

SAYRE'S MATERIA MEDICA - Part VI

COMPOSITÆ.—Composite Family (Continued)



FIG. 253.—*Eupatorium perfoliatum*—Portion of plant and flower (enlarged).

574. EUPATORIUM, N. F.—EUPATORIUM

BONESET. THOROUGHWORT

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The dry leaves and flowering tops of **Eupatorium perfoliatum** Linné.

DESCRIPTION OF DRUG.—As it appears in the market, the drug consists of broken, wrinkled fragments of the dark green leaves and corymbs of the numerous white florets. The leaves have a rough upper surface, and downy, resindotted lower surface. Odor faintly aromatic; taste strongly bitter and slightly astringent.

Powder.—Yellowish-green. Characteristic elements, Sclerenchyma with bast fibers, thin-walled, very slightly or not at all lignified; ducts, spiral, annular, with bordered pits; trichomes, glandular and non-glandular present, 2- to 12-celled, of different shapes; stomata present; pollen, ellipsoidal (10 to 20 μ diam.); pappus, multicellular axis, unicellular branches.

CONSTITUENTS.—A peculiar, bitter, crystallizable glucoside (**eupatorin**), soluble in boiling water, alcohol, ether, and chloroform; resin, gum, tannin, and an undetermined wax-like, crystalline matter.

ACTION AND USES.—Stimulant and tonic, in large doses emetic and cathartic, and as a diaphoretic often used in warding off a cold and in fevers. Dose: 30 to 60 gr. (2 to 4 Gm.), in infusion, powder, or fluidextract, which was formerly official.

575. **EUPATORIUM PURPUREUM** Linné.—QUEEN OF THE MEADOW. GRAVEL ROOT. The leaves and root of this indigenous plant are an excellent diuretic. Also tonic, stimulant, and somewhat astringent. Dose: 30 to 60 gr. (2 to 4 Gm.).

576. GRINDELIA.—GRINDELIA

GRINDELIA

The dried leaves and flowering tops of **Grindelia camporum** Greene, or **Grindelia cuneifolia** Nuttall, or **Grindeliasquarrosa** (Pursh) Nuttall, without the presence of admixture of more than 10 per cent. of stems and other foreign matter.

BOTANICAL CHARACTERISTICS.—Woody herbs; *leaves* clasping, resinous, somewhat cuneate. *Involucre* hemispherical or globular, coated with resin; rays fertile, yellow; disk-florets yellow, tubular, and perfect. *Akenes* compressed, the outermost somewhat triangular; pappus awned. *Grindelia robusta* is found in rather elevated regions, while *G. squarrosa* is found in the plains. The former is more woody than the latter.

SOURCE.—This genus inhabits the western part of both North and South America. A resinous exudation is common to the various species of the genus, being most abundant in the flower-heads, and it is possible that medicinal properties are common to the genus. Besides the official

species, there are found the *hirsutula* and the *glutinosa*, similar species growing in the western part of the United States, often cultivated and mixed with the official.

DESCRIPTION OF DRUG.—Rough, grayish-green fragments of the leaves, mixed with brownish-yellow stem fragments, and with flower-heads about 15 mm. (3/5 in.) in diameter, usually destitute of florets, leaving the **bare receptacle surrounded by the stiff, varnished, resinous bracts** of the involucre; odor balsamic; taste aromatic and bitter.

Distinction of the Two Species.—It may be said that the two species, *squarrosa* and *robusta*, resemble each other very much. *Robusta* is said to have a more leafy involucre and the leaves to be more coarsely serrate. The *squarrosa* in general is said to be less leafy and bushy, but on close examination of numerous specimens it is a question whether the distinction will hold.

Powder.—Characteristic elements: See Part iv, Chap. I, B.

CONSTITUENTS.—The medicinal properties of *grindelia* seem to reside in **the resinous exudation**. An alkaloid principle has been claimed by some investigators and termed grindeline.

ACTION AND USES.—**Antispasmodic and sedative, in asthma.** Dose: 15 to 60 gr. (1 to 4 Gm.). The fluidextract is said to be an efficient application in rhus poisoning.

OFFICIAL PREPARATION.

Fluidextractum Grindeliæ Dose: 15 to 60 drops (1 to 4 mils).

577. **TANACETUM.**—TANSY. The leaves and tops of **Tanacetum vulgare** Linné. Off. in U.S.P. 1890 Leaves pinnate, the lobes sharply serrate, in wrinkled, broken pieces mixed with the reddish stems; midrib heavy and prominent on under side; odor strong, fragrant, diminished by drying; taste bitter, somewhat mint-like. Constituents: Tanacetin, $C_{11}H_{16}O_4$ (a bitter principle), malic acid, volatile Oil (0.25 per cent.), tannin, resin, etc. Stimulant, tonic, emmenagogue, and anthelmintic. The dose of the volatile oil is from 1 to 5 drops; used also as a domestic abortifacient and as a remedy for amenorrhea. Its use should be prohibited except upon physician's order, as it is a dangerous drug. Dose: 15 to 60 gr. (1 to 4 Gm.), in infusion.

578. **ABSINTHIUM.**—WORMWOOD, N.F. The leaves and tops of **Artemisia absinthium** Linné. Off. U.S.P. 1890. Consists of the grayish, softly, hairy,



Artemisia Absinthium.

longitudinally ribbed or furrowed stems with the petiolate, pinnatifid, pubescent leaves mostly broken beyond recognition; flower-heads in racemes, hemispherical, about 3 mm. ($\frac{1}{8}$ in.) broad; receptacle small, hairy, convex, with all yellow, tubular florets; akenes obovoid, without pappus; odor strongly aromatic; taste intensely bitter and nauseous. *Constituents:* Tannin, resin, malates, absinthin, $C_{15}H_{20}O_4$ (a bitter glucoside), absinthic acid (probably succinic acid), and a dark green volatile oil, about 1 per cent. (mainly absinthol), which has the odor of the drug, and when mixed with alcohol and oil of anise constitutes the absinthe of the French. Stomachic, tonic, anthelmintic and febrifuge. Dose: 15 to 60 gr. (1 to 4 Gm.).

Isolation of Absinthin.—Obtained by precipitating infusion, previously deprived of color, with tannin. The alcoholic extract of this precipitate is mixed with lead oxide and again extracted with alcohol. Absinthia deposits on evaporation of this tincture.

579. **ARTEMISIA.**—Nearly all the varieties of **Artemis'ia** seem to have similar properties—anthelmintic. Besides absinthium and santonica, some common indigenous plants of this genus are more or less used in medicine:

579a. **ARTEMISIA ABROTANUM.**—SOUTHERNWOOD. OLD MAN.

579b. **ARTEMISIA VULGARIS.**—MUGWORT. Also alterative and emmenagogue, and externally as a vulnerary.

579c. **ARTEMISIA FRIGIDA.**—MOUNTAIN SAGE. Antiperiodic; first introduced as a substitute for quinine.

579d. **ARTEMISIA TRIDENTATA.**—SAGE BRUSH—of the Rocky Mountains. **A. trifolia**, the dwarf variety of the above, and **A. dracunculus** Tarragon, are well known, but only used locally in making domestic remedies of aromatic, bitter, and tonic character.

580. **ERIGERON.**—FLEABANE. DAISY FLEABANE. The herb of **Erig'eron an'nuus** Persoon, **E. philadelphicus** Linné, and **E. strigosus** Muhlenberg. *Habitat:* North America and Europe. All resemble one another and are indiscriminately employed in medicine. They have erect stems, much branched at the top, bearing terminal corymbs of wheel-shaped flowers having delicate, thread-like, white or purple ray-florets and yellow disk-florets; all parts of the plant are pubescent. Taste bitterish; odor feebly aromatic, due to a small quantity of volatile oil. Diuretic and stomachic, sometimes used in the treatment of gravel and dropsy. Dose: 30 to 60 gr. (2 to 4 Gm.),

in infusion.

581. **ERIGERON CANADENSE** Linné.—CANADA FLEABANE. *Habitat*: North America. (Herb.) This differs from the other species principally in having a bristly stem and flowers with very inconspicuous ray-florets and straw-colored disk-florets. Odor aromatic; taste bitterish, somewhat acrid. It contains a bitter principle, and a volatile oil which is OFFICIAL in the U.S.P. VIII. Properties and dose about the same as preceding.

