the extent of about 1% and on interaction with the myrosin yields a light yellow volatile oil—the volatile oil of mustard. It is this oil which gives to mustard its acrid, burning taste and pungent odor.32

**Mustard** is extensively used as a counterirritant. The volatile oil is employed in rubefacient liniments up to 3% or the mustard may be mixed with flour and spread on thick paper or cotton cloth in the form of a poultice or mustard paste. Counterirritants redden the skin by irritating the sensory nerves, thus dilating the superficial blood vessels by simple reflex action. By simple reflex mustard may cause
vomiting and is considered a good emetic. The action of counter-irritants may extend further and stimulate the vasomotor center, thus causing a sensation of warmth in distant parts of the body. It is because of this action that warm mustard foot baths are used to counteract the effects of a chill. Finally, their action may be referred to other parts of the body than that to which they are applied. This is called "referred pain" or "head's areas" and is thought to be caused by the stimulation of certain segments of the spinal cord. Because of this principle, a mustard paste on the chest is considered effective in case of chest cold or a mustard plaster on the abdomen used to relieve gas in the intestines.

Theobroma Cacao—Linne is the botanical name of the cocoa plant. The word theobroma comes from Greek—meaning "food of the Gods." In 1519 the Spaniards found chocolate in common use in South America both as a confection and a beverage. The Aztec believed that their ancestors received the seed of the chocolate tree from Quetzalcoatl and used the beans for many purposes. Chocolate is of Mexican origin—from chocolatl or cacahuatl. Montezuma drank chocolate from a gold cup and is said to have had fifty jars for daily consumption. Cortes introduced it into Spain in 1529 where it was at first considered a great luxury. In 1770 the first factory for the manufacture of cocoa was established in the United States. In 1921 the United States imported three hundred million pounds of crude cocoa.

Theobroma Cacao is a wide-branching, evergreen tree, twenty to twenty-five feet high. It has pubescent twigs and alternate oblong-
oval, or elliptic-oblong, entire, short petioled leaves with blades about six inches long, rounded at the base and sharply acuminate at the apex. The leaves have strong midribs and paired, or somewhat alternate, arching side veins. The flowers are small, growing in fascicles directly on the old wood of the trunk or main branches. They have a rose-colored calyx with acuminate segments and a yellowish long-petaled corolla. The petals consist of stalk-like claws and expanded blades. The fruits are one-inch-long red, yellow, purplish or brown "pods" with about ten ribs. They have a chick, hard, leathery rind and five cells, each containing a row of five to twelve "beans" embedded in white or pinkish acid pulp. These "beans", which are flat brownish or purple, constitute the commercial cacao, from which the products are manufactured.

The bitter principle in the raw product is more or less destroyed by the process of fermentation to which the seeds are subjected in preparing them for use. At the same time an aroma is developed. In the roasting of the seed, which is the next step, the seed-coat is more readily detachable and the embryo more easily broken into smaller fragments. By a process of winnowing, the seed-coat is separated and constitutes what is known in commerce as cocoa shells. The broken embryo constitutes the product known as cocoa nips or cracked cocoa. Plain chocolate or cocoa mass is obtained by grinding the broken cotyledons (cocoa nips) in a mill and separating the pasty mass, which is moulded into forms that weigh a pound. Cocoa is plain chocolate from which a part of the fat (cocoa butter) has been removed, the resulting product being then powdered. The powder is reddish-brown, consisting chiefly of protein grains, oil, and starch grains.
The seeds contain a fixed oil known as cocoa butter (Cocoa Theobromatis), caffeine, sugar, and a small amount of tannin. The red color of the seed is known as cacao-red and is formed by the action of a ferment or a glucoside.  

Cocoa butter is chiefly used in making suppositories. Sometimes it is used as a lubricant in massage or in covering sore nipples. Theobromine, 3,7-dimethylxanthine, a base occurring in the plant and also made synthetically, is closely related to caffeine, 1,3,7-trimethylxanthine. It has an effect similar to that of caffeine on the kidneys and heart but it has a lesser effect on the Central Nervous System, which makes it preferable as a diuretic in all forms of dropsy. Since it is very slightly soluble in water, it is usually used in the form of Theobromine sodiosalicylate. Theophylline, another dimethylxanthine, has a diuretic action similar to caffeine and theobromine, but is more active and often effective when the others are not. However, this effect is not as lasting, so that it is advisable to replace it by theobromine in two or three days. These drugs are said to produce their effects by stimulating the heart, thus increasing the general circulation of blood through the kidneys, with consequent greater elimination of waste products. 

Citrus aurantium, the name of the orange plant, was derived from the ancient name of a fragrant African wood. The orange was brought to Arabia from India in the ninth century. From here the Moors took it west in the twelfth century where it was cultivated. In 1290 there was
a shipment of oranges from Spain to England. It is not certain how
the oranges first came to America, but they were probably introduced
by the Spaniards and spread quickly in the south. Orange culture
reached its highest development in southern California. The Seville
orange, or the sour variety, is grown in large quantities in Seville,
Spain, and shipped to England and Scotland to make orange marmalade.
The petals yield valuable perfume—oil of Neroli—produced in south-
ern France and the Italian Riviera. There are many varieties of
sweet orange, C. aurantium var. sinensis.51

The sour or Seville orange has winged petioles and crenate
leaves with obvious joints between the blade and the petiole. The
flowers are medium sized, axillary, single or clustered, white in the
bud with very fragrant white petals. There are twenty to twenty-four
stamens and a globular ovary, sharply delimited from the deciduous
style. The fruit is globose, slightly flattened at the top with a
hollow core, acid pulp, and bitter membrane when ripe. The seeds
are flattened and white inside. This plant is a medium sized tree
with rounded top and regular branches with long, blunt, and flexible
spines. The leaves are light green when young, with a tapering, some-
what wedge-shaped base, and more or less acuminate at the tip, and
with broadly winged petioles. The sweet orange has leaves which are
rounded at the base, pointed at the apex, and have narrowly winged
petioles. The fruits have solid piths, sweet pulp, and a membrane
which is not bitter in taste. The sweet orange is not as hardy as
the sour.4

The outer layer of the rind of the fresh fruit of Citrus
aurantium is the part usually employed in medicine. In the bitter
orange the rind is removed before the fruit is ripe. It is removed
from the fruit by grating or paring and consists of epidermal cells, the thick-walled parenchyma cells of the sarcocarp with schizolyticogenous oil cavities and globules of volatile oil. The odor is highly fragrant and the taste pungently aromatic. A light brown powder may be made from it. The volatile oil is obtained by expressing it from the fresh peel. It consists of about 90% d-limonene and 5% citrol, citronellal and the methyl ester of anthrahydrolic acid. The sour orange also contains bitter principles, mainly glucosides.

The fresh orange flowers are distilled with water and the clear, saturated portion of the distillate containing the odoriferous principles of the flowers is also used in medicine.49

The orange is frequently used as a flavoring substance or a vehicle in medicine, but the chief contribution of the orange is the antiscorbutic vitamin C obtained from its juice. Orange juice may be subjected for four hours under high vacuum to a temperature of from 40 to 45° Centigrade (104-113° Fahrenheit) and still retain its vitamin C content. Dried-orange juice also retains almost all of its antiscorbutic value. The vitamin C content of citrus fruits does not vary in potency according to acidity.35

Citrus medica var. Limonum (Risso) Hooker filius is another one of the citrus fruits commonly used in medicine. Medica gets its name from the Greek Media whence it was derived, while lemon is of Arabic origin. It was probably introduced by the Moors who carried it to Palestine about the tenth century.51 This plant is cultured on a large scale in the Mediterranean region, especially Sicily.
The lemon is a small tree with long irregular branches and short, stout and stiff thorns. The leaves are pale green, elongated-ovate and pointed at the tip. The petioles are wingless, but sometimes narrowly margined, and articulated both with the blade and the twig. The rather large flowers are solitary or in small clusters in the axils of the leaves. They have petals which are white above and reddish purple below. The lemon-yellow fruits are oval or oblong with an apical papilla and a prominently glandular dotted peel, often more or less rough and moderately thick. They have very abundant, very acid pulp and usually a few small white seeds.\(^4\)

The fruits are gathered just before they ripen, while still green, and are ripened in curing houses where the temperature and humidity are artificially controlled. Citric acid is found in the fruits of lemons as well as other members of the Genus Citrus. The essential oil of lemons is one of the terpenes \(\text{C}_{10}\text{H}_{16}\). The outer yellow layer of the rind is removed by grating or paring like that of the orange and used in like manner. The volatile oil obtained by expression from fresh lemon peel consists of 90% d-limonene; 7 to 10% \textit{citral}, which is the most important constituent, and other constituents.\(^3\)

Citric acid, a tribasic organic acid, is used to produce an acid flavor and used in effervescent drinks. It is oxidized in the body to carbonic acid which does not act as an acid on tissues. This acid is not a substitute for lemon juice as an antiscorbutic.\(^{12}\)
Pilocarpus is derived from the Greek pilos, a cap, and Karpos, fruit, because of the shape of the fruit. This genus is native to Tropical America, principally Brazil, but has been introduced into California.¹⁴

The Pilocarpus spp. are shrubs or small trees, sometimes attaining a height of ten feet. The leaves are pinnately compound, of one to four pairs, and a terminal leaflet. The leaflets are opposite but the leaves are usually alternate. The flowers are in elongated racemes with four to five petals, four to five stamens and a four-to-five lobed ovary. Pilocarpus pinnatifolius-Lex has glabrous or puberulent branchlets with leaves about one and one-half feet long and leaflets three to nine inches long. It has spike-like racemes with about 100 reddish-brown flowers. The rachis is stout, the pedicels stout, and there are two small, greenish tooth-shaped bracts at their bases.

P. Jaborandi-Holmes has short leaves and leaflets, stiffly pubescent branchlets and stems and openly flowered racemes with slender rachis and pedicels, and two inconspicuous bractioles above the middle of the flower pedicels.⁴

The leaflets of the various species of Pilocarpus are used in medicine. A dark green or greenish-brown powder is made from them. The plant contains pilocarpine, an alkaloid which occurs as a colorless, syrupy liquid, but forms well-defined crystalline salts. Pilocarpine is decomposed by heat or alkalies and yields an isomeric substance, isopilocarpine, which is an oily compound and is usually present in the commercial nitrate of pilocarpine. The alkaloid, pilocarpidine, has been obtained from the mother liquors, after the crystallization of pilocarpine, as syrupy substance forming a crystalline nitrate and resembling somewhat pilocarpine in its physiological action.³²
Pilocarpus stimulates the endings of the parasympathetic nerves. It increases the secretion of salivary, mucous and sweat glands. It stimulates the unstriated muscles of the body generally, including the motor systems of the intestines and bronchi. The pupils are contracted and the muscles of accommodation undergo a spasm, while ocular tension is reduced. Pilocarpine is administered internally chiefly for its diaphoretic effect, especially in cases of Nephritis. It may also be of service in certain diseases of the skin. In doses just large enough to produce free diaphoresis, it sometimes relieves itching in generalized acute eczema, urticaria and pruritus. In diseases of the eye, such as glaucoma and corneal ulcer, pilocarpine is applied locally as a weak miotic.

The source of Myrrh is the Commiphora Myrrha (Nees) Baillon. The Greek word for perfume was the origin of the word myrrha. The Myrrh Family or Burseraceae are distinguished for their internal secretory system. Schizolysigenous balsam canals or gum-resinuous canals occur within the pericycle, also in the secondary cortex and medullary rays and occasionally in the primary cortex and pith. The epidermal layers in the leaves is usually modified to mucilage. These are mostly tropical trees and shrubs having alternate compound leaves and small flowers formed in racemes.

The dried gum-resin which exudes naturally from incisions made in the green bark of the stems is myrrh resin. It is first of a yellowish color, but upon hardening becomes darker and is collected. The pieces have a balsamic odor and aromatic, bitter, acrid taste.
yellowish, rather thick, volatile oil with the characteristic odor of myrrh, resin, gum, a bitter principle, and ash form the constituents. The volatile oil of myrrh consists of cuminol (about 1%), eugenol, meta-cresol, pinene, limonene, dipentene and two sesquiterpenes. The acidity of the old oil is due to free acetic, myrrholic and commiphorinic acids.34

The gum-resin of myrrh is used as a carminative, especially in connection with aloe. Due to the irritating quality of the volatile oil contained therein on the mucous membrane, the muscles of the intestines are stimulated by reflex action to contract. For this same reason myrrh in the form of a tincture containing alcohol is used as an astringent mouth wash for spongy gums and as a gargle for a relaxed throat.

Erythroxylon Coca—Lamarck, the source of the important drug, cocaine, comes from the Greek—meaning red wood which is characteristic of some species. The native country of this plant is uncertain but the earliest described form was Peruvian. The Indians chewed the leaves to ward off the sense of fatigue on long journeys.14

Erythroxylon Coca is a shrub, five to six feet high, with rusty brown, slender branches, on the extreme tips of which the leaves are borne. Below the leaves, on the wood of the preceding year, which is reddish, clusters of three to five yellow, five-lobed, small flowers spring from the protection of the small scales that line the branchlets and which are colored like the bark. The stamens are connate at the base and the fruit is a one-seeded drupe, but the leaves are most import-
ant in medicine. They are oval, obovate or elliptical, differing in different cultured strains or varieties, one and a half to two and a half inches long, and marked on the under side with two lines extending on either side of the midrib from base to apex.4

The leaves of Erythroxylon coca, and its varieties, when fully grown are picked and quickly dried in the sun. Two or three harvests are obtained in a year. On keeping the leaves, the alkaloid, cocaine, is dissipated and the stimulating properties are lost, particularly if the leaves are not thoroughly dried. There are several alkaloids, the most important, cocaine. In addition, coca leaves contain an aromatic volatile principle, a tannin and calcium oxalate. It has been shown that young coca leaves contain more than twice as much total alkaloids as the older leaves. Cocaine hydrochloride is the form in which this drug is usually employed in medicine. It may appear as colorless poisons, flaky lustrous leaflets, or white crystalline powder which is very soluble in water and freely soluble in alcohol.5

Because cocaine paralyzes the sensory nerves on direct application, it is used as a local anesthetic. It also constricts superficial blood vessels, making a bloodless anesthetized field for local operation. It is the oldest drug used for this purpose. Numerous synthetic drugs later discovered have an identical action except for lack of vasoconstriction. Among these, procaine hydrochloride, or novocaine, is perhaps most commonly used. Cocaine, when absorbed into general circulation, loses its local action and is more or less toxic if absorbed rapidly. For this reason it is desirable to use the smallest possible dose and confine it as close as possible to the place of operation. Through stimulation of the sympathetic nervous system, cocaine effects sydriasis. It is therefore widely used in ophthalmological work.

Cocaine (1 to 4%) is preferred, though Phenocaine (holocaine) 1% is
equally efficient and less irritating. The use of cocaine for psychic excitement leads to habituation, which is difficult to cure. Sudden withdrawal causes distress, and continuance results in chronic poisoning, especially mental deterioration. The Harrison Narcotic Law lessens this danger by making illegal the refilling of prescriptions. The drug is rarely used except locally.\(^\text{18}\)

Ricinus communis—Linne is the ancient Roman name of the Castor-oil plant. The name *Ricinus* was also applied to a tick resembling the beans of this plant. The plant is native to India, but has been cultivated in many parts of the globe. The oil was known to the Egyptians and Greeks and probably the Hebrews. Its name indicates that perhaps this is the plant referred to in the book of Jonah as a gourd. The use of the oil fell into neglect until Dr. Cavara, a physician of Bath, who had practiced in the West Indies, recommended it in 1764 as a gentle purgative. Now it is widely used in medicine as well as in art and in the preparation of food.\(^\text{4}\)

*Ricinus communis* is a tall, stately annual, thirty to forty feet high in the tropics, three to fifteen feet high in this country, with very large alternate peltate and palmately seven to eleven cleft leaves. The flowers are in terminal racemes, the fertile ones above and the staminate below. The stamens are very numerous, with repeatedly branched filaments and the calyx three to five parted. There are three styles united at the base, each one bifid and colored red. The fruit is a large three-lobed capsule with three large seeds. These are oblong, shining, variegated with white. The cotyledons are large
and the endosperm oily and fleshy.51

The seeds of this plant, called "castor beans" or "mole beans," yield the castor oil of commerce. In harvesting, a common method is to cut off the spikes with a knife and collect them in large sacks. They are then hauled to a shelter of some kind and allowed to dry until the pods will crush easily. Various methods are used in threshing castor beans. If the variety is one which "pops" or drops its seeds when they are ripe, the spikes are sometimes piled on a hard ground or plank floor, fully exposed to the sun, and furnished with sides of boards or cloth six to eight feet high to catch the beans as they pop out. In some varieties more drying does not cause the pods to open, and specially constructed machines have been used to remove the beans from the pods. After the beans have been threshed or popped out, a fanning mill is used to separate the hulls, chaff and dirt from the beans, which are then sacked and stored for the market. The best grade of oil is obtained from the beans by hydraulic pressure. An additional quantity of oil of lower grade is obtained by treating the press cake with naphtha or some other volatile solvent. Castor oil is a pale yellowish or almost colorless, viscid fluid with a faint, mild odor and a bland, afterward slightly acrid and nauseating taste. It contains 50 to 70% fixed oil, consisting chiefly of triricinolein, together with considerable ricinolein, palmitin and dihydroxstearin. There is about 20% protein substances, a very toxic alkaloid, ricine, which apparently is not removed in the extraction of the castor oil, but remains in the oil-cake, and other constituents of minor importance.49

Like other fixed oils and fats, castor oil is an ester of a fatty acid—in this case ricinoleic acid—with glycerol. So long as the fatty acid is combined with glycerol the oil is non-irritant, and
so can be applied to the skin or even mucous membranes as an emollient. Castor oil, to which has been added a few drops of balsam of Peru or oil of eucalyptus, when placed freely on gauze, is an excellent dressing for ulcers, wounds, and burns. When ingested, it passes unchanged through the stomach, but in the intestine is split up, like other fats, by the fat-splitting ferment of the pancreas (lipase) into its two constituents—glycerol and ricinolic acid. The freed fatty acid acts as a mild irritant to the gut and so provokes purgation. It is a very safe purgative with little tendency to cause griping. Hence it can be used in cases where more violent purgatives are contraindicated; for example, in infants, for the aged, and during pregnancy. After irritant materials such as bad food, putrid flesh, or decaying or green vegetables have been ingested, causing diarrhea, castor oil gives excellent results because it tends to be followed by obstinate constipation. It is used also to induce labor at term. 20

The purging Buckthorn - Rhamnus cathartica - has a medicinal history extending back to a period dating before the Norman Conquest. It was then called Maythorn or Hartsthorn. In the thirteenth century Welsh physicians prescribed the juice in honey as a mild aperient drink. In Spain it is referred to as early as 1305; and it is then noted by all writers on medicinal plants during the sixteenth century. Buckthorn first appeared in the London Pharmacopoeia in 1650. 36 It has also held a place in the Pharmacopoeia of the United States, but its space is now held by Rhamnus Purshiana—DeCondolle. The Purging Buckthorn has fallen
into disuse because of the violence of its action and the resulting severe irritation of the bowels. Common names of Rhamnus Purshiana are Chittewibark, shittimwood, sacred bard (a translation of the Spanish name "cascara sagrada"), and bearberry or bearwood (because of its being eaten by these animals).

Rhamnus Purshiana is a tall shrub or medium sized tree. The young branchlets are pubescent or tomentose, the leaves elliptic to ovate, acute or obtuse, usually denticulate, with often wavy margin, dark green above and glabrous or pubescent beneath. The calyx is usually synsepalous with the petals on the calyx and the stamens on a disc opposite the petals. The fruit is globose, changing from red to black with two or three nutlets.

The bark from the trunk and branches is the source of the drug. If the trees are pruned properly, a crop of bark may be harvested each year without killing the whole tree, as is done in collecting the bark from wild trees. At the time of transplanting, the trees are cut back to a straight stem about a foot high, from which all except the four uppermost buds are removed. The branches which afterwards develop from these buds are deprived of their lower side shoots, thus causing the tree to grow a head of four long stout branches, instead of a single, straight trunk. When the trees are large enough to yield a crop of bark, the longest of the four branches is cut off early in the spring, and a new branch allowed to grow in its place. This process may be repeated yearly, removing only the largest branch each season. The bark on the cut-off branches is divided with a sharp knife into lengthwise strips of about an inch or two in width, which may be readily pulled off. It is then dried carefully at a low temperature in the shade and broken into small pieces to pack. A light-brown to olive-brown powder is made from
the bark. The nature of the active constituents of this drug is not known. It may contain the glucoside, cascarin (purshianin), which on hydrolysis yields esmodin, and one or more active principles.49

Cascara sagrada should never be used as a purge, but is one of the best laxatives to empty the bowel of fecal matter in constipation. It performs this function without intestinal disturbance and also simultaneously acts as a tonic to the intestine and so prevents constipation. The bitter taste may be partially disguised by additional use of Syrupus Aurantii in proportion of one part cascara extract to two parts syrup of orange peel. Other volatile oils may be used instead, such as oil of cinnamon, oil of anise, or methyl salicylate.22

Betula lenta—Linne is popularly known by many names, including Spice-birch, River birch, Mahogany birch, Mountain birch, Black birch, Sweet or Cherry birch.23

The white birch is a very handsome tree, round-headed and with pendulous branches when older. It grows sixty to seventy feet high; the trunk is a dark reddish-brown and the young bark aromatic and of agreeable flavor. The leaves are oblong-ovate, usually cordate at the base, sharply and doubly serrate, hairy beneath when young, later nearly glabrous. Each scale of the staminate catkin bears three flowers with two stamens divided at the apex, and a minute four-toothed calyx. The pistillate catkins bear three naked ovaries in the axil of every three-lobed shoot. The minute nutlet has membranous wings and is crowned with two spreading stigmas.4
The bark of the trunk and larger branches of *B. lenta* yields a volatile oil known as the oil of birch, consisting chiefly of methyl salicylate. It is obtained from the bark by first macerating the pieces with water and then distilling the oil by means of copper stills. The oil does not pre-exist in the bark, but is formed from a glucoside, gaultherin. Methyl salicylate may also be produced synthetically or obtained from *Gaultheria procumbens* by maceration and steam distillation. The label on the drug must indicate which is the source. It contains not less than 98% \( C_6H_4(CH)CO_2H_3 \).

Methyl salicylate is commonly used as a counterirritant. It is especially employed as a solution to be rubbed on Rheumatic joints. The salicylates are considered specifics for Rheumatic Fever. This may be due to the fact that they have analgesic and antipyretic effects.

The name *Quercus* is said to come from the Celtic, *Quer-fire* and *quæst* (tree). The oaks were well known to the ancients both in historical and religious connections. It was an oak that sheltered the cradle of the Greek God Zeus on Mt. Lycaeus. The druids were supposed to inhabit oaks. The Gall oak, *Quercus Ilex* var. *infectoria* of Western Asia bears galls, used for dying and tanning. Centuries ago tannic acid obtained from tea was used to treat burns by the Chinese. In 1925 when Davidson recommended tannic acid for burns it was hailed as a new and brilliant discovery and nut galls began to be employed to obtain the medicine.

*Quercus infectoria* is an evergreen tree up to sixty feet high
with a large round-topped head. The bark is not corky. The leaves are variable, ovate to lanceolate, remotely serrate or almost entire with revolute margin, dark green above and yellowish or whitish, tomentose or sometimes glabrescent, beneath. The acorn is ovate, about half embraced by the cup with thin, oppressed scales.  

The nut gall is an abnormal development of the young twigs of Quercus infectoria, due to the presence of the deposited ova of a Hymenopterous insect, Cynips tinctoria. The galls are collected before the maturing of the insect. A yellowish-brown powder is obtained from the gall. The principle constituent is tannic acid, which has a characteristic odor and astringent taste. It is soluble in cold water and alcohol.