581a. **OLEUM ERIGERONTIS**, U.S.P. VIII.—(CANADA FLEABANE.) A limpid, straw-colored liquid becoming thick and dark on exposure; odor aromatic, persistent; taste characteristic. Adulterated with the oil of fireweed, *Erechthites hieracifolia* (567). Stimulant and diuretic, resembling oil of turpentine in action, especially as a hemostatic, but is less irritating and stimulating. Dose: 10 to 30 drops (0.6 to 2 Mils).

582. **GNAPHALIUM**.—LIFE EVERLASTING. The herb of **Gnaphalium polycephalum** Michaux. *Habitat*: North America. Leaves lanceolate, entire, woolly, sessile on the erect stem, which is branched, and bears dense terminal clusters of small obovate flower-heads surrounded by dry, whitish involucre; florets yellow, tubular; odor pleasant, taste aromatic, bitterish. It probably possesses little medicinal value, but is a popular domestic remedy, used as a tea in diarrhea, hemorrhages, etc., and externally in a fomentation as a vulnerary. Dose: 30 to 60 gr. (2 to 4 Gm.).

583. **HELENIUM**.—SNEEZEWORD. The herb of **Helenium autumnale** Linné. *Habitat*: North America. A square-stemmed herb, the leaves and flowers of which, when powdered and snuffed up the nose, produce violent sneezing, hence the name sneezewort. It has been used as an errhine.



Achillea Millefolium.

584. **ACHILLEA**.—YARROW. MILFOIL. The herb of **Achillea millefolium** Linné, common in Europe and North America. Stem hairy, branched at top bearing the large corymbs of white flower-heads, each composed of five pistillate ray-florets, and greenish-white, perfect disk-florets; leaves lanceolate, thrice pinnatifid, the divisions linear. In market, however, the leaves are broken or crumpled, and the flower-heads destitute of florets; odor chamomilelike; taste aromatic, bitterish, and astringent. Used as a vulnerary and occasionally as an internal remedy for hemorrhages and mucous discharges, as in consumption. Dose: 30 to 60 gr. (2 to 4 Gm.), in infusion.

585. **TUSSILAGO**.—COLTSFOOT, N.F. The herb of *Tussilago farfara* Linné. *Habitat*: Europe, and Middle and Northern United States, along the banks of streams. Demulcent, popularly used in the

treatment of coughs (hence the name, from tussis, cough). Its expectorant properties are not pronounced, however. Dose: 30 to 60 gr. (2 to 4 Gm.), in decoction.

586. **CARDUUS BENEDICTUS**.—BLESSED THISTLE. The herb of **Cni'cus benedic'tus** Gaertner. *Habitat*: Levant and Europe. The drug consists of the woolly stems, with the soft, spiny leaves and a few of the large, ovate, yellow flower-heads; it has a slight, unpleasant odor and a very bitter taste. In cold infusion it is a bitter tonic, in hot infusion in large quantities diaphoretic and emetic. *Cnicus marianus* Gaertner has been used for the same purposes, and in Europe as a depurative.

587. **SILPHIUM LACINIATUM** Linné.—ROSIN WEED. *Habitat*: United States. (Herb or root.) It has given good results in intermittent fevers, and in dry, obstinate coughs, its action being somewhat like grindelia.

588. **MUTISIA VICIÆFOLIA**.—CHINCHIROCOMA. This herb is said to be a valuable antispasmodic and cardiac tonic.

589. **ELEPHANTOPUS TOMENTOSUS** Linné.—ELEPHANT'S FOOT. *Habitat*: United States. (Herb.) Diaphoretic and expectorant; in large doses emetic. Dose: 5 to 30 gr. (0.3 to 2 Gm.).

590. **RUDBECKIA LACINIATA** Linné.—THIMBLE WEED. CONE FLOWER. This indigenous herb is used in catarrhal affections of the urinary tract. Diuretic and tonic. Dose: 15 to 60 gr. (1 to 4 Gm.).

591. **BIDENS BIPINNATA** Torrey and Gray.—SPANISH NEEDLES. An indigenous herb, popularly used as an emmenagogue. Dose: 15 to 60 gr. (1 to 4 Gm.).

592. **SENECIO AUREUS** Linné, N.F.—LIFE-ROOT. RAGWORT. (Herb.) Used by the Indians as a vulnerary. Emmenagogue. Dose: 30 to 60 gr. (2 to 4 Gm.), in infusion, decoction, or fluidextract.

593. **SOLIDAGO**.—GOLDEN ROD. The herb of **Solida'go odo'ra** Aiton. (See *Conspectus*.) Aromatic, stimulant, carminative, and diaphoretic, in infusion. Used also to disguise the taste of other medicines.

594. LACTUCARIUM.—LACTUCARIUM

LETTUCE-OPIUM

The concrete milk-juice of **Lactu'ca viro'sa** Linné.

BOTANICAL CHARACTERISTICS.—A biennial, rank-smelling herb, abounding in a milky, acrid juice. Root napiform; stem 2 to 4 feet high, erect, slender, glaucous, slightly prickly below, covered here and there with blood-red spots. Leaves with midrib prickly, otherwise smooth, finely toothed; radical leaves obovate, undivided, those of the stem lobed, auricled, and partly clasping. *Flower-heads* paniced, with small heart-

shaped bracts; *flowers* all ligulate, perfect, light yellow.

SOURCE.—Europe; chiefly produced in Scotland, France, and Prussia.

DESCRIPTION OF DRUG.—In sections of plano-convex circular cakes, or angular pieces, of a grayish or reddish-brown color, breaking with a waxy, yellowish-white fracture; **odor** opium-like and disagreeable, characteristic; taste bitter and acrid. It is partly soluble in alcohol and ether. When triturated with water it yields a turbid solution; boiling water dissolves about 50 per cent., forming a brown infusion.

Powder.-Grayish-brown to dark brown, consisting almost entirely of irregular, angular masses, without any cellulose structure; when mounted in hydrated chloral T.S. the fragments become clear, showing a granular ground mass; from this separated rod-shaped crystals, monoclinic prisms and rosette-shaped crystal-like masses.

To powder lactucarium, the crude drug should be dried at a temperature not exceeding 70°C,

CONSTITUENTS.—Lactucin, lactucopicrin (very bitter and acrid), lactucic acid, $O_{44}H_{32}O_{21}$ (very bitter, probably an oxidation product of lactucopicrin), lactucerin (lactucone), and wax. Ash, not more than 10 per cent.

Preparation of Lactucerin, Lactucone.—Boiling alcohol extracts it in almost pure state from lactucarium, which has been deprived of resin and caoutchouc.

ACTION AND USES.—Anodyne, hypnotic, and sedative, resembling opium in its action, but much feebler and without the depressing aftereffects. Dose: 5 to 60 gr. (0.3 to 4 Gm.).

OFFICIAL PREPARATIONS.

Tinctura Lactucarii (50 per cent.), Dose: 10 to 60 drops (0.6 to 4 mils)
Syrupus Lactucarii (10 per cent. of Tincture) $\frac{1}{2}$ to 2 fl. dr. (2 to 8 Mils).

595. **LACTUCA SATIVA.**—GARDEN LETTUCE. Popularly used as a mild antispasmodic to allay nervous irritability and mental worry. It yields a lactucarium during flowering, but before that period the juice is pellucid and insipid.

596. **LACTUCA CANADENSIS.**—WILD LETTUCE. Used as a mild soporific for children. Dose: 20 gr. (1.3 Gm.).

597. **PARTHENIUM.**—FEVERFEW. The herb of **Matrica'riaparthe'nium** Linné. *Habitat:* Europe; cultivated in this country. Resembles chamomile in odor and taste, in medical properties, and also in the appearance of the flowers, which differ, however, in their peculiar odor, their rounded and somewhat flattened receptacle, and the numerous large and long disk-florets which they bear.

598. **COTULA.**—MAYWEED. WILD CHAMOMILE. The herb of **Anthe'mis cotu'la** Linné. *Habitat:* Europe; naturalized in the United States. It has essentially the same properties as anthemis and chamomile, but has a disadvantage for general use in its strong, disagreeable odor. It is popularly used as a sudorific and antispasmodic, in doses of $\frac{1}{2}$ to 2 dr. (2 to 8 Gm.), in infusion.



FIG. 254.—*Matricaria chamomilla*—Branch and dissected flowers.

599. MATRICARIA.—MATRICARIA

GERMAN CHAMOMILE

The dried flower-heads of **Matrica'ria chamomil'la** Linné.

BOTANICAL CHARACTERISTICS.—*Plant* annual; stem 1 to 2 feet high, much branched. *Leaves* alternate, more or less pinnate, smooth. *Heads* solitary; *ray-florets* white, pistillate, spreading, soon reflexed; *disk-florets* deep yellow, perfect; pappus none. The *flowers* have a peculiar aroma and a bitter aromatic taste.