Tannic acid is used in medicine as an astringent and hemostatic. It may be given internally in the form of acetyltannic acid to treat diarrhea. Externally, it is a favorite for treating burns. It may be sprayed on in $2\%$ or $5\%$ solutions or spread on in the form of tannic acid ointment. A $2\%$ ointment, glycerine suppository, is also used locally for hemorrhoids.

Salix is variously known as Willow, Common European Willow, Duck Willow, Huntington Willow. The word itself comes from the Celtic *gel* (near) and *lia* (water) because of the affinity of the plant to boggy places.

Salix alba, the white willow, which is one of the willows used in medicine, is a noble tree of rapid growth, sometimes attaining a height of ninety feet with a trunk six feet in diameter. It belongs to
a group known as the "crack willows" or "brittle willows" because of the brittleness of their twigs. The leaves are lance-shaped, pointed at the apex and narrowed at the base with saw-toothed margins. When young, there are silky hairs on both sides of the leaves; when mature they are less hairy and pale green on the lower surface or covered with a "bloom." The long, loose, green, cylindrical aments or catkins are staminate and pistillate and are born on different trees, appearing with the leaves in the spring. There are two to five stamens in the axil of each hairy bract or one pistil, accompanied by a stipitate nectary. *Salix nigra*—marsh, the black willow, pussy willow, or swamp willow, is likewise used in medicine. It is tall, has rough, dark brown or black bark and brittle yellowish branches.

In the spring of the year the bark is stripped from two or three year old branches of the willows and dried quickly. The commercial article frequently consists in large part of the bark of more mature branches or the trunk of young trees and is frequently deprived of the periderm. It has a slight, aromatic odor and bitter, astringent taste. The active principle is a bitter glucoside, calicin, the amount of which varies in different portions of the bark and according to the time when it is gathered. Salicin, through the actions of ferment, forms saligenin which, when taken into the human system, is decomposed into salicylic acid.

Salicylic acid is antiseptic, antiparasitic and keratolytic. It is, therefore, employed externally in weak strengths, 2 to 3%, as a dusting powder or ointment for pruritus, urticaria, and some eczemas, or in 20% strength ointments or alcoholic solutions for exfoliation of corns, warts, or for epidermophytosis. In the latter, the salicylic acid removes the upper layers of skin, thus allowing the 70% alcohol to
penetrate to the fungus growth and destroy or inhibit its growth. Internally, salicylic acid is employed in the form of soluble sodium salicylate or acetyl salicylic acid (aspirin) to act as a specific in case of Rheumatic Fever or as an analgesic in the symptomatic treatment of pain.

Santalum, of Santalum album—Linné, comes from the Persian chandal, which is in turn derived from the Sanskrit Chandana, the original name of this tree. Because of its very fragrant heart wood, sandal wood is burned as incense. This plant is native to India and the Pacific Islands.

Santalum album is about twenty-five feet with small, opposite, elliptic-ovate, or ovate-lanceolate, acute or subacute leaves, narrowed into a slender petiole. The flowers are at first straw-colored, then blood-red, inodorous even when bruised. The fruit is a globose drupe about the size of a cherry and black when ripe. The wood is white or citron-colored; sweet-scented when dry.

The trees, when twenty to forty years of age, are cut down, the bark removed, and the wood cut into billets. There are some eighteen different commercial varieties of wood which are recognized. The most select is used in India for the distillation of the oil. The amount of volatile oil found in these trees depends upon the altitude at which the trees grow, those growing at higher altitude yielding ten times as much oil as those growing in the lower locations. The oil obtained from the heart wood is superior to that obtained from the sap wood and that obtained from trees which have been slow in developing is best of all.
Oil of Sandalwood is a rather viscid, nearly colorless, or light yellowish liquid of a peculiar, but persistent odor. It contains from 80 to 96% of santalol, a sesquiterpene (santalen), an aldehyde (santalal), a ketone (santalon), santalic acid, teresentalic acid, formic acid, and acetic acid in the form of esters, and a strongly odorous constituent. Sandalwood oil, like other volatile oils, is a counterirritant and antiseptic to mucous membranes. It is especially effective when used on the genito-urinary tract against the gonococcus organism. It is not suitable in the acute stages of Gonorrhea because it may increase the irritation, but in subacute and chronic stages its irritant action may promote healing. Sandalwood is preferably given in capsules to disguise the strong taste.

Chenopodium ambrosioides—Linne is the Mexican Tea or Wormseed. Chenopodium means goose-foot, which refers to the shape of the leaves. This plant lives on steppes and deserts to which it is peculiarly fitted because of hairy coat, succulent habit and reduced leaves.

Chenopodium is a widely dispersed weedy herb with very inconspicuous greenish flowers. The flowers are perfect, bractless, sessile in small masses and those clusters arranged in spikes or panicles. C. ambrosioides is a smooth annual with slightly petioled, aromatic, oblong, lanceolate, toothed or nearly entire leaves. The flowers are in spikes, leafy or intermixed with leaves. The fruit is dry, enclosed by the calyx.

The fruits and the volatile oil distilled from the tops of the plant are employed in medicine. Harvesting is begun usually in early
September or as soon as the seeds have taken on a black color, but before the plants have turned brown. If harvesting is delayed until the plants are fully mature, there will be considerable loss through shattering and a diminution in the yield of oil when they are distilled. The crop may be harvested with large knives or sickles, either by cutting off the entire plant at the ground or by cutting the branches separately. After cutting, the plants are laid out on the ground in rows and allowed to cure for about three days before they are distilled with steam. The volatile oil of wormseed has a peculiar, strong, offensive odor and a pungent, disagreeable but aromatic taste. It is assayed to contain not less than 65% ascaridol. It must be kept in well-stoppered amber-colored bottles, in a cool place, protected from light.

This oil is a most efficient remedy against Ascaris lumbricoides or the Round Worm, the Hookworm, and intestinal amoebas. It paralyses but does not kill the worms which are eliminated by free purgation. Its efficiency seems to be increased when followed by castor oil. Minor toxic symptoms, such as dizziness, nausea and vomiting, temporary deafness or general depression may be produced.

Rha, the old Greek name for rhubarb, led to the name Rheum. This plant was mentioned in Chinese works of 3700 A.D. Rheum officinale-Baillon is a perennial herb indigenous to northwestern China and eastern Tibet. It is sparingly cultivated in other parts of the world.

Rheum officinale is a robust herb with a short, branching stem or crown four to ten feet high. The leaves are very large, one to three feet across, round-oval, more or less pointed or acuminate, hairy, and
three-seven lobed. The flower stems are three to ten feet high, much branched, bearing numerous, greenish flowers that give a feathery effect to the panicle. The flowers have a six-parted spreading perianth, six to nine stamens, a three angled ovary bearing three styles and ripening into a red winged achene.\(^4\)

The rhizomes are collected in the autumn from the eight to ten year old plants; most of the bark is removed, and they are then perforated, strung on ropes, and dried. This is done either in the sun or by artificial heat. The principal constituent of these rhizomes seems to be a glucoside or an undetermined substance which yields successive oxidation products such as chrysophanic acid, emodin, and rhein. Rhubarb, as a medicine, is occasionally administered as a powder, but more commonly it is employed in the form of one of its preparations.\(^49\)

Rhubarb and the extract of rhubarb are bitter tonics, stomachics and cathartics. As cathartics they act chiefly on the colon, stimulating peristalsis by irritation. After the initial laxative effect they have a tendency to produce constipation. Hence they are useful in the case of diarrhea due to an irritating substance, by first expelling the offender and then returning the movement of the intestines to normal by their constipating influence.

\textit{Rosa gallica-Linne} is the ancient Latin name for the red rose.\(^4\)

This plant was introduced from Europe to the United States where it is often cultivated and grows wild along the roadsides of New England.

\textit{Rosa gallica} is a prickly shrub, about one to one and a half meters high, with odd-pinnate leaves and stipules adnate to petiole. The
hispid stem is glandular. The leaflets are broadly elliptic, cordate at the base, roundish or obtuse at the apex, doubly glandular and serrate. The flowers of this plant are large, mostly deep red and double.\textsuperscript{17}

The petals are obtained from the cultivated plants before the expansion of the flower, the lower clawed portion usually being removed. They are used fresh or are carefully dried and preserved. The petals have a velvety texture, an agreeable odor and an astringent and slightly bitter taste. A volatile oil is contained in small amount in the petals together with a yellow, crystalline glucoside, quercetin, which yields on decomposition, quercetin, tannin, and gallic acid.\textsuperscript{49}

A solution of the volatile oil of rose in water is known officially as Aqua Rosae and as Aqua Rosae Fortior. In medicine it is used mainly as a flavoring substance.\textsuperscript{54}

\textit{Prunus serotina}, the Rum Cherry or Wild Black Cherry, was native to Mexico. The fruits are used for flavoring or manufacturing alcoholic beverages, while the wood, because it takes on such an excellent finish, is highly desirable for cabinet making. \textit{Prunus virginiana}, the Choke Cherry, has a light colored wood that is also used in cabinet work.\textsuperscript{51}

\textit{Prunus serotina} is a large tree, reaching one hundred feet, with reddish-brown branches and reddish wood. The inner bark is aromatic; the leaves are thick, oblong, or lanceolate, taper-pointed, and serrate with incurved teeth. The flowers are in elongated racemes.
The fruit is purplish-black. *Prunus virginiana*, on the other hand, is a tall shrub or small tree with grayish bark, the inner layers having a rank, disagreeable odor. The leaves are oval, oblong or obovate, abruptly pointed, with very sharply serrate teeth. It has red to dark crimson fruit.\(^{17}\)

The bark of the stem and branches is collected in the autumn and should be carefully dried and preserved in air-tight containers. The odor of the drug is distinct and on addition of water it develops an odor of benzaldehyde and hydrocyanic acid. The taste is bitter, aromatic and astringent. The bark of the trunk is dark brown and rough externally. A cyanogenetic glucoside is one of the main constituents. It also contains a ferment resembling emulsin. Besides these, there is starch, resin, tannin, gallic acid, fatty matter, lignin, red coloring matter, salts of calcium, potassium and iron, a volatile oil, and prussic acid.\(^{49}\)

Wild cherry is used principally in the form of a syrup. It is tonic and astringent because of its constituents. The chief use of wild cherry syrup, however, is as a vehicle for cough medicines—this because of its agreeable taste and ability to disguise other disagreeable principles.

The *Acacias* are plants of Africa, Australia and South America. The name itself means thorny, coming from the fact that the stipules often become cruel thorns. Because of its gum, the Acacia wood is very durable. It was used by the Egyptians to make coffins for their kings. The precious woods, such as rose wood, black wood, and Shittim wood of
Biblical fame, are acacia woods. The gum was employed as far back as 1700 B.C. by the Arabs, both for the purpose of art and as food. 51

Acacia arabica, the Gum Arabic Tree, is a shrub or small tree with gray branchlets and spiny stipules. The leaves are all bi-pinnate, having three to eight pair of pinnae and ten to twenty pair of leaflets. The flowers are in globular heads with two to five flowers each. They are actinomorphic. The calyx is half the length of the corolla. There are many stamens and one carpel. The gray, downy pods are distinctly stalked, flat, and mostly moniliform. 4

A dried, gummy exudation from the stem and branches is used in medicine. The gum exudes spontaneously from the bark of the tree and is apparently formed by the action of a ferment on the cell-contents as it does not contain any remains of cell walls. The trees are also incised to increase the production of gum. The more or less hardened pieces are collected and then sorted into different grades. The gum is now in roundish tears of variable size or broken into angular fragments, externally whitish or yellowish-white, translucent, very brittle, nearly inodorous and having a mucilaginous taste. An oyster-white powder soluble in cold water, forming a sticky paste, is obtained from the gum. A crystalline glucoside which is apparently arabic acid (arabin or gummic acid) in combination with calcium, magnesium and potassium constitutes the greater part of the gum. 32

The mucilage of Acacia is used in medicine as a demulcent and to suspend agents in making emulsions and mixtures. Demulcents are bland, starchy substances used as protectives to mucous membranes or skin by mechanically adhering to them and thus coating them. Acacia is also sometimes used in intravenous solutions of saline to add body to the solution and thus make it nearer the consistency of blood.
Cassia is the ancient Greek name for the plant giving Senna leaves. Cassia acutifolia is from Nubia and Cassia angustifolia from Arabia and India. The leaves were used as a purgative in folk medicine.\(^{37}\)

The Sennas are herbs, shrubs or, in tropical regions, trees with abruptly pinnate leaves. The flowers are nearly regular with five nearly-equal calyx teeth mostly longer than the calyx tube; five nearly equal, spreading, clawed petals; five to ten stamens, frequently unequal and some of the anthers abortive. There is one carpel with numerous ovules. The fruit is a stalked pod which is either flat or terrate, often partitioned crosswise.\(^4\)

The Senna leaves contain several glucosides which yield oxymethylanthraquinone compounds resembling those found in aloes and rhubarb; a glucosidal substance, anthraglucossennin, which occurs as a brown-black powder and yields on hydrolysis senna-emodin (tri-oxymethyl anthraquinone) and senna-chrysophanic acid (dioxyethylanthraquinone); and other substances. The active principles of senna are emodin, chrysophanic acid and cathartic acid.\(^{49}\)

Senna belongs to the anthraquinone-containing group of vegetative purgatives which act mainly on the large intestines by stimulating peristalsis. Senna is one of the most efficacious drugs of this class. It is used for the treatment of chronic constipation. The drugs of this group are usually too griping to use by themselves. They are therefore employed in combination with a volatile oil or some other drug which lessens the griping. One of the best combinations of drugs containing Senna is Compound Licorice Powder. The constituents of Compound Licorice Powder are senna, glycyrrhiza, sulphur, oil of fennel, and sugar. This is widely used as a laxative.\(^{18}\)
Toluifera Pereirae-Beillon, the source of Tolu Balsam, is also known as *Myroxylon Pereirae*-Klotzsch because its scent is similar to that of myrrh wood. Central America is the home of this plant.51

*Toluifera Pereirae* is a tree with uneven-pinnate leaves. There are six to nine leaflets, two to three inches long, and glabrous. The flowers are white or whitish, in axillary simple racemes or paniculate at ends of branches. The calyx is irregularly dentate, the standard orbicular, the four inferior petals subequal, narrow and free, the stamens deciduous with the petals, free or connate at the base. The pod has a stalk about four and a half inches long, terete and sparsely puberulent. The pod is indehiscent, hardened at the apex and one-seeded, the basal part long, narrow and two winged.4

The balsam is formed by reason of mechanical injuries to the trees. Schizogenous secretion canals occur only in the young twigs, petioles and leaves, but are not formed in the older bark. The process of producing the balsam is an ancient custom, and is in essential the following: During the rainy season in November and December the bark of the balsam tree is beaten with a hammer on all sides, leaving uninjured areas between, this being done so as not to kill the trees. The injured bark soon cracks and can be stripped off in rather long pieces. The cell-walls of the inner bark and their contents change to a balsam due to the decomposition of the cell sap or metamorphosis of the cell walls. In the course of a week or so, the maximum yield of balsam is obtained and it soaks into the rags which have been applied to the bark. The rags are then collected, thrown into vessels containing water, and boiled until the balsam is liberated and settles to the bottom. The water is decanted and the balsam poured into gourds or tin containers. The balsam is a dark brown, viscid liquid, ruby-red.
and transparent in thin layers. It is free from stringiness or stickiness, has an empyreumatic, aromatic vanilla-like odor and a bitter, acrid persistent taste. The chief constituent is a volatile oil known as Cinnamon or Peru Balsam oil and consisting chiefly of benzyl benzoate, a small quantity of benzyl cinnamate and other aromatic compounds.49

Balsam of Peru has been employed internally as a stimulating expectorant. The volatile oil acts as a counterirritant on the mucous membranes which reflexly stimulates secretion of the glands in the bronchi. Externally it is used in salves for ulcers. It stimulates the healing of indolent wounds and ulcers, promoting the formation of granulations. Mixed with vaseline and rubbed over the hands it prevents disagreeable odors remaining on the skin after treating ulcerative surfaces or making postmortem examinations. Balsam of Peru is a parasiticide in diseases of the skin such as scabies. If applied over a large area of the body as a remedy for scabies, it may cause acute nephritis.21

Astragalus gummifer and other plants of Astragalus species are the source of Gum Tragacanth. These plants are indigenous to southeastern Europe and western Asia.4

They are hardy, spiny herbs or sub shrubs. The leaves are mostly odd pinnate, sometimes simple, and the yellow, purple or white flowers are in spikes or racemes. They have a tubular calyx, its teeth nearly equal, clawed petals, an erect standard; the stamens are in two clusters, the anthers similar. The pods are fleshy, leathery, or papery.4

Tragacanth is a gummy exudate from this plant. Some of the walls of the pith and medullary rays are transformed into mucilage, which
exudes spontaneously, but is obtained in commercial quantities by making incisions in the bark, the gum being collected after it dries. This is nearly colorless or pale yellowish, externally, translucent, inodorous and having an insipid taste. The chief constituent of this drug is bassorin (traganthin) which gives the mucilage made from this gum its peculiar density and which serves to distinguish it from Acacia.32

Gum tragacanth swells on the addition of water and gradually forms a cloudy, gelatinous mass. On the further addition of water, it forms a mucilage which is occasionally used in pharmacy in making emulsions and is widely used as a basis for a greaseless catheter lubricant or as a protective application for chapped skin.54.

Glycyrrhiza means sweet root in Greek. This is the Licorice plant, spelt Liquorice or Lickerish.4

Glycyrrhiza glabra is a perennial herb, often glandular, which attains a height of two to three feet. The leaves are odd-pinnate, the leaflets ovate, subglutinous beneath, four to eight pair with an odd one. The peduncled axillary spike is shorter than the leaves, the blue, violet, white or yellowish flowers are closely clustered. The calyx is glandular pubescent and the pod glabrous—three to four seeded.4

Harvesting the licorice plant is primitive, the roots being exposed by plow and pulled by hand. While the plants may be grown from the seed, propagation by means of cuttings made from the younger parts of the rhizome, or so-called root, usually give best results.

The Spanish variety of licorice are mostly unpeeled rhizomes,
nearly cylindrical, more or less tortuous, cut or broken into pieces. They have a distinct odor, sweetish taste, slightly acrid and may be ground into a light yellowish-brown powder. Russian licorice is chiefly large roots deprived of the periderm. The licorice root contains about 3% of the glucoside, glycyrrhizin, a crystalline, intensely sweet substance; a bitter principle, glycyrrhizin, which occurs principally in the bark and hence is less abundant in the Russian licorice; a volatile oil, considerable starch, and calcium oxalate. 32

Glycyrrhiza is used in medicine chiefly as a vehicle and principally in the form of the fluid extract. Compound Licorice powder is an excellent cathartic, containing Senna, of the "anthracene derivative" group which acts mainly on the large bowel by inducing peristalsis. The other constituents of this powder are the volatile oil of Fennel which aids in preventing griping, and Sulphur, a simple purgative. Licorice disguises the taste of the less agreeable constituents of this powder and gives it its name. 54

Physostigma venenosum-Balfour is the Calabar Bean or Crudeal Bean—the latter name being derived from the fact that it was used by the natives to produce poisoning. 37

This climbing woody perennial plant, resembling the scarlet runner and native to the region of the Gulf of Guinea on the western coast of Africa, is a member of the Leguminosae Family. The "Calabar beans," or seeds, are anatropous, somewhat reniform or irregularly oblong or ellipsoidal with a brownish, black, groove extending about half way around the edge, containing the raphe as a narrow line. 37
The ripe seeds have a brownish-red, hard, thick, smooth seed-coat somewhat rough near the groove. Reserve layers are wanting. The embryo is large, white, with a short hypocotyl and two concavoconvex cotyledons, inodorous and having a starchy taste. A grayish-white powder with numerous starch grains is made from the seed. Besides starch, proteins, fixed oils, ash and several alkaloids have been isolated from this bean—the most important of which is physostigmine or eserine. Physostigmine contains eseridine, an alkaloid resembling physostigmine in its physiological action; calabarin, an alkaloid which is physiologically antagonistic to physostigmine, and eseramine which is inactive.32

Physostigmine salicylate is used officially because of its stability. It is found in the form of colorless or faintly yellowish crystals which acquire a red tint on exposure to light and air. Physostigmine acts on the autonomic nervous system by stimulating the peripheral endings of parasympathetic nerves. Since the parasympathetic nerves control the vegetative actions of the body in general, and since physostigmine has a more marked effect on smooth muscles than on glands, intestinal peristalsis is increased. Physostigmine is used occasionally to stimulate peristalsis in paralytic forms of constipation. It relieves abdominal distention, but large doses are necessary and its effects must be carefully watched. An overdose may be counteracted by atropine which is a depressant of the parasympathetic nervous system. Physostigmine also has a local effect on the eye, contracting the pupil. It is used to contract the pupil and reduce intra-ocular tension in cases of glaucoma. It may also be employed to hasten recovery from mydriatics, such as homatropine.18
The clove tree, *Caryophyllus aromaticus*—Linne is also called *Eugenia aromatic*—Baillon or *Eugenia caryophyllata*—Thunb. *Eugenia* refers to Prince Eugene of Savoy in whose honor the plant was named. DeCondolle believes the clove originally comes from the Moluccas, for they were the first to cultivate it. It has never been found in the wild state, however. The Sanskrit language had a name *lavan* for clove, which suggests that it may have been even older. This plant is widely cultivated in the tropics.14

*Caryophyllus aromaticus* has ovate-oblong, acute leaves strongly tapering to the conspicuous petiole, coriaceous, and dotted. The lateral veins are numerous and parallel, the cross-veinlets obscure. The flowers are in terminal trichotomous cymes, pale purple, only one-fourth of an inch across.4

The flower buds are collected, dried in the sun or artificially, the color changing from crimson to a brownish color. The odor and taste is strongly aromatic. The powder of cloves is light brown to reddish-brown. The powder of the fruit of cloves is the so-called *Mother of Cloves*. The chief constituent of cloves is the volatile oil and consists of caryophyllene and eugenol. The darkening of old oil of cloves is supposed to be due to furfural, an aldehyde formed on the decomposition of some of the carbohydrates and albuminoids. The oil of cloves is distilled from the dried flower buds and yields not less than 82% by volume of eugenol.5

The oil of cloves is slightly antiseptic and counterirritant on mucous membranes. It is commonly used as an anodyne for toothaches, being applied on a piece of cotton. If taken internally, the oil of cloves, like other volatile oils, is a carminative—aiding in the expulsion of gas.
Eucalyptus Globulus—Labillardiére is the Gum-Tree or Blue-Gum. In analyzing the word Eucalyptus, we find eu—meaning well in Greek, and Ealupto—meaning to cover as with a lid. This originated from the fact that the petals, and usually also the calyx-limb, are fused and cover the flower before anthesis, then fall off in the form of a lid or cover. E. Globulus is frequently planted in malarial regions of warm climates, as at the Campagna at Rome, with a very beneficial effect. 37

Eucalyptus Globulus is a tree, three hundred feet or less in height, with bark deciduous in long, thin strips or sheets, leaving the trunk smooth and grayish or bluish-white except at the base. The leaves are thick and lanceolate, often one-half to one foot long. Those on the young shoots and seedlings are opposite, sessile, broad and white-mealy. The flowers are solitary or two to three together, closely sessile or on a short peduncle. The calyx tube and lid are warty and covered with bluish-white wax. The angular capsule fruit has flat, non-protruding valves by which it opens at the top, and many seeds. 4

The leaves are collected from the older portions of the tree and dried. They contain a volatile oil, mostly eucalyptol, and some d-pinene or eucalypten. There are also other terpenes, several resins, a neutral bitter principle, eucalyptic acid, tannic acid and calcium oxalate. Eucalyptol occurs as a colorless liquid, having a distinctly camphoraceous odor, and a pungent, spicy and cooling taste. This oil is miscible in all proportions with alcohol but practically insoluble in water. 32

Eucalyptol is antiseptic and irritating to the mucous membranes, stimulating secretion of the bronchial glands by reflex action. 12 It is used as an expectorant and respiratory tract antiseptic either in the form of oil sprays or in the form of vapor to be inhaled from boiling
water. For internal use, it is preferably administered in the form of capsules.