SOURCE.—Europe and Asia. The genus *Matricaria* is widely distributed; two or three species of the “wild chamomile” of this genus have been introduced into the United States.

DESCRIPTION OF DRUG.—After drying, the flower-heads are of a dull yellow or yellowish-white color, about 10 mm. ($\frac{2}{5}$ in.) broad, surrounded by a flattish, imbricated involucre; this involucre is composed of oblong scales, having a membranous, translucent margin; the receptacle is conical, internally hollow, and bears a single row of about fifteen short, toothed, reflexed ray-florets, and numerous tubular yellow disk-florets, without pappus; disagreeably aromatic; taste bitterish, aromatic.

Powder.—Greenish. Characteristic elements: The interesting microscopical constituent for study is found in the pollen grains with three distinct pores; seldom dispensed as powder.

ADULTERATIONS.—*Anthemis arvensis* and *A. cotula*. These have solid, chaffy receptacles.

CONSTITUENTS.—Deep blue **volatile oil**, **anthemic acid**, **anthemidin**, and tannin. Ash, not more than 13 per cent.

Preparation of Anthemic Acid.—The concentrated infusion, made with water acidulated with acetic acid, is precipitated with alcohol. The alcoholic residue, after evaporation of the alcoholic solution, is treated with chloroform. The precipitate produced by alcohol contains anthemidin.

ACTION AND USES.—Mild **stimulant** and tonic, in large doses emetic. Dose: 15 to 60 gr. (1 to 4 Gm.) in infusion.

600 ANTHEMIS.—ANTHEMIS, U.S.P. VIII

ROMAN CHAMOMILE. ENGLISH CHAMOMILE

The dried flower-heads of **Anthe'mis nobil'is** Linné, collected from cultivated plants.

SOURCE.—Europe; cultivated in Germany, England (Mitcham Gardens), Surrey; introduced in United States.

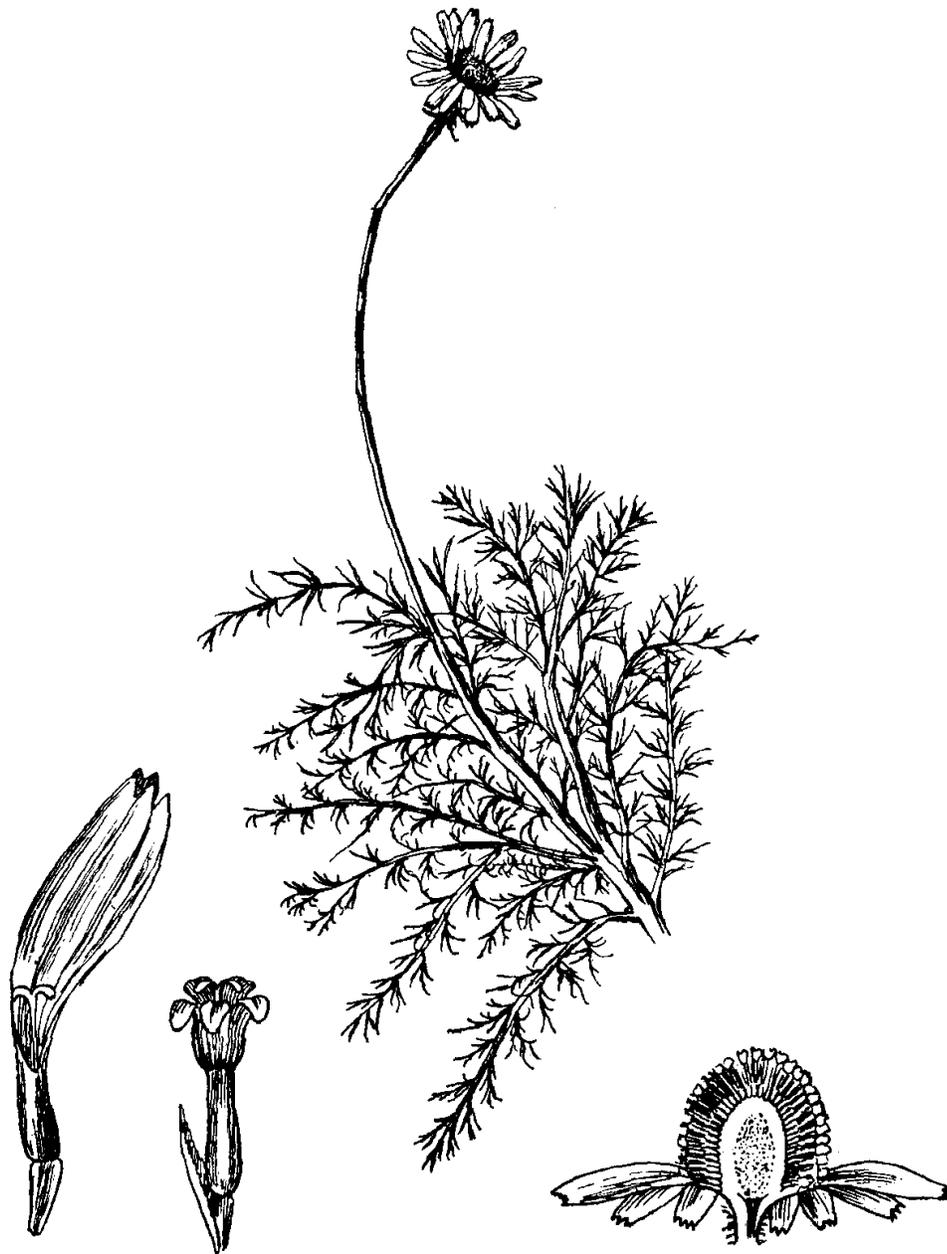


FIG. 255.—*Anthemis nobilis*—Plant and dissected flowers.

DESCRIPTION OF DRUG.—There are two kinds of flower-heads, the single and the double. The latter is developed by cultivation, the disk-florets being partly or wholly converted into the white, strap-shaped, three-toothed ray-florets, forming an **almost spherical head, dull white** when dry and about 20 mm. ($\frac{4}{5}$ in.) broad; it is the kind preferred, on account of its greater aromatic properties, which reside in the rays, but

as the conversion is more or less incomplete, both kinds may be found intermingled in the commercial article. It is stated, however, by some that the single flowers are more odoriferous and yield a larger proportion of volatile oil; the double flowers, being more showy, are preferred by the public. Involucre imbricate, the scales ovate-oblong, with a scarios margin; receptacle solid, conical, chaffy; odor strong, agreeable; taste aromatic and bitter.

Powder.—Straw color. Characteristic elements: Trichomes, glandular, single-celled, thick-walled; pollen and stomata present.

CONSTITUENTS.—**Volatile oil** (Oleum Anthemidis, 1 per cent.), at first pale blue, becoming yellowish-brown on exposure; it is regarded as a mixture of hydro carbons with the angelic, valerianic, and tiglinic esters of butyl and amyl. Anthemis also contains a brown, bitter extractive, probably a glucoside. Ash, about 6 per cent.

ACTION AND USES.—**Stimulant** and tonic, in enfeebled digestion during convalescence; also carminative, and in large doses emetic. Dose: 15 to 60 gr. (1 to 4 Gm.), in infusion.

601. SANTONICA.—SANTONICA, U.S.P. VIII

LEVANT WORMSEED

The dried unexpanded flower-heads of *Artemisia pauciflora* Weber.

BOTANICAL CHARACTERISTICS.—A low, shrubby, tomentose, aromatic plant. *Leaves* downy, pinnatifid; *flower-heads* drooping, in dense thryoid panicles.

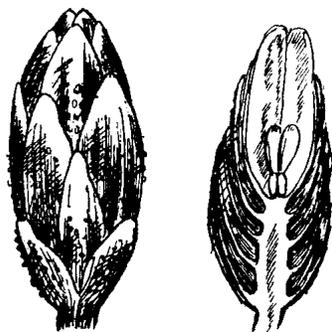


FIG. 256.—Santonica—Head and longitudinal section enlarged.

SOURCE.—*Artemisia pauciflora* grows on the desert plains or steppes of several parts of Russia, especially in the districts near the lower course of the Volga and Don Rivers. It is quite abundant in Persia and Turkestan, where it is known as Damanah. This Asiatic drug does not differ materially from the Russian, except that it is slightly shaggy and mixed with tomentose stalks. Of late years most of the wormseed of commerce has come from the steppes of the northern part of Turkestan, whence it finds its way to Moscow and Western Europe.