Thea is the Latinized Chinese name (chia) for the tea plant. The wild tea plant was brought from South China into China and Japan to be cultivated as early as 810 A.D. Giovanni Pietro Maffei in his Historiae Indicae, 1589, made the first mention of tea in Europe.

Giovanni Botero said in his Della Cause della Grandezza that the Chinese had an herb from which they extracted a delicate juice which they used instead of wine. Then, in 1618, an Englishman of the East India Company asked an official at Macas for "chaw." In 1638 the Japanese name was said to be Tsia. The black and green teas came from the same species.

Thea sinensis is a woody evergreen shrub, sometimes a tree to thirty feet high. It has simple, alternate, glabrous, leaves, sometimes pubescent beneath. The showy white flowers are regular and hypogynous on very short stalks, nodding, mostly axillary. There are several bracts at the base which pass into sepals (5-6) then into petals (5-6-7) a bit united at the base. There are many stamens in several whorls, the external ones arranged into bundles and united with the petals. The syncarpous gynoecium has styles which are free almost to the base. The ovary is three to five locular and the fruit a woody capsule which opens loculicidally.

Green tea is produced by quick drying and constant stirring in a pan over the fire. The leaves are curled and pale green. Black tea is produced by slow drying. It is usually in more or less crumpled masses, more or less coriaceous, the odor agreeably aromatic, the taste pleasantly
bitter and astringent. The active principle of tea is a bitter alkaloid, caffeine or thein. It is feebly alkaline. Tea also contains caffeedin, theophyllin, theobromin, and some saponin. 37

Caffeine has no particular action on the gastro-intestinal tract except that in large quantities it may be irritable. Caffeine increases the blood pressure, causing the heart to beat more forcibly and rapidly. It does this by acting on the vasomotor centers. It is a certain and direct stimulant on the Central Nervous System, especially the higher centers of the brain, producing wakefulness and restlessness and stimulating the reasoning and imaginative faculties in man. Caffeine also stimulates the respiratory center. The flow of urine is increased because of the stimulated circulation. Caffeine is used in cardiac dropsy to reduce the edema. It is used in collapse from cardiac weakness or shock to raise the blood pressure. Finally, it is used as an antidote in narcotic or alcohol poisoning to stimulate respiration.

Tschuntzogenous Kurzii—King is a plant native to Burma, India, which yields the famous Chaulmoogra oil used in Leprosy.

The seeds of chaulmoogra on expression yield a fixed oil, commonly known as Chaulmoogra oil. Chemical analysis has shown it to consist to a large extent of the glyceryl esters of optically active unsaturated fatty acids. The acid present in the largest proportion has been designated as Chaulmoogra acid. It also contains hydromargaric acid. These acids occur in the form of glycerides. Chaulmoogra oil is a yellow or brownish-yellow liquid, or whitish, soft-solid at a temperature
below 25° Centigrade. It has a characteristic odor and somewhat acrid taste.\textsuperscript{22}

Chaulmoogra oil has a destructive action on acid-fast bacilli, such as the bacillus of leprosy, and its beneficial effects are probably due to this property. It has been used in Leprosy for many years. There is evidence that it affords relief but seldom effects a complete cure. The dose must be gradually increased to the limit of tolerance. Ethyl Chaulmoograte is said to be better tolerated and less likely to produce abscesses on injection.\textsuperscript{18}

\textit{Gaultheria procumbens}-Linne, the wintergreen with its warmed berries, has many names: checker-herry, boxberry, deer berry, groundberry, ivy-herry, ginger-herry, grouseberry, mountain tea, jersey tea, Canadian tea, and wety plum. Its tender leaves are known as little Johnnyes, pippins, drunkards, and other names of like import, although there is nothing about them to suggest stage entrances, or gaiety, or inebriety. The name Gaultheria is after Hugues Gaultier, a naturalist and court-physician at Quebec in the middle of the eighteenth century.\textsuperscript{17}

\textit{Gaultheria procumbens} is a trailing shrub with a slender and extensively creeping stem on or below the surface. The flowering branches ascend, with simple evergreen leaves at the summit. The leaves are obovate or oval, obscurely serrate. There are a few solitary white flowers, mostly single in the axils, and nodding. They have urn-shaped, five toothed corollas, ten stamens on the corolla base, their anthers opening by pores. The capsule is depressed, five-
lobed, five-celled, five-valved, and many seeded. It is enclosed, when ripe, by the calyx which thickens and turns fleshy so that the fruit looks like a bright red berry.  

The bright red berries and foliage of this plant have a spicy-aromatic flavor similar to Sweet Birch. The plants are collected, chopped into small pieces, mixed with water and allowed to stand for about twelve hours when distillation is affected by means of a copper still. The oil is generally further purified by rectification. Owing to the demand for this oil and prices obtained for it, it is frequently substituted by oil of birch and adulterated with methyl salicylate. The volatile oil of wintergreen consists chiefly of methyl salicylate. It also contains eugenanic alcohol and its ester, which possess the characteristic odor which distinguishes the true oil of Gaultheria from the artificial methyl salicylate.

Oil of wintergreen has actions and use identical with oil of Sweet Birch. It is antiseptic and counterirritant. It relieves pain in local rheumatic swellings and neuritis to which it is externally applied, usually in the form of a liniment.

_Styrax_ is the ancient Greek name for the Benzoin plant.  
_Styrax_ Benzoin—Dryander produces Siam or Sumatra and Java benzoin resin. It is a tropical or subtropical plant of Malay, Archipelago.

The _Genus Styrax_ is made up of deciduous or evergreen trees or shrubs which are more or less stellate-pubescent. The leaves are short-stalked, exstipulate, more or less covered with stellate hairs like the inflorescence. The flowers are white, the calyx obscurely
five-toothed or truncate, the petals five, connate only at the base. There are ten stamens inserted at the base of the corolla and usually somewhat connate below. The ovary is superior, often united at the base with the calyx. The gynoecium is three-loculed at the base and one-loculed at the apex. It has a slender style and ripens into a fleshy drape or a dry, one-to-two seeded fruit with dehiscent pericarp.

The composition of the resin in Styrax Benzoin varies according to the age of the tree, the youngest trees yielding the best product. The constituents of the commercial resin are not found in the tissues of the tree, but appear to develop as a pathological product due to an injury of the trees resulting from the manner of incising the bark, although probably the exposure of the resin to the air has an influence on the constituents. Sumatran Benzoin occurs in irregular masses composed of yellowish or reddish-brown tears of variable size and a reddish-brown and translucent or grayish-brown and opaque matrix. It is brittle, becoming soft on warming and yielding benzoic acid on sublimation. It has an agreeable, balsamic odor and a slightly aromatic taste. The chief constituent of Sumatran Benzoin is cinnamic acid. Siam Benzoin, on the other hand, occurs in concavo-convex tears. It has a vanilla-like odor and, unlike Sumatran Benzoin, does not yield cinnamic acid—its chief constituent being benzoic acid.

Benzoin is an antiseptic and counterirritant. It is inhaled from boiling water for soothing inflamed mucous membranes of the throat and bronchi. Benzoin is also a stimulating expectorant. Benzoin is used on ulcers, bedsores, cracked nipples, fissures of lips, etc. as a stimulant to healing and a protective coating.
Gentiana lutea—Linné was named after Gentius, King of Illyria, who is said to have discovered the tonic value of these plants. The gentian is also the source of the liqueur or cordial called "gentiane". The plant grows wild in the mountains of central and southern Europe, but it has proved very poorly adapted for cultivation in situations beyond its natural range.  

The Family Gentianaceae are usually herbs, stiff and glabrous, with opposite sessile leaves. They yield a bitter principle used in tonics. The gentians are chiefly perennial, rarely biennial or annual. The yellowish flowers of Gentiana lutea are in dense, umbel-like cymes; the calyx is spathe-like, split in two; the corolla five-to-six parted, its lobes oblong-linear and acuminate; the anthers free and there is no style. The fruit is a capsule.  

The rhizome and roots of gentiana lutea furnish the gentian of commerce. The fleshy rhizomes and roots are collected in autumn and frequently cut into longitudinal pieces and slowly dried, during which latter process they develop a distinctive color and heavy odor. These rhizomes are externally light brown and internally dark yellow. They contain a bitter glucoside, gentiosopicrin, occurring in yellow needles which are readily soluble in water and to which the drug owes its peculiar bitterness and odor.  

Gentian is one of a large class of substances which are supposed to stimulate the appetite by their bitter taste. These substances were formerly thought to stimulate the secretion of the gastric juice, but they do not exert any appreciable effect on the mucous membrane of the stomach directly, and if any such action is induced, it can arise only reflexly from the action of the nerves in the mouth, chiefly those of taste. Bitters are given a short time before meals in the treatment
of loss of appetite. The effect will show itself in a few days. Gentian may be prescribed with nux vomica.

Strychnos is an old Greek name used by Theophrastus for some plants belonging to the Selenaceae. The bark and roots of this plant were used by the natives of India for snake bites and fevers. It is indigenous to India and the islands of southern Asia and known as the Kookia tree in its native country.

Strychnos Nux-vomica—Linné is a small straggling tree with fruit resembling an orange but with hard rind and many flat seeds covered with silky hair. This tree may attain a height of forty feet. It has ovate, five-nerved, glabrous opposite leaves. The flowers are on short peduncled, terminal cymes. They have hardly any pedicels, are white to yellowish, calyx four-to-five lobed, corolla four-to-five cleft, with valvate lobes, five stamens, and ovary usually two-celled.

The dried ripe seeds of Strychnos are used in medicine. The fruit is a kind of berry with three to five seeds, which are freed from the bitter pulp by washing and dried before exportation. They are very hard when dry and tough when damp. Externally they are grayish-yellow or grayish-green with a satiny lustre due to the long hairs; internally they are whitish. These seeds are inodorous but have an intensely and persistently bitter taste. The active principles of this plant are the alkaloids, strychnine and brucine. A glucoside, loganin, is present in the seeds in small amount but it is found in the pulp of the fruit to the extent of 5%. Strychnine forms crystallizable salts with various acids but the sulphates are commercially most important.
The drug *Nux-vomica* contains strychnine and has essentially the same action as strychnine. Because of their bitter taste, both are used in very small doses to stimulate the appetite by causing the flow of gastric juice. They do this indirectly by acting on the taste buds and causing the flow of saliva. Gentian is frequently combined with strychnine as an appetizer. Strychnine also has a stimulating effect on the Central Nervous System. It acts chiefly on the spinal cord, increasing its reflex excitability and much less on the higher centers. Because of this effect, strychnine is used (usually in the form of *Nux vomica*) as a tonic to the muscular system, increasing response to stimuli. It is employed in some forms of paralysis, such as post-Diphtheric or Lead paralysis, but is of no value when the paralysis results from an organic lesion of the spinal cord. Strychnine is also found in many cathartics, since it relieves the depression which usually follows their use. Strychnine stimulates the respiratory center, although only temporarily. For this reason, it is often employed as an antidote to an overdose of some drug which is a respiratory depressant, such as Morphine or the Barbiturates. Great care must be taken not to give the patient an overdose of Strychnine or the patient will be seized with convulsions and death occur, either from fixation of the chest by spasm of respiratory muscles or during the interval between convulsions from respiratory paralysis.21

*Strophantinus* comes from the Greek *twisted cord* and *flower*, alluding to the corolla segments of this Genus. This is a tropical plant belonging to South Africa and Asia. Both *Strophantinus hispidus*-DeCondolle
and *Strophanthus* Kombe-Oliver are used in medicine.⁴

The *Genus Strophanthus* is composed of shrubs which have opposite leaves and terminal inflorescences—often at the ends of short branches. The flowers are mostly showy with five umbonate sepals, sometimes foliaceous; a tubular corolla, the mouth with paired appendages alternating the five lobes—these are acuminate and produced into very long filiform tails. The short filamented stamens are borne on the tube and the carpels are separated. The fruit is two mericarps.⁵¹

The ripe seeds of *Strophanthus* are the part of the plant used in medicine. The plumose awns at the ends of the seeds are usually removed before exportation. These seeds have no odor except when broken, but they have a very bitter taste. *Strophanthin*, a crystalline glucoside, occurs chiefly in the endosperm. Another principle, pseudostrophanthin has been isolated from the seeds of some species. This principle seems to be more powerful than strophanthin but is less satisfactory as a heart tonic.⁵²

The effects of *Strophanthin* are practically the same as those of *Digitalis* and will, therefore, be discussed more fully under the latter drug. Since the rate of absorption of strophanthin from the gastro-intestinal tract is very variable, its oral use is distinctly dangerous. When injected intra-muscularly or intravenously its action is induced promptly; hence it is a useful heart tonic when immediate action is imperative. It is used much less frequently than Digitalis because it is less reliable.¹⁸
**Atropa Belladonna**—Linné, commonly known as the Deadly Nightshade or Belladonna, is a very poisonous plant as its various names suggest. *Atropos* was that one of three Fates who cut the thread of life. The drug produced by this plant was much used by the ladies of Venice to enhance the lustre of their eyes by dilating the pupilla—hence the derivation of the name belladonna—beautiful lady. Southern Europe and Asia Minor are the native habitats of Atropa.\(^4\)

This plant is a tall, glabrous, herb, bearing a perennial rootstock. It stands erect and has leafy branches. The leaves are simple, entire and pointed. The flowers are single or in pairs and nodding on lateral peduncles with blue-purple, or often greenish-purple, bell-shaped corollas. The calyx is made up of five ovate, leafy divisions. The androecium is five-parted and the ovary two-loculed, superior. The purple berries of this plant are poisonous.\(^4\)

The leaves are picked when the plants are in full bloom. They should be carefully handled to avoid bruising and dried in the shade in order to retain their green color. While only the leaves should be collected for the best pharmaceutical trade, the young growth, including the smaller sappy twigs, has medicinal value and may be sheared from the plants and dried in the same manner as the leaves. The roots are not as profitable as the leaves. The best roots are those of the second and third year's growth. They are harvested in the fall after frost, the tops being mowed and raked off, and the roots turned out with a deep running plough. They are carefully washed and cut into about four-inch lengths, the larger pieces being split lengthwise to aid in drying.

Thorough drying either in the sun or with mild artificial heat is essential; otherwise the roots will mold when stored. Several alkaloids have been found in the various parts of the plant, the principle ones being atropine,
hyoscine (scopolamine) and hyoscyamine. 37

All Solanaceae have a similar physiological action dependent on the active principle Atropine. Atropine has a depressing effect on the parasympathetic part of the autonomic nervous system. 32 It checks secretions. Because it reduces the secretion of saliva, it is used in cases of bronchitis where there is excessive expectoration or preceding anaesthesia, especially ether. Because it diminishes the secretion of hydrochloric acid by the stomach, it is useful in treating the hyperchlorhydria of gastric ulcers. Atropine relaxes intestinal spasm and decreases peristalsis. It is therefore useful for treating the painful spasm caused by ulcers, colic, or spastic constipation. The pupils are dilated by this drug. It is therefore used as a mydriatic in ophthalmological work, but care must be taken not to increase ocular tension in cases of glaucoma. Hyoscine Hydrobromide or Scopolamine Hydrobromide resembles Atropine in its influence on the parasympathetic system but it differs in having a sedative effect on the brain. It is, therefore, used as a cerebral sedative in many forms of insanity; also with morphine for surgical anaesthesia, either before or without ether.

**Hyoscyamus niger**-Linne, the Black Henbane, derives its name from the Greek words for "hog" and "bean" because it is said to be poisonous to swine. Some authors say it is not poisonous to swine but to domestic fowls only. 37

**Hyoscyamus niger** is a coarse, clammy, ill-smelling wayside weed found on open, sandy soil. These annual or biennial herbs grow one to two and a half feet high. They have clasping, toothed or angled
leaves and sessile flowers borne on one-sided, leafy spikes. The lurid flowers have dull greenish-yellow corollas reticulated with purple veins. The five-lobed calyx is bell-shaped while the five-lobed corolla is funnel-form. A two-celled capsule is enclosed in the persistent calyx and opens transversely all around near the apex.17

The leaves, flowering tops, and sometimes the seeds are used medicinally. Ordinarily the plants blossom about August of the second year and die after ripening their seed, but individual plants started early frequently bloom and set seeds the first year. The leaves and flowering tops are collected when the plants are in full bloom and are carefully dried in the shade. The irregular, matted fragments of leaves are ground into a grayish-green or dark green powder.49

The alkaloids, hyoscine and hyoscyamine (an isomer of atropine), have been isolated for medicinal purposes.22

The use of the drug hyoscine has already been discussed under Atropa belladonna. Hyoscyamine is made into a tincture which has actions and uses similar to those of Atropine or of Tincture of Belladonna whose active principle is Atropine.54

**Capsicum frutescens**—Linne, the Guinea pepper or Indian Cost Pepper, and **Capsicum annum**, the Cayenne Pepper, have names of uncertain origin. It may be that Capsicum came from Kapo—meaning to bite—on account of the pungency of the seed or pericarp; or from capsae, a chest, referring to the form of the fruit.14

**Capsicum frutescens** is a shrubby perennial, three-to-six feet high, with prominently angled stems and branches, the branches loosely
spreading or trailing, the leaves broadly ovate-acuminate. The fruit is red, obtuse or oblong acuminate. Capsicum annuum is an herbaceous annual. It yields the "pimento" of Tropical America.\(^{17}\)

The dried ripe seeds of several of the capsicum species are ground for use. They form a yellowish-brown or brownish-red powder with a very characteristic pungent taste. Powdered capsicum is sometimes mixed with about 1/2 of a fixed oil to improve its appearance.

There are two crystalline pungent principles found chiefly in the fruit: Capsaicin, which is slightly soluble in water and volatile, forming irritating vapors; and capsaicin, which is so powerful that one part in eleven million parts of water has a distinctly pungent taste.\(^{37}\)

Cayenne pepper locally applied to the skin or mucous membranes causes redness and finally vesication. It is used locally as a counter-irritant but not as a vesicant because these blisters would be too painful and difficult to heal. It is one of the best remedies for atony of the stomach, due to general debility, errors in diet, and alcoholism of the chronic type. It is also useful as a remedy for subacute alcoholism since it often satisfies by its stimulating effect and hot sensation, at least to some degree, the craving for alcohol. In flatulent colic of old persons or young adults, cayenne pepper may be used as a carminative to aid in the expulsion of gas.\(^{12}\)

**Digitalis or Foxglove** is said to have been mentioned in the treatise of Welsh physicians in the year 1250 A.D. but it was first described botanically in 1542 by Sachsina, who gave it the botanical name *Digitalis purpurea*.\(^{15}\) He used this name because the tubular
corollas resemble fingers and because of its purple color. The origin of the name *foxglove* is lost in antiquity. The word "fox" is said by some to be a corruption of "folk," meaning the "little folk" or fairies, but etymologists discredit this suggestion. Although the drug from this plant appeared in one or two pharmacopoeias, it received little attention and was little used until 1775. At this time William Withering, a physician of Birmingham, England, had his attention directed to a secret remedy used by an old woman in Shropshire. With this remedy she often cured patients with dropsy when medical men of the day failed to help them. The formula for this remedy comprised some twenty herbs and from his knowledge of medicinal plants, Withering concluded that Digitalis was the drug responsible for the beneficial action of the remedy. He used it in his practice for ten years and then in 1775 introduced the drug into medicine by publishing a description of it with an account of 163 patients whom he had treated with it. Some of Withering's results were presented in 1779 to the Royal Medical Society in Edinburgh by Stokes which led to the inclusion of Digitalis in the Edinburgh Pharmacopoeia in 1783. The Digitalis plant is native to Europe and very commonly seen on English pasture lands or by their roadsides.

*Digitalis purpurea* is a stout pubescent biennial or annual, two to four feet high. The lower leaves of this plant are ovate or ovate-lanceolate, slender, petioled, the upper leaves smaller and sessile. The flowers are large, two inches long, and borne in long, drooping racemes. They are purple to white, more or less spotted, and rather obscurely lobed. The calyx is five-parted with foliaceous lobes. The tube of the corolla is somewhat inflated, the limb scarcely spreading and short. There are four didynamous stamens undivided in the corolla, and a two-carpeled, two-loculed ovary. The fruit is a many seeded cap-
It was formerly supposed that the leaves were not medicinally active until the second year's growth, but it is now generally recognized that those of the first year's growth are equally as potent. Leaves, therefore, may be harvested the first year when plants have reached sufficient size and annually thereafter. The best product of leaves are gathered prior to the expansion of the flowers. They are carefully dried in the shade and should be stored in such a manner that they will not be exposed to light. The most active digitalis is not necessarily the best from the pharmacological point of view; pharmacologists prefer to use those preparations which show a maximum of the therapeutic action with a minimum of side effects. Digitalis has a distinct odor, a bitter taste, and forms a dark green powder. The active principles of this drug are several crystalline glucosides with actions which are essentially similar. The most important ones are digitoxin, digitalin, digitonin and digitogenin. The whole drug is also used and often preferred to one of the isolated principles.

Digitalis is called a cardiac tonic. It slows and strengthens the action of the heart. It may slow the heart beat by stimulating the vagus center or by reducing the conductivity of the auriculo-ventricular bundle of His. In prolonging the periods between contractions, it gives the heart more time to dilate completely and so draw in more blood. In increasing the force of the contraction, it makes the heart empty itself more completely. Thus the circulation is improved, including the circulation of those vessels supplying the heart, which again gives the heart muscle better nourishment and therefore increases its efficiency. The improvement of cardiac output, in turn, relieves congestion, dyspnoea, dropsy, and increases the flow of urine. Overdoses of Digitalis may
produce nausea, vomiting, diarrhea, headache, cardiac irregularities and heart block. The rate of elimination of Digitalis is slower than the rate of absorption; hence it has what is known as a cumulative action, which must be carefully guarded. Digitalis is useful in myocardial insufficiency and symptoms arising therefrom, such as edema, and in auricular fibrillation.21

*Mentha piperita*-Linnae and *Mentha suaveolens*-Linnae are respectively the Peppermint and the Spearmint. *Mentha* is of Greek origin, coming from the name of a nymph who was fabled to have been changed into mint by Proserpine. Peppermint is nowhere considered truly indigeneous, though probably its native haunt is the basin of the Mediterranean. It grows as an escaped plant in all European countries, as it does with us. It was first said to be found in England about the year 1700, by Dr. Eales. The cultivation of the plant was begun in Great Britain about 1750, and on the Continent in 1770. The Spearmint is also primarily a European plant.26

*Pepermint* leaves have punctate spots. The flower has a bell-shaped calyx with five teeth, a corolla with a short included tube—the upper lobe slightly broader, entire or notched—, four equal stamens with smooth filaments, and a two-carpeled superior gynoeceum. The flowers are small, pale purplish or white, and closely clustered. The Spearmint has narrow, densely crowded, leafless, interrupted spikes; oblong or ovate lanceolate, unequally serrate, sometimes short petiolated leaves. The Peppermint is branched and glabrous. It has loose, leafless spikes and oblong petiolated leaves with glabrous or pubescent veins beneath.17
The volatile oil of the peppermint forms the principle marketable product, but there is some demand in the crude-drug trade for the dried leaves and flowering tops. Harvesting is begun when the plants are in full bloom. The herb is cut and cured like hay, and when fairly dried is placed in large vats or stills and distilled with steam to obtain the volatile oil. Spearmint oil is distilled in the same way. To prepare the dry peppermint drug for market the leaves and flowering tops are collected when the first flowers appear and before the leaves begin to fall and are carefully dried in the shade. The volatile oil of the peppermint contains menthol while that of spearmint contains carvol.46

Oil of peppermint has a strongly aromatic, pungent taste and characteristic odor. Like other volatile oils, it acts as a counterirritant, especially on mucous membranes. It may be used as a carminative in cases of gaseous distention because it relaxes the cardiac sphincter and allows the gas to escape. It also relaxes the urethral sphincter so that it is used to aid the patient who is unable to void, especially post-operatively. Solid menthol is used for its cooling sensation in cases of neuralgia or headache by rubbing over the painful area. It is used in antipruritic ointments for the same soothing effect or as an antiseptic and stimulant for inflamed mucous membranes of the nose and throat, in which case it is inhaled as a vapor. Spearmint is most commonly used as a flavoring substance, though it may be employed to produce effects similar to those of peppermint.
**Thymus vulgaris** is the Common or Garden Thyme. This small evergreen shrub is indigenous to Spain and Italy and extensively cultivated in Europe and the United States.  