DESCRIPTION OF DRUG.—**Greenish-brown, small, oblong-ovoid**, about 2 mm. ($\frac{1}{8}$ in.) long. They consist of fifteen to eighteen imbricated scales, each having a green midrib containing oil-glands, which inclose four or five tubular florets so minute that they can scarcely be distinguished by the naked eye; **odor** strong, aromatic; taste bitter, aromatic, camphoraceous.

Powder.—Greenish-brown. Characteristic elements: Parenchyma cells, elongated, thin-walled; trichomes, glandular, 1 or 2 short cells or two or three pairs of cells, non-glandular, one-celled, long, slender, thin-walled; pollen mostly in masses, brown, 15 to 20 μ in diam.; pores distinct.

CONSTITUENTS.—Volatile oil about 1 per cent., having a characteristic smell and taste, devoid of anthelmintic properties, which reside in the neutral principle, **santonin**, $C_{15}H_{18}O_{31}$. Santonin (Santonium, U. S.) constitutes about 2 per cent. of the drug; it occurs in colorless, rectangular, tabular crystals, which, when exposed to the light, assume a yellow hue. Soluble in 5300 parts of water, 34 of alcohol, 78 of ether and 2.5 of chloroform at 25°C. (77°F.).

Preparation of Santonin.—Digest powdered Santonica in dilute alcohol mixed with slaked lime; recover alcohol; add acetic acid in excess to residue, which separates santonin in white, shining, odorless bitter prisms, turning yellow on exposure.

This important principle is manufactured to a considerable extent in Russia, large factories at Oldberg turning out about twelve tons annually. It is well known to the natives of India, and is now imported from Germany. Much of the imported santonin is adulterated, sometimes to the extent of three-fourths of its weight, with gum and boric acid. These can easily be detected upon exposure as santonin turns yellow. The quantity of santonin in the plant diminishes as the plant grows older and the flowers expand.

Tests.—On dissolving with nitric acid and adding sulphuric acid we get a red color, and on adding Fe_2Cl_6 it changes to violet. With an alcoholic solution of KOH a pinkish-red liquid is obtained, soon becoming colorless.

On account of the fact that santonin is easily decomposed, it should be kept in amber-colored bottles, away from the sunlight, which converts it into yellow photo-santoninic acid. Heating it with alkalis changes it into santoninic acid, while long boiling with baryta water changes it into santoninic acid.

ACTION AND USES.—**Anthelmintic.** Dose; 15 to 60 gr. (1 to 4 Gm.), in infusion or electuary. Dose of santonin: $\frac{1}{4}$ to 1 gr. (0.016 to 0.065 Gm.), in powder or troches. **Trochisci Santonini**, U.S. VIII., $\frac{1}{2}$ gr. (0.03 Gm.).

602. CALENDULA.—CALENDULA, N.F.

MARIGOLD

The dried ligulate florets of **Calen'dula officina'lis** Linné.

DESCRIPTION OF DRUG.—Florets about 12 mm. ($\frac{1}{2}$ in.) long, **linear** and **strap-shaped**, delicately veined in a longitudinal direction, **yellow or orange-colored**, 3-toothed above, the short, hairy tube inclosing the remnants of a filiform style

terminating in two elongated branches; odor slight and somewhat heavy; taste somewhat bitter and faintly saline.

CONSTITUENTS.—Trace of volatile oil, a bitter principle, and a peculiar gummy principle, calendulin, $C_6H_{10}O_5$, regarded by some authorities as analogous to bassorin.

ACTION AND USES.—It has slight stimulant and diaphoretic properties, but is used principally in the form of tincture, as a vulnerary. Dose: 15 to 60 gr. (1 to 4 Gm.). **Tinctura Calendulæ**, formerly official.

603. **CARTHAMUS**.—SAFFLOWER. AMERICAN SAFFRON. The florets of **Cartha'mus tincto'rius** Willdenow. (Official, 1820-1880.) *Habitat*: India, Levant, and Egypt; cultivated. Orange-red; tube long, slender, cylindrical with the two-cleft yellowish style protruding; strap divided into five narrow, lanceolate lobes; odor peculiar, aromatic; taste bitter. It contains two coloring principles, safflower-yellow, $C_{24}H_{30}O_{15}$ (24 to 30 per cent.), and a red principle, carthamin, $C_{14}H_{16}O_7$, or carthamic acid, to the latter of which its value as a dyestuff is due, and which, mixed with talc, forms rouge. Cathartic and diaphoretic in large doses of the warm infusion; in domestic practice used as a substitute for saffron to promote eruption in measles, scarlatina, etc. Dose: 8 to 15 gr. (0.5 to 1 Gm.).

604. **HELIANTHUS ANNUUS** Linné.—Our common sunflower, the seeds of which are sometimes used as a diuretic and expectorant in pulmonary and laryngeal affections. Dose of fluidextract: 1 to 2 fl. dr. (4 to 8 mls). The fixed oil expressed from them has become an article of commerce, and the growing plants themselves enjoy the reputation of purifying malarial districts.

SECTION II.-ANIMAL DRUGS

605. CANTHARIS.—CANTHARIDES

SPANISH FLIES. BLISTER BEETLES

The beetle, **Can'tharisvesicato'ria'** De Geer. (Fam.Coleoptera.) Thoroughly dried at a temperature not exceeding 40°C. (104°F.). Should not contain more than 10 per cent. moisture, and should contain not less than 0.6 per cent. of cantharidin.

HABITAT.—Southern and Central Europe and Northwestern Asia, feeding on plants of the families Oleaceae and Caprifoliaceae.

COLLECTION.—By shaking or beating the food-plants; the insects are then killed by heat (hot water) and rapidly dried.

DESCRIPTION.—A bronze-green beetle, with long (about 1 in. or 25 mm.) and narrow ($\frac{1}{4}$ to $\frac{1}{3}$ in., about 7 mm.), subcylindrical body. The vertical, rather triangular, head is constricted behind so as to form a conspicuous neck. Odor strong and disagreeable, caused, in the living insect, by a secreted fluid containing uric acid, according to Maquetti. The crushing of the dried insect yields a grayish-brown powder containing green shining particles (the bits of the green wing-covers and the body-wall).

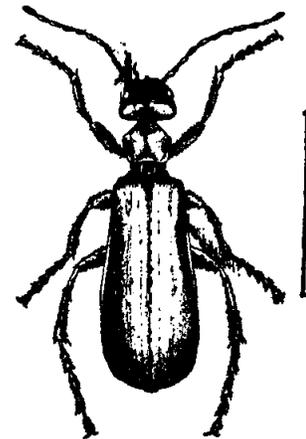


FIG. 257.—Spanish Fly (*Cantharis vesicatoria* De Geer)—(Original).

The dried insects or the powder is subject to the attacks of several Dermestid beetles and of several mites (*Glyphigus*). The addition of a little chloroform, oil of turpentine, or naphthalene balls in a tightly closed vessel will help to keep out these cantharid-eating pests; or, if they have established themselves in the vessels, they may be killed by the use of carbon disulphide. (See Part III.)

OTHER SPECIES.—Besides *Cantharis vesicatoria*, several other beetles of the family Meloidæ, especially species of **Mylabris**, **Epicauta**, and **Macrobasis**, are used to obtain vesicatory agents, and give a larger percentage of cantharidin than the officially recognized insect.

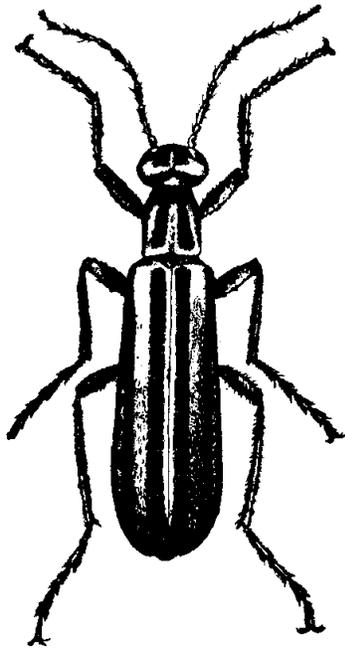


FIG. 258.—Old-fashioned Potato Beetle (*Epicauta vittata* Fab.)—(Original).

Epicauta vittata.—The Old-fashioned Potato Beetle.¹ Found, often abundantly, in the United States; feeds largely on leaves of potato-plants. This insect was formerly official.