Thymus vulgaris of the Labiatae, or Mint Family, has a slender, quadrangular, pubescent stem. It is externally light grayish-brown; the older, woody portions are purplish-brown and the pith is hollow. It has lanceolate leaves with an acute summit and base tapering into a short petiole. Their margin is entire and revolute, both surfaces grayish-green, glandular and hairy, the veins prominent. The flowers are in axillary clusters or in terminal glomerules. They have a bi-labiata calyx and corolla, four stamens, and a four-parted ovary with a double style. The fruits are minute, ovoid nutlets.

When the plant is in full bloom the flowering tops are cut and carefully dried in the shade in order to preserve the natural color. This is the dry herb. The volatile oil is obtained from the entire herb which is cut when in full bloom and subjected to steam distillation. This is the Oil of Thyme or Thymol. Thymol is a phenol with an aromatic, thyme-like odor, and a pungent taste.

The chief use of thymol is as an antiseptic and anthelmintic in treating hookworm infections. Like all anthelmintics, the administration of thymol should be preceded by a cathartic so that the worm may be exposed to the full action of the drug and followed by a cathartic to prevent possible absorption of the drug with subsequent toxicity of the patient.

Thymol is commonly used in the form of Thymol Iodide, otherwise known as Aristol, as an antiseptic dusting powder for broken-down areas of the skin.
The origin of the use of Cinchona or Quinina bark in medicine is a well known, romantic story. It is said that the Countess of Chinchon, a district southwest of Madrid, Spain, fell ill of the ague while in South America with her husband, the Viceroy of Peru. She was cured by bark sent to her from Loxa, a town in the Andes, by the Mayor. In 1640 when the Count and Countess returned to Spain they carried the bark with them to distribute to the poor peasants of Chinchon where malarial infection was common. In 1742 Linnaeus called the plant *Cinchona officina*, omitting the first "h" of the Countess' name by mistake. The Indians of Peru, however, called it *Quinamina*, or "bark of barks." In 1810 Gomes of Lisbon obtained a mixture of alkaloids from the plant from which were isolated quinine and cinchoniac.

Some of the *Cinchona* sp. are trees, some shrubs with opposite leaves and deciduous stipules. The flowers are fragrant, white and pink in color, growing in terminal panicles and much frequented by humming birds. They have a small, five-toothed, persistent calyx, a long, tubular corolla with five short, spreading valvate lobes, hairy at the margins, five stamens, and a two-celled ovary with numerous ovules on an axillary placenta. The fruit is a capsule with septicidal dehiscence and many, flat winged seeds.

When the trees are from six to nine years old they possess the maximum amount of alkaloids and the bark of the trunk as well as the roots is removed and allowed to dry. The bark of the stem is used in the manufacture of galenicals, while the root-bark is employed for the extraction of the alkaloids, especially quinine. Owing to the fact that light influences the production of quinine in the plant, it was formerly customary to cover the bark of the tree with moss and other materials, and this is known as "mossed bark." For a time the cultivators followed
the practice of removing the bark in alternate strips from the trunk, the denuded places being again covered, after which another layer of bark developed, very rich in alkaloids and known as "renewed bark."
The outer bark, consisting of periderm layer and some of the cortex, is flattened out and allowed to dry under pressure, constituting "flat" bark. The older methods of cultivation have been replaced by selecting the seeds of those plants highest in alkaloids and by hybridization. The most important alkaloid found in the bark is quinine. Others are quinidine, cinchonine, cinchonidine, quinassine, hydroquinone, hydroquinidine, and hydrocinchonidine. Quinine has a bitter taste even in dilutions of 1 to 10,000.32

Because of its bitter taste quinine is frequently found in tonics. But quinine is also a protoplasmic poison, especially in respect to protozoa. Its chief use is as a specific in cases of malaria. It should be given in large doses before the time of the expected chill. It then has the effect of an antipyretic. Another use of quinine is based on its power of contracting the smooth muscle of the uterus. It is frequently employed to induce labor, either at term or before. Solutions of quinine, especially with urea hydrochloride, have a marked anaesthetic action when injected hypodermically. They may be used to inject varicose veins, in which case enough irritation is produced to effect sclerosis. Their anaesthetic effect may also be useful in Malaria cases.18

The name Cephalis comes from the Greek, referring to the fact that the flowers of this plant are borne in heads. Cephalis
Ipecacuanha (or Psychotria Ipecacuanha) is Brazilian.\(^4\)

The \textit{Cephaelis} genus are tropical shrubs, sub-shrubs, or herbs. They have opposite leaves, and small, white flowers collected in an involucrate head. The calyx of the flowers is four-to-seven toothed and persistent, the corolla trumpet-shaped with four-to-five-lobed limbs and four to five stamens inserted into the throat of the corolla. The fruit is a dry or fleshy two-seeded drupe. \textit{Cephaelis Ipecacuanha-Wilid} is a low, creeping herb with oblong-ovate, entire leaves which are pubescent beneath. The heads are pendulous, the roots slender and knotty.\(^4\)

The roots of Cephaelis are gathered during the dry season and dried as quickly as possible by being placed in the sun during the day and covered at night. In the course of two or three days they are ready for market. They are cylindrical, more or less tortuous, externally dark brown and internally light brown. They have a slight odor and a bitter, acrid taste. Ipecac contains three alkaloids—emetine, cephaline, and psychoctrine.\(^45\)

When given by mouth, ipecac has a local irritant action. In very small doses it may be used as a stomachic because of its mild irritation of the gastric mucosa. In slightly larger doses it is an expectorant, while in still larger doses it causes nausea and vomiting. Its action as an emetic, however, is not dependable. It is therefore restricted almost entirely to Pediatrics where vomiting is induced to stop spasmodic croup. Ipecac and its alkaloid, emetine, are considered specific for amelie dysentery. In these cases ipecac must be given with a depressant drug such as opium or morphine to prevent vomiting.\(^18\)
Coffee arabica was introduced in early Mohammedan times from Abyssinia to Arabia, whence it became known to Europeans in the sixteenth century. Coffee comes from the Arabian name for the drink, which in turn is conjecturally derived from Coffa, a district in southern Abyssinia. Although coffee has been used as a beverage for hundreds of years by a few persons, as a world beverage it is comparatively modern.

Coffee arabica is an evergreen shrub growing ten to fifteen feet high. The lateral branches are opposite, horizontal, and in pairs. The pairs of branches are in whorls on the main stem. The leaves, which are opposite and borne in pairs, are elliptical, acuminate at the tip and attenuate at the base. The tip of the leaf is frequently curled and rather abruptly contracted. The margin is entire and wavy. The leaves are a dark, glossy green, and though thin are firm in texture. The pure white and delicately fragrant star-like flowers are borne on very short pedicels in axillary clusters. The stigma is two- branched, the anthers linear. The short annular calyx with its denticulate limb is so small as almost to escape notice. Normally two seeds are produced in each red cherry-like drupe.

The "wet process" for curing the coffee consists of passing the ripe fruits through a machine which pulps and separates the coffee in its parchment from the pulp. The former is then fermented and washed to remove a slimy covering. After thorough drying in the sun or heated driers, the parchment coffee may be stored or it may have the thin, brittle parchment removed by special machinery. If desired, it may be further polished and artificially colored. After being sized and having the better grades cleaned of inferior beans, it is ready for roasting. In some places where the "dry or old preparation" is followed
the coffee is allowed to ripen and much of it to fall from the trees and lie on the ground until all can be collected in one picking. It is then dried in the sun without preliminary preparation.\(^5\) The active principle of the coffee plant, the alkaloid caffeine, is isolated for medicinal purposes.

Caffeine is one of the most important emergency stimulants in medical use today. It acts rapidly, chiefly influencing the brain and spinal cord. It is of great interest to know that caffeine does not exhaust the brain unless taken in such large doses as to interfere with rest and nourishment. Caffeine has a marked effect on the pulse, increasing its rate by stimulating the sino-auricular node or pace-maker of the heart. This action, coupled with the fact that it increases respiration by central stimulation, makes caffeine an invaluable emergency stimulant in cases of shock, or of drug poisoning, especially when it is due to morphine or alcohol. Caffeine also increases diuresis by improving the circulation. It is not generally employed as a diuretic, however, because the cerebral stimulation which results from this drug is not always desirable.

**Ferula Asafoetida**—Linne\(^1\) or **Ferula foetida**—Regel is the source of the drug Asafoetida. The name **Ferula** is an old Latin name probably from the verb "to strike" because the stems were used as ferales in ancient times. This is an Asian plant.\(^4\)

The plant Ferula Asafoetida stands six to twelve feet high, is very stout and much-branched. Its leaves are puberulous and minutely glandular or somewhat tomentose. The radical ones are large. The yellow
flowers are on twenty-to-thirty-rayed umbels with fleshy peduncles. This plant has an evil odor.\(^4\)

A gum resin is obtained from the milky juice of the plant. It has a strong, penetrating odor resembling garlic. It is obtained by incising the living rhizomes and roots of the plant. When fresh it is tough, yellowish while translucent, or milky white and opaque. It changes gradually to pinkish, dry and brittle. In order to powder asafoetida, it is dried at a temperature not higher than 30° Centigrade or placed over freshly burnt lime.\(^32\)

When taken internally, asafoetida gives a sensation of warmth and acts as a stimulant and carminative in the alimentary canal. It is useful in intestinal indigestion of old persons when associated with flatulence and in flatulent colicky children. It may be injected rectally to relieve tympanites. Asafoetida is also used as a stimulating expectorant in bronchitis.\(^21\)

\[\text{Artemisia Absinthium}\] Linne is the common garden herb known as wormwood or absinthium.

This plant is an herb two to four inches high, very branching and spreading, resembling closely a shrub. The leaves are parted into two or three oblong lobes, while the flower heads are small and numerous in their leafy panicles.\(^4\)

It is these flower heads which are collected before they expand and are carefully dried and preserved. They yield a medicinal principle known as santonin under these conditions. Just as soon as the head matures this principle disappears. Santonin is odorless and
tasteless when first put into the mouth, but later develops a bitter taste. 49

Santonin is an anthelmintic which is especially effective when employed against roundworms. The procedure followed in its administration is the same as that used with other anthelmintics—that is, the bowel is cleaned before and after its use to render it most effective and least toxic to the patient.
SUMMARY

Chief Groups of Plant Drugs

The largest number of plants used as drug sources falls into the group employed for its action on the alimentary tract. Of these, a whole list of plants producing volatile oils as their active principles is used as carminatives. Volatile oils or essential oils are derived naturally from plants. While they differ in chemical composition—consisting of various neutral principles, aldehydes, ketones, phenols, esters or compound ethers—they have certain physical properties and physiological actions in common. That is, physically, each one has a distinctive aromatic odor by which it is easily recognized, a pungent aromatic taste, is practically insoluble in water but soluble in alcohol, volatilizes and decomposes fairly readily. Physiologically, each has an antiseptic and astringent effect on mucous membranes, is stimulating to nerve endings when used in small quantities and paralyzing in large quantities, relaxes sphincters, such as the cardiac sphincter, and reduces spasms of the intestines but adds tone to flabby or relaxed smooth muscles, effecting in this way the expulsion of gas. The chief plant drugs used as carminatives are Capsicum, Camphora, Cardamomi Semen, Cinnamonum, Menthol, Piperitae, and Zingiber. It is to be noted that volatile oils are characteristic of entire botanical families. Of these, we may mention the Lauraceae, Zingiberaceae, and the Labiatae.