***Mylabris cichorii* Fab., and *M. phalerata* Pallas.**—Chinese Blister Beetles. *Habitat*: Southern and Eastern Asia. *Cichorii* has its black wing-covers crossed by three broad orange-yellow bands; one band is terminal, thus rendering the apices of the wing-covers yellow.

Mylabris bifasciata.—The Two-striped Blister Beetle. *Habitat*: Northern Africa. The body is black, the wing-covers presenting two undulating narrow yellowish stripes. All these species of *Mylabris* yield about 1 per cent. of cantharidin.

ADULTERATION.—Spanish flies exhausted of their vesicating principle have been met with as substitutions. Powdered euphorbium has been spoken of as one of the adulterants, but adulteration is not common in this drug. The assay of the drug is accomplished by treating the powder with a mixture of benzine (2 vols.) and petroleum ether (1 vol.), acidulated with HCl; digesting the mixture; decanting the clear liquid, after cooling; evaporating and purifying the residue. For details, see U.S.P. IX.

CONSTITUENTS.—The chief constituents are: (1) cantharidin, the active principle, a fatty crystallizable body forming shiny, colorless plates, soluble in alcohol, ether, acetic ether, glacial acetic acid, chloroform, and oils-, volatilizable by heat (100°C., 212°F.) without decomposition, the vapor condensing in acicular crystals; (2) a volatile oil, giving the odor of cantharides, and said to have vesicatory properties; and (3) a green oil, the coloring principle, closely allied to chlorophyll.

¹ This "Potato Beetle" should not be confused with the well-known Colorado Potato Beetle (*Doryphora decemlineata*, Say), belonging to the family Crysomelidæ, a short, oval, yellow-and-black insect with ten longitudinal stripes on its wing-covers. This latter beetle probably possesses no vesicatory principle.

Preparation of Cantharidin.—Obtained by percolating the powder with chloroform, distilling off the liquid, and purifying the resulting crystals by washing them with CS₂ to remove fat. Colorless prisms; soluble in alcohol, ether, fats, etc.

Cantharidin is associated with certain alkalies and alkaline earths in the drug, and seems to exist partly in combination with them. The principle itself has been found to combine with salifiable bases like an acid.

ACTION AND USES.—Internally cantharides acts as a powerful irritant, and has a peculiar effect on the urinary and genital organs. Large doses produce violent strangury, attended with excruciating pain and a discharge of bloody urine. The principle use of cantharides is the application, externally, of the cerate as a blistering plaster. It is seldom used as a rubefacient, but as an epispastic or vesicant it is to be preferred of all substances of this class. Its blistering action terminates in a copious secretion of serum under the cuticle. Dose: 1/2 gr. (0.03 Gm.).

OFFICIAL PREPARATIONS.

Ceratum Cantharidis (32 per cent.).

Collodium Cantharidatum (60 per cent.).

Tinctura Cantharidis (10 percent.) Dose: 1 to 5 drops (0.065 to 0.3 mil)

606. COCCUS.—COCHINEAL

COCHINEAL BUG. RED SCALE INSECT

The dried female insect, **Coc'cus cac'ti** Linné. (Fam. Coccidae), enclosing the young larvæ.

HABITAT.—Mexico, Central America, and Northern South America (originally), and Spain and Algiers (introduced); feeds on various cacti, especially upon *Opuntia coccinifera*.

COLLECTION.—Only the females (wingless) are used; they are brushed off from the food-plant, and, if alive, are killed by heat (hot water or oven). The cochineal insect is cultivated on a large scale, and large quantities are annually exported from Mexico and Peru. Humboldt estimated that 800,000 pounds of coccus (each pound representing 70,000 insects) were annually imported into Europe.

DESCRIPTION.—The females (which alone are used) are small, wingless, oval, dull purplish-brown insects, convex above, about 4 mm.

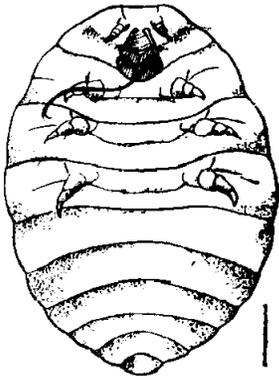


FIG. 259.—Cochineal Bug (*Coccus cacti*) Linné—(Original).

($\frac{1}{6}$ in.) long, covered, when alive, with a white cottony secretion. When the insects are dead and dry, this “cotton” rubs off, and the crushed insects yield a dark red powder; odor faint, taste slightly bitter.

VARIETIES.—These are: (1) silver, recognized by the presence of a soft, silvery white powder contained in the furrows and wrinkles; it appears to be a fatty substance as it melts on the application of heat, and the insects lose their silvery appearance. This variety is said to be the mature and fecundated insect. (2) Black cochineal, of a reddish-black color, nearly devoid of silvery powder, is supposed to be the female exhausted by propagation. (3) Granilla, an inferior kind composed of small and imperfect insects.

ADULTERATION.—The silvery gray variety with carbonate or sulphate of barium and lead; the black cochineal with graphite, ivory black, or manganese dioxide. “When completely incinerated, cochineal should leave not more than 5 per cent. of ash.”

CONSTITUENTS.—Cochineal contains principally a red coloring matter soluble in water, alcohol, or water of ammonia. This coloring matter is composed of carminic acid, $C_{17}H_{18}O_{10}$ (?).

Carminic acid is obtained by treating the drug first with ether to remove fat, then with alcohol. Let alcoholic solution stand a few days, when carminic acid will deposit as a brownish-purple substance. A vermilion-red powder (carmine), soluble in water, alcohol, and alkalis, is obtained as a combination of this acid with alumina or occasionally with oxide of tin or with albumen. Commercial carmine is made by precipitating the decoction of cochineal with alum or cream of tartar.

MEDICAL PROPERTIES.—Cochineal has some reputation as an anodyne and antispasmodic, but it has not for many years been used as a remedial agent, its chief use being that of a coloring matter, and for this purpose it enters into the following preparation.

OFFICIAL PREPARATION.

Tinctura Cardamomi Composita (0.5 per cent.) Dose: 1 fl. dr. (4 mls).

607. **BLATTA**.—COCKROACH. **Periplaneta orientalis** Linné. Class, Insecta; order, Orthoptera; family, Blattidæ.

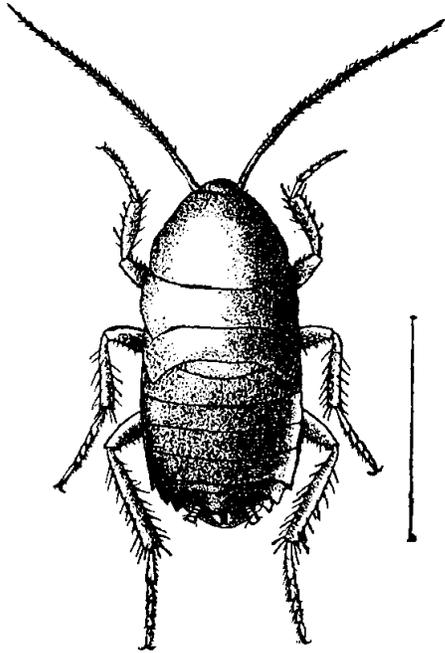


FIG. 260.—Cockroach (*Periplaneta* sp.)—(Original).

HABITAT.—Asia (originally); now found in almost all parts of the world, in kitchens, laundries, and any warm, damp room. Nocturnal in habit, feeding omnivorously on vegetable and animal products.

DESCRIPTION.—A large (1 in. long), dark brown, short-winged, broad, flat, oval insect with long, thread-like antennæ. Wings of the female rudimentary; of the male not reaching quite to the tip of the abdomen. Odor disagreeable.

OTHER SPECIES.—*Periplaneta americana* (American cockroach) is larger than *orientalis*, lighter brown in color, and has the wings well developed in both sexes. Numerous in houses about the water pipes; also abundant, often in green-houses, feeding injuriously on various plants.

Ectobia germanica (German cockroach or Croton Bug), very common in New England cities; smaller than the two preceding roaches (about $\frac{1}{2}$ in. long), very light (yellowish-brown) in color, with two longitudinal dark stripes upon the prothorax.

Blatta gigantea, found in the West Indies, attains a length of 2 inches.

CONSTITUENTS.—Foetid oil, ammonia, trimethylamine, and a crystallizable principle, not diuretic, antihydropin.

ACTION AND USES.—Diuretic. Dose: 5 to 10 gr. (0.3 to 0.6 Gm.), in powder or tincture.

608. **HIRUDO**.—LEECH. **Sanguisuga medicinalis** Savigny. Class, Vermes; order, Annelida; family, Hirudinea.

HABITAT.—Northern and Central Europe chiefly, but found more or less in all parts of Europe, in ponds of fresh water.

DESCRIPTION.—The body, which varies in length from 75 to 150 mm. (3 to 6 in.), is smooth and round, tapering toward both ends, and made up of about 100 soft rings or folds. Both ends are provided with a flattened disk, the posterior being the larger, each of which is adapted to fix upon objects by suction. The mouth has three jaws, with a

double row of fine sharp teeth in each; the small anal opening is found on the under side of the last posterior wrinkle. Color of black greenish and striped longitudinally with numerous black spots; belly somewhat lighter green.

OTHER SPECIES.—Besides *S. officinalis*, which is next to *S. medicinalis* in importance and is similar in appearance (only there are no spots, and a black line extends along each side), may be mentioned *Hirudo provincialis*, *H. obscura*, and *H. interrupta*, the species common in this country being known as *H. decora*. Leeches are said to be found in great abundance throughout India.

PRESERVATION.—The usual way of keeping leeches is to place them in clear water, in a shaded spot if possible, where the temperature will range from 10° to 20°C. (50° to 68°F.), care being taken to have a considerable quantity of charcoal, moss, and pebbles in the containing vessel.

USE.—For local blood-letting, a single leech being able to extract from 1 to 2 drachms of blood.

SPECIAL ANIMAL TISSUES AND SECRETIONS

609. **SPONGIA**.—SPONGE. **Spon'gia officina'lis** Linné. Class, Porifera; order, Ceratospongiae.

HABITAT.—Red Sea, Mediterranean Sea, Atlantic Ocean, and other bodies of salt water, upon the rocky bottom.

COLLECTION.—The best sponges are secured by diving and cutting away their fastenings from the rocks; those of inferior quality are usually torn away with an instrument made for the purpose. The fresh sponges are exposed to the sun and washed, for the purpose of removing the animal matter with which they are filled.

DESCRIPTION.—A soft, elastic skeleton or framework of fibrous tissue surrounding the original animal matter, which, being removed, leaves a number of large and small cavities. The color is a light yellowish-brown.

VARIETIES.—The Turkey sponge is considered the best and belongs to the species *Euspongia mollissima*; *Euspongia zimocca*, from the coast of Greece, is harder and not so elastic. A still coarser sponge is *Euspongia equina*, collected along the north coast of Africa. The various sponges of the West Indies and Florida are different varieties of the three preceding species.

CONSTITUENTS.—A characteristic substance known as **spongin**, which yields leucin and glycocoll when treated with sulphuric acid, and when treated with KOH evolves ammonium hydrate. The ash is made up of various compounds of iodine, sodium, magnesium, calcium, etc.

USES.—Its power to absorb liquids and to expand at the same time makes sponge valuable as a surgical accessory in absorbing blood, dilating cavities, cleansing surfaces, etc., but great care should be exercised in its use, so that the same sponge may not be used more than once without being thoroughly washed in a dilute solution of carbolic acid; otherwise there is danger of contamination by infection, which is easily carried from one patient to another when the same sponge is used repeatedly. Burnt sponge is occasionally administered, on account of the iodides of sodium and potassium which it contains, in cases of goiter and scrofulous swellings.

610. **CORALLIUM.**—CORAL. **Oculi'na virgi'nea** Lamarck. Class, Polypifera; order, Hexacoralla.

HABITAT.—Atlantic Ocean and Mediterranean Sea.

DISCRIPTION.—A hard, calcareous substance produced by coral polypi. The pieces are often branched, presenting a surface more or less porous and striate, and the interior is radiate or hollow.

VARIETIES.—Besides *Oculina virginea* there are several other species, among which may be mentioned *Corallium rubrum*, the red coral.

CONSTITUENTS.—Calcium carbonate 83 per cent., animal matter 7 to 8 per cent., magnesium carbonate 3 to 4 per cent., and ferric oxide 4.25 per cent. (in the red coral).

USES.—Antacid. Used in tooth powders. Dose: 5 to 15 gr. (0.3 to 1 Gm.).

611. **TESTA.**—OYSTER SHELL.

SOURCE.—**O'streavirginia'na** and **O. edulis**, which excrete a calcareous bivalved covering or shell, and inhabit the shallow coast water of the Atlantic and Indian Oceans.

DESCRIPTION.—External surface rough, inner surface smooth and white, the two toothless, hinged valves made up of imbricate, foliaceous layers, presenting, when closed, an irregularly rounded, oblong, or ovate form.

CONSTITUENTS.—Largely calcium carbonate, there being only 4 per cent. or less of animal matter present and a small percentage of silica, alumina, magnesia, and calcium phosphate and sulphate.

USES.—Antacid. The shell, to be used, should first be thoroughly purified and washed in boiling water. Dose: 5 to 15 gr. (0.3 to 1 Gm.).

612. **OS SEPIÆ.**—CUTTLEFISH BONE.

SOURCE.—*Se'pia officina'lis* is the species from which this calcareous bone is obtained; it inhabits the Atlantic Ocean and the Mediterranean Sea.

DESCRIPTION.—A white, flattish, oval-oblong bone about 100 mm. (4 in.) in length; exterior hard and smooth, interior porous and friable; inodorous; taste somewhat saline and earthy.

CONSTITUENTS.—Mostly calcium carbonate, with from 10 to 15 per cent. of animal matter and a very small percentage of sodium chloride, calcium phosphate, and magnesia.

USES.—An antacid. Extensively employed in the manufacture of tooth powders, and used to some extent as a polishing agent.

613. CALCULI CANCRORUM.—CRABS' STONES.

SOURCE.—The stomach of the crab (*Astacus fluviatilis* Fab. or *Cancer astacus* Linné), where they are formed by concretions. The crab is found in rivers throughout the North Temperate Zone.

DESCRIPTION.—The circular, plano-convex stones vary in size from 3 to 10 mm. ($\frac{1}{8}$ to $\frac{2}{5}$ in.) in diameter, and are white and hard, changing in hot water to a rose-red; tasteless and inodorous. When treated with hydrochloric acid, they effervesce until nothing is left but a small plano-convex, cartilaginous mass.

SUBSTITUTIONS.—Artificial stones are sometimes manufactured, but can be distinguished from the true crabs' stones by treating with HCl, when, if they are artificial, they leave little or no residue.

CONSTITUENTS.—Calcium carbonate 63 per cent., calcium phosphate 17 per cent., animal matter 12 to 15 per cent., and small portions of phosphate of magnesium and sodium salts.

USES.—Antacid.

614. ICHTHYOCOLLA.—ISINGLASS. The swimming-bladder or sound of the Sturgeon, a fish found in the Black and Caspian Seas and their tributary streams. The swimming-bladders of other fish are also employed for this purpose, but the isinglass from the Russian species, *Acipenser huso*, *A. guldenstadtii*, *A. ruthenus*, and *A. stellatus*, is considered the finest and purest. The inner layer of the swimming-bladder is separated from the outer, and after being washed is thoroughly dried. The sheets of commercial isinglass are prepared in various forms—leaf isinglass (single sheets), book isinglass (several sheets folded together), and staple isinglass. In appearance it resembles horn, is of a yellowish-white color, semi-transparent and iridescent. The substance is tough, tearing with difficulty even in the direction of the fibers, but dissolves completely in hot water, forming a transparent jelly on cooling in a solution of 24 parts of the same. *Constituents:* Gelatin (98 per cent., in the best Russian variety) and from 2 to 30 per cent. of insoluble membrane, the ash amounting to only about 0.5 per cent. Nutritive, easily digested. Emollient and protective externally.

615. **AMBRA GRISEA**.—AMBERGRIS.

SOURCE.—*Physe'termacroceph'alus*, a species of whale inhabiting the Indian Ocean and the southern part of the Pacific Ocean, excretes a substance from the intestines which is found floating on the surface of the water; this is known as ambergris.

DESCRIPTION.—Waxy, grayish-brown, with streaks and dots; odor peculiar, taste slight; soluble in hot alcohol, ether, fats, and volatile oils.

CONSTITUENTS.—Ambrein (brilliant white needles precipitated from alcoholic solution) 85 per cent., a balsamic extractive, and a very small proportion of ash. On account of its high price adulterations of and substitutions for ambergris are common, but the genuine article is easily distinguished by means of its complete solubility in hot alcohol, and evaporation without evolving acrid vapor.

Preparation of Ambrien.—Obtained by crystallizing from hot alcoholic solution of ambergris; it forms white, shining, tasteless, and inodorous needles which fuse near 350°C.

USES.—As a perfume it is highly prized. It possesses very uncertain medical properties and is very rarely administered as a remedial agent.

616. **OLEUM MORRHUÆ**.—COD-LIVER OIL. A fixed oil obtained from the fresh livers of *Ga'dus mor'rhua* Linné, or of other species of *Gadus* (class, Pisces; order, teleostei; family, Gadidæ). For tests see U.S.P. *Description*: A pale yellow thin oily liquid. Peculiar, rancid odor; bland, fishy taste. Specific gravity at 15°C. (59°F.) 0.922 to 0.927. Should be kept in dry, well-stoppered bottles. *Constituents*: Chiefly olein, palmitin, and stearin. The oil also contains dissolved in it minute quantities of the halogen elements, iodine, bromine, and chlorine, with phosphorus and sulphur. A peculiar substance named gaduin is also claimed to have been found. A crystalline substance, morrhuol, a compound body containing phosphorus, iodine, and bromine, is also said to be among the “active principles” of cod-liver oil. *Action and Uses*: A nutritive agent, generally of easy assimilation. It has long been used as a stimulant and alterative in rheumatic and strumous diseases. In pulmonary consumption it has for a long time enjoyed a great reputation. Dose: a tablespoonful (1/2 fl. oz.) three or four times a day.

617. **CETACEUM**.—SPERMACETI

SPERMACETI

A peculiar concrete, fatty substance obtained from the head of the sperm whale, **Physe'ter macroceph'alus** Linné (class, Mammalia; order, Cetacea).

DESCRIPTION.—A pearly-white, somewhat translucent, waxy mass, but of a somewhat granular texture, fusing at about 45°C, (113°F.). Odor

faint and bland, taste mild. Insoluble in water, soluble in 50 parts of boiling alcohol; also in ether, chloroform, and carbon-disulphide. It becomes yellow and rancid on exposure to air.

CONSTITUENTS.—Mainly cetin (cetyl palmitate, $C_{10}H_{33}(C_{16}H_{31}O_2)$), with small amounts of other fatty compounds.

USES.—Mainly as a base for cerates and ointments.

618. MEL.—HONEY

HONEY

A saccharine secretion deposited in the honeycomb by the bee, *A'pis mellifera* Linné (Pam. Apidæ).

USES.—Mainly as a vehicle for remedial agents.

The honeycomb, from which the honey is drained, is the source of the two pharmaceutical products:

618a. **CERA FLAVA.**—YELLOW WAX. BEESWAX. Obtained by slicing the honeycomb, draining it thoroughly, melting the residue after impurities have subsided, and allowing the melted liquid to cool. A yellowish or brownish-yellow solid, having an odor suggesting honey, and a rather agreeable taste. It melts at about $63^{\circ}C$, ($145.4^{\circ}F$).

618b. **CERA ALBA.**—WHITE WAX. BLEACHED WAX. The yellow wax is bleached by exposing an extended surface to the light and atmospheric influence. This is done in various ways. Bleaching may be accomplished by chemical means, such as by the use of chlorine gas, etc. A white, shining, inodorous, insipid solid, fusing at about $65^{\circ}C$. ($149^{\circ}F$). For Tests see U.S.P.

USES.—As an ingredient in cerates, ointments, plasters, etc.

619. **OVUM.**—Gallinaceum, N. F. Fresh hen's egg.

SOURCE.—The egg of the common domesticated hen (probably from India originally) is well known as an article of food throughout the country.

DESCRIPTION.—A thin, calcareous shell incloses an albuminous substance known as white of egg, which in turn incloses the vitellus or yolk.

CONSTITUENTS.—The three parts of an egg are entirely separate and distinctive in composition.

(a) *Testa Ovi*, Egg-shell.—Almost pure calcium carbonate (90 to 97 per cent.), the remainder being made up of magnesium and calcium phosphates, together with about equal quantities of organic matter.

(b) *Albumen Ovi*, White of Egg.—Made up mostly of a solution of albumen and water (albumen 15 per cent., water about 85 per cent.), with slight traces of fat and sugar, as well as KCl and NaCl, which are the chief components of the ash. *Ovi Albumen Recens*, N.F. Fresh egg albumen.

(c) *Vitellus*, U.S.P. 1890.—Egg Yolk, or Yelk. Compounded of water (about 52 per cent.), fat (30 per cent.), vitellin (16 per cent.), and inorganic salts (1.5 per cent.), such as chloride of sodium, sulphates and phosphates of magnesium, etc., together with coloring matter and traces of lactic acid and sugar. *Ovi Vitellum Recens*, N.F. Fresh egg yolk,

ACTION AND USES.—Shell sometimes used as antacid. The white, besides its nutriment, is valuable as an antidote when corrosive sublimate, sulphate of copper, or other metallic poisons have been taken into the stomach. The yolk is even more nutritious than the white, having a greater amount of digestible solids. It is used in preparing emulsions of oils and applied as a dressing for burns.

620. MOSCHUS.—MUSK

MUSK

The dried secretion from the preputial follicles of **Mos'chus moschiferus** Linné (Fam. Moschidæ).

SOURCE.—Musk is obtained from a small bag or sac attached to the prepuce of the male Musk deer, *Mos'chus moschiferus*, a species of hornless deer found in Central Asia from Thibet to China. The musk-sac is somewhat oval and about 50 mm. (2 in.) in diameter, containing in the mucous lining a number of delicate glands which secrete the musk.

DESCRIPTION.—A granular substance of a brownish or reddish-black color, having a very strong, peculiar, and penetrating odor. The granules are irregular in size, and have a smooth, oil appearance and a bitter taste. The color of the fresh article is considerably lighter than that which has been dried and prepared for the market, although the commercial product is estimated to contain about 10 per cent. of moisture. The dried musk is contained in the original sac, one-half of

which is smooth and the other covered with hairs arranged concentrically around two orifices. The quantity of musk in each sac amounts to about 160 grains. Not more than one-tenth of this musk is dissolved by strong alcohol, with which it forms a light yellowish-brown tincture, while as much as one-half of it can be dissolved in water, forming with it a dark brown solution having a very strong odor. Should not contain more than 15 per cent. of moisture nor 8 per cent. of ash.

VARIETIES.—Besides the Chinese or Thibetan musk, which is of the most excellent quality, there is also a Siberian musk, the quality of which is inferior. There is also an artificial musk which comes more properly under the head of adulterations. The Siberian or Russian variety is generally quite easily distinguished, the containing sac being more elongated than that of the Chinese variety, and the hair thinner and lighter.



FIG. 261.—Tonquin Musk Pod. ($\frac{1}{2}$ natural size.) (Photograph.)

ADULTERATIONS.—An artificial musk is manufactured by the Chinese and is made up chiefly of a mixture of blood and ammonia to which a small quantity of real musk is added, the whole being inclosed in a piece of the skin of the musk ox. Resin, lead, and other substances are also resorted to in preparing adulterations.

CONSTITUENTS.—Free ammonia, fat, albumen, an acid, wax, and gelatinous principles can be easily separated, but it has been impossible to separate the odoriferous principle. The gray ash left after burning the pure musk constitutes about 8 per cent. of the drug. The odor of musk is destroyed or greatly modified by the action of several substances, such as camphor, ergot, hydrocyanic acid, etc.

ACTION AND USES.—Antispasmodic and diffusible stimulant, together with more or less aphrodisiac action. Its powerful and lasting odor makes it valuable as a perfume, either alone or in combination with other substances. Dose: 1 to 10 gr. (0.065 to 0.6 Gm.), administered in the form of powder, pills, or enema, the powder being generally taken with milk.

OFFICIAL PREPARATION.

Tinctura Moschi (5 per cent.) Dose: 2 fl. dr. (8 mils).

621. FEL BOVIS.—OX GALL

OX GALL

The fresh bile of **Bos taurus** Linné (Fam. Bovidæ).

DESCRIPTION.—The fresh bile of the ox is a brownish or dark green, viscid liquid, with a characteristic, unpleasant odor, and a nauseous, bitter taste. It is neutral or faintly alkaline. Pettenkofer's test for this liquid is as follows: Two drops in 10 mils of water, when treated first with a drop of freshly prepared solution of one part of sugar and four parts of water, and afterward with sulphuric acid cautiously added until the precipitate first formed is redissolved, gradually acquires a brownish-red color, changing successively to carmine, purple, and violet.

PREPARATION.—**Fel Bovis Purificatum.** The method by which this medicinal preparation of the crude ox-gall is made, according to the U. S. Pharmacopœia, is as follows: Fresh ox-gall 300 mils; alcohol 100 mils. Evaporate ox-gall in tared porcelain capsule on waterbath to 100 Gm.; add to it the alcohol. When precipitation has occurred and the solution cleared, the clear liquid is decanted, the remainder filtered, and the filtrate evaporated to a pilular consistence.

Purified ox-gall is a yellowish-green, soft solid, having a peculiar odor and a sweetish, bitter taste.

Extractum Fellis Bovis U.S.P. IX.

ACTION AND USES.—The purified ox-gall only is used in medicine. It is tonic and laxative, at one time much used to increase the secretion of bile. Dose: 3 to 10 gr. (0.2 to 0.6 Gm.).

622. SANGUIS.—BLOOD.

SOURCE.—The ox (*Bos taurus* Linné) furnishes this liquid from the arterial circulation of the vascular system.

DESCRIPTION.—A red, opaque fluid, slightly heavier than water (sp. gr. 1.05), containing corpuscles in suspension, and coagulating on exposure.

CONSTITUENTS.—Chiefly water (78 per cent.), with albumen 7 per cent., salts 9 per cent., fibrin 4 per cent., and corpuscles and other constituents 13 per cent. Hæmoglobin is a peculiar coloring matter made up of globulin and hæmatin, which gives blood its red appearance.

MEDICAL PROPERTIES.—Desiccated blood has enjoyed some reputation as a nutritive or restorative, the dose being about 15 gr. (1 Gm.), but it has not been very generally adopted as an agent among therapeutists for treatment of debilitated conditions.

623. LAC. VACCINUM, Cow's milk, N.F.

SOURCE.—The mammary glands of the cow (*Bos taurus*), the well-known domestic animal.

DESCRIPTION.—A white, opaque liquid or emulsion, made up of butter and casein, and having a pleasant taste and slight odor; specific gravity about 1.030. When allowed to stand for a few hours, the oily globules rise to the surface on account of their lower specific gravity. Under the microscope these globules are seen to be separate, and each surrounded by an albuminous envelope, but when a caustic alkali is added, this envelope is destroyed, so that the globules are released and accumulate as pure butter. When exposed for a considerable time in a warm place, milk changes from sweet to sour on account of the development of an acid by chemical action between the constituents.

CONSTITUENTS.—A large percentage (about 87 per cent.) of milk is represented by water, 4 per cent. by butter, 5 per cent. by sugar and soluble salts, and only about 3.6 per cent. by casein and insoluble salts.

Butter is composed of olein (about 30 per cent.), palmitin, and stearin (68 per cent.), and about 2 per cent. of glycerides of butyric and other acids.

Casein, which is soluble in a solution of the alkalies, is a modification of albumen, and is precipitated from solution by the action of rennet or acetic acid.

Lactic acid (*Acidum Lacticum*, U.S.), which is developed by the action of heat, is said not to be a normal constituent of milk, but is always present in sour milk. *Syrupus Calcii Lactophosphatis* employs this acid. Dose: 8 Mils (2 fl. dr.).

PREPARATION: **LAC FERMENTATUM**, N.F.

623a. SACCHARUM LACTIS.—SUGAR OF MILK. LACTOSE. Forms about 5 per cent. of milk and is obtained from the whey by evaporation and recrystallization. A hard, somewhat gritty, slightly sweet powder, almost inodorous. Soluble in about six parts of water. For Tests see U.S.P. It has been recommended as a dietetic in wasting diseases, but in pharmacy is merely a diluent for triturations of various kinds.

ACTION AND USES.—Milk is nutritious, and its value as an article of diet is well known. In addition to this use, milk may be satisfactorily employed as a vehicle for the administration of certain remedies having an unpleasant taste.

624. OS.-BONE.

SOURCE.—The skeleton of vertebrate animals.

CONSTITUENTS.—Calcium phosphate 40 to 67 per cent., which includes a small percentage of calcium carbonate; phosphates of magnesium and other salts are also present. With the salts are also found organic substances yielding gelatine on boiling with water. The basic substance of the bony structure contains two chief constituents, namely, an organic substance, ossein, and the so-called bone earth inclosed in or combined with it. Ossein is generally considered identical with collagen of the connective tissue.

Preparation of Ossein: that portion of bone that is left undissolved after treatment with HCl.

USES.—For preparing bone-black, animal charcoal, and phosphates.

625. GELATINUM (U.S.).—GELATIN.

SOURCE.—Bone, cartilage, skin, tendons, and ligaments; a boiling-hot solution of these, resulting in a jelly when cooled, is dried in the air.

DESCRIPTION.—Thin, transparent sheets or porous, opaque layers or shreds, amorphous, swelling in water without dissolving, dissolving in warm water, forming a sticky liquid which solidifies on cooling. The solution is lœvogyrate. Solutions of gelatin on boiling are not precipitated either by mineral acids, acetic acid, alum, lead acetate, or mineral salts in general, but precipitated by potassium ferrocyanide, tannic acid, mercuric chloride in the presence of HCl and NaCl, and by alcohol, especially when neutral salts are present. Its solution containing KCr₂O₇ yields an insoluble compound on exposure to light.

Gelatinoids.—To this group belong a number of substances occurring in bones, skins, horns, etc., having generally the property of forming a jelly with water. The organic matter in bones, usually called ossein, contains, besides albuminous substances, the two gelatinoids, collagen and gelatin, a pure mixture of which forms common glue. Chondrin resembles gelatin; it is obtained from cartilages of the ribs and non-ossifying cartilages; its aqueous solution is precipitated by alum, lead acetate, ferric salts, acetic acid, and a small quantity of mineral acid, but not precipitated by tannin or mercuric chloride. Properties: Emollient, nutritive, and protective.

626. SEVUM.—SUET

MUTTON SUET

The internal fat of the abdomen of **O'vis a'ries** (Fam. Bovidæ), purified by melting and straining. Suet should be kept in well-closed vessels impervious to fat. It should not be used after it has become rancid.

DESCRIPTION.—White, unctuous, smooth solid, melting at about 48°C. (113°F.). *Sevum Præparatum* (U.S.) is identical with suet as above described.

CONSTITUENTS.—Stearin, palmitin, and olein, with a preponderance of the first mentioned.

USES.—Lenitive, as an external application and as a base for unctuous preparations.

627. OLEUM BUBULUM.—NEAT'S-FOOT OIL. From the fatty tissue of the feet of the ox, previously deprived of hoofs, obtained by boiling in water and skimming off the fat, which is subsequently strained and pressed. At ordinary temperatures this is a semifluid, oleaginous fat, of a peculiar odor.

CONSTITUENTS.—Mainly olein, with solid fats. Used externally.

628. ADEPS.—LARD

LARD

The prepared internal fat of the abdomen of **Sus scrofa** Linné (class, Mammalia; order, Pachydermata), purified by washing with water, melting, and straining. Lard should be kept in well-closed vessels impervious to fat, and in a cool place.

DESCRIPTION.—A white unctuous solid with faint odor and bland taste. Insoluble in water. Soluble in chloroform, carbon bisulphide and benzine. Specific gravity at 15°C. (59°F.) about 0.932.

CONSTITUENTS.—Olein, stearin, and palmitin; of the first mentioned it consists of about 50 to 60 per cent.

USES.—Emollient, and a's a base for ointments and cerates.

628a. OLEUM ADIPIS.—LARD OIL. U.S. VIII. A pale yellowish or colorless fixed oil having a slight odor and taste. It is produced by

exposing lard, at a low temperature, to strong pressure.

CONSTITUENTS.—Olein, with palmitin and stearin. Used externally.

629. PEPSINUM.—PEPSIN

PEPSIN

A mixture containing a proteolytic ferment or enzyme obtained from the glandular layer of fresh stomachs of healthy pigs, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumen. See details of test U.S.P. IX.

SOURCE.—Pepsin is prepared from the stomach of the ox (*Bos taurus*), the sheep (*Ovis aries*), or the hog (*Sus scrofa*), the mucous membrane being the part used. Several methods have been employed for its extraction. The ordinary methods of manufacture may be briefly stated as follows:

(1) The extraneous matter is first removed from the inner surface of the stomach by washing, and the mucous membrane scraped off with a blunt instrument; the pulp thus obtained is placed on glass or porcelain and dried and finally reduced to a powder. This forms a rather poor quality, owing to the presence of mucus and inert matter.

(2) The finely chopped mucous