Another group, composed primarily of plant drugs, is used as vegetable purgatives to promote evacuation. This group owes its purgative effect to the fact that each one of these drugs has a more or less
irritating effect on the nerve endings of the intestinal tract which stimulates peristalsis. The irritating effect is due in most cases to the presence of the chemical known as anthracene. The active principles of Aloe, Cascara, Rhus and Senna are anthracene derivatives.

Gleum Nicini and Podophyllum, on the other hand, have other irritating chemicals in their compositions, the former containing ricinoleic acid which is believed to be the purgative principle, and the latter a resinous mixture, Podophyllin. Botanically, the cathartic plants are generic groups rather than family ones. Other members of the same families are not necessarily purgative.

The vegetable drugs used as anthelmintics are Aspidium, Chenopodium, Santonin, and Thymol. Their actions depend on the poisonous principles they contain. It is true that they are poisonous to the patient as well as the parasite but precautions are taken to allow a minimum absorption of these drugs from the Gastro-Intestinal tract. They are administered under close supervision and followed after a certain period of time by cathartics or irrigations to dispel the drug as well as the worms.

These drugs used to increase secretion of saliva are selected because of their bitter taste and are used to stimulate appetite. Gentian, Nux Vomica, Quinine, and Strychnine are the plant products included here. Nux Vomica and Strychnine come from the same plant, Strychnos Nux Vomica, while the other two are not related. In the emetic group Sinapis nigra and Ipecac are irritating to the mucous membranes of the gastro-intestinal tract, setting up a reflex stimulation which produces emesis. Apomorphine, on the other hand, acts on the vomiting center to produce the same end result. These drugs were undoubtedly chosen by a trial and error method in their usage and the scientific basis of their
action discovered later. Not only are they products of unrelated plants, but their actions, aside from the emetic factor, are also unrelated.

Two more groups of plant drugs have rather obvious actions on the alimentary tract. The demulcents—Acacia, Amylum, and Glycyrrhiza—which form a coating over this tract and protect it mechanically from irritation, and the flavoring substances—Citric acid, Prunus, and Saccharum—used to disguise the less pleasant tastes of other drugs.

Drugs commonly used for their local action on skin wounds or visible mucous membranes rank next in their number of plant sources. The disinfectants, or rather antiseptics, used on mucous membranes are for the most part volatile oils. Among these are found the following: Eucalyptol, oil of Santal, oil of Terpentine, Pinol, Thymol, and Methyl Salicylate. The properties and actions of volatile oils have already been discussed in a previous paragraph. Suffice it to say that while most of these volatile oils, too, are characteristic of entire botanical families, there is one—Methyl Salicylate—which has sources in entirely unrelated plants. It may be obtained naturally by extraction from Gaultheria procumbens or Betula lenta, or it may be prepared synthetically from the Salicylic acid of the Salix sps. Irritants of the skin, used either to produce local stimulation by simple reflex action or counter-irritation of distant parts of the body, possibly by stimulating certain segments of the spinal cord, also owe their actions to volatile oils. Camphor, Menthol, Oil of Terpentine, and Sinapis nigra belong in this class. Camphor and Menthol are very often used in large enough quantities to paralyse the nerve endings in the skin and, thereby, become anodynes or antipruritics rather than irritants. Other plant drugs used as anodynes are Cocaine, which is a local anaesthetic, and Belladonna leaves or Hyoscyamus, these being used in plaster form to relieve local rheumatic and neuralgic pains.
and soreness. Emollients and protectives of the skin are Amylum, Thymoliodide, Oleum Theobromatic, and Oleum Ricini; the first two forming a pasty or powdery protective coating, while the last two form an oily coating, preventing the absorption and evaporation of water along with other substances. Vegetable astringents come, for the most part, from plants yielding tannic acid. Commercially, the Oak Gall is the most important of these, although the tea plant and the bark of many trees contain tannic acid in smaller quantities. Tannic acid precipitates proteins, causing the surface to become hard and non-porous. Myrrh is also an astringent, used mostly on the mucous membranes of the mouth.

In summarizing the plant drugs used primarily for their effect on circulation and secondarily as diuretics, we find they are very limited as to numbers but extremely important as to therapeutic use. We find that the plants which produce them are totally unrelated botanically but the drugs themselves are closely related chemically. Caffeine, theobromine and theophylline are formed by the introduction of methyl radicals into a corresponding number of NH₂ groups of xanthine. These groups occupy various positions in the xanthine; consequently many methyl xanthines occur naturally, and several have been prepared synthetically. Caffeine (1:3:7 trimethylxanthine), theobromine (3:7 dimethylxanthine) and theophylline (1:3 dimethylxanthine) are the only members of the group that are important therapeutically. Caffeine is a vasoconstrictor, while Theobromine and Theophylline are vasodilators. Each has a diuretic action because of its effect on circulation, but these actions differ quantitatively. Caffeine alone has a marked effect on the Central Nervous System. Caffeine occurs in tea and coffee, and less abundantly in cocoa. Theobromine is more abundant in cocoa, but it is also prepared synthetically. Theophylline occurs in small amounts in tea but it is more often pre-
pared synthetically. Digitalis and Strophanthus are unrelated botanically, only slightly related chemically (both having glucosides in their active principles), but closely related in physiologic action, and in therapeutic uses. Both are used to slow the pulse and strengthen the contractions of the heart; both have a diuretic action on the excretory system, although Digitalis is considered much safer when administered by mouth because of the variability in the rate of absorption of Strophanthus from the gastro-intestinal tract, while Strophanthus is useful when immediate action is imperative because it may be injected intravenously.

Of all the drugs used on the Central Nervous System, the group of plant drugs popularly known as "the opiates" or the alkaloid derivatives of *Papaver somniferum* are certainly outstanding in importance. Being central nervous system depressants they are widely used as cerebral sedatives or hypnotics where the cause of excitement is due to pain. In this way, they are also analgesic. The stimulants of the Central Nervous System are two very similar yet very different drugs, Caffeine and Strychnine. Caffeine stimulates the higher centers of the brain and has a less marked effect on the spinal cord, while Strychnine stimulates the spinal cord with little action on the higher centers. Both have a slight stimulating effect on the Respiratory System. The autonomic part of the Central Nervous System is effected by several plant drugs, too. Atropine or Belladonna (with Atropine as its active principle) and Ephedrine produce very similar and results; that is, they stimulate "emergency reactions" of the body, such as increased respirations, relaxed bronchial spasm, quickened pulse, decreased secretions and decreased peristalsis. However, Atropine does this by depressing the Parasympathetic part of the Autonomic Nervous System, while Ephedrine stimulates the Sympathetic portion. An animal product, Adrenalin, is much more commonly employed than Ephedrine.
since its action is produced much more quickly, which is an important factor in emergencies. Physostigmine and Filocarpine are stimulants of the Parasympathetic part of the Autonomic Nervous System—that is, they promote vegetative actions of the body such as increased peristalsis, increased secretions, and a decrease in the actions of the vital organs. Physostigmine, however, has a more marked effect on peristalsis, while Filocarpine is more stimulating to secretions. This last group of drugs has been very much supplemented and in some cases replaced by animal products—glandular substances or hormones.

The last group of plant drugs—known as specificsis reduced to five drugs: Ipecac for Amebic Dysentery, Colchicum for Gout, Chaulmoogra for Leprosy, Quinine for Malaria, and the Salicylates for Rheumatic Fever. Scientific experimentation has placed the use of these drugs on a rational rather than an empirical basis. Scientific experimentation has likewise added to this list of plant specifics a larger number of biological substances—sera and vaccines—, vitamins, and glandular substances, placing emphasis on the preventive as well as the curative aspects of medicine.

**Present Day Trends with Plant Drugs**

Today, the revered secrecy of our fathers with regard to plant drugs has given way to world-wide advertising of even the minutest details, whether they be merely suppositions, theories, or well established facts. Drug companies issue enormous amounts of literature which is intended to present every aspect of their product to the public and especially to the medical profession. There is increasingly less tendency to depend on the empirical value of a drug. Since the time Dr. Withering found that Digitalis was the one useful herb out of twenty used to cure Dropsy, other
research workers have been busy not only isolating plants but also isolating active principles of plants. After these are isolated their chemical synthesis is attempted, so that in many cases there is a competition between the natural product and the synthetic product. Since the medical profession now choose to use natural remedies, drugs whose actions are understood, it is the best known plants which are most in demand. There is a tendency toward simplicity—toward the use of fewer and simpler drugs. The attitude today is that one drug of whose action we are certain will do more good than twenty of which we know little or nothing. The latest revision of the U. S. Pharmacopoeia (1936) has omitted a long list of drugs whose actions are uncertain. The modern drug store shows a marked contrast to the old time druggists. In place of the crude drugs dried and hanging from rafters with a mortar and pestle close by ready to do service, there are rows of sealed containers bearing refined and even sterilized plant drugs which can be identified by the labels on the bottles. Even these refined plant products do not retain quite the same importance as their forerunners, the crude drugs, for here and there are gradually creeping in the latest additions to therapeutics, those drugs used for prevention as well as cure—the vitamins, sera and vaccines (BiologicaIs), and glandular substances. Be that as it may, occasionally a drug is found not to be improved by modern treatment. Digitalis, for example, is still preferred in the crude form rather than in the form of isolated principles. Both the American Medical Association and the American Heart Association recommend the use of the whole drug.
CONCLUSIONS

1. Plant drugs have for centuries been the backbone of therapeutic practice.

2. Some plants in use for centuries past are today used for the same purposes:
   a. One of the primary causes of death, heart disease, would be practically impossible to treat without the plant drug, Digitalis.
   b. Medical practice would be crippled beyond repair without morphine to combat the most distressing and common symptom of disease, pain.

3. While the number of plant drugs used for therapeutic purposes has been greatly diminished, there is little evidence that those which are now in use will be replaced in the near future.

4. The largest group of drug plants is used in treating conditions of alimentary tract.

5. Certain botanical families are characterized by the fact that they yield identical or similar drug products.

6. Some drugs which are chemically or physiologically related come from plants with very little or no botanical connection.

7. Many drugs formerly only obtained from plants are today chemically synthesized.

8. Most of the active principles of plants fall into a few classes—the alkaloids, glucosides, essential oils, fixed oils, and tannins.

9. The isolation of active principles has led to the rational rather than empirical use of drugs.

10. Many active plant principles have analogues in the Animal Kingdom.

   For example: Epinephrine from the mammalian suprarenal gland and Ephedrine from Ephedra species.
11. Improved factory methods permit refinement and sterilization of plant products formerly impractical.

12. In the face of the decreasing therapeutic use of plant drugs, investigation of poorly known and little understood drug principles is continuing; as evidenced by a recent favorable report on the use of *Cardamum* in Diabetes.
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<td>Citrus aurantium</td>
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<td>Citrus medica var. Limonum</td>
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<td>Erthoxylon Coca</td>
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<td>Santalum album</td>
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<td>Rheum officinale</td>
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<td>Rosa gallica</td>
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<td>Prunus serotina</td>
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### Index to Individual Medicinal Plants (Continued)

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<td><strong>Rutales</strong></td>
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<td><strong>Artales</strong></td>
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<td><strong>Ebenales or Diapryales</strong></td>
<td><em>Styrax Benzoin</em></td>
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<td><em>Gentiana lutea</em></td>
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<td><em>Strychnos Nux-vomica</em></td>
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<td><em>Strophanthus Kombe</em></td>
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<td><strong>Polycytales</strong></td>
<td><em>Atropa Belladonna</em></td>
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<td><em>Digitalis purpurea</em></td>
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<td><strong>Lamiaceae or Diapryales</strong></td>
<td><em>Mentha piperita</em></td>
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<td><em>Thymes vulgaris</em></td>
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<td>Family</td>
<td>Genus/Species</td>
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<td><em>Artemisia Absinthium</em></td>
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Approved by

R.W. Herrenden

M. Crampton

Graduate Committee

Date May 24, 1937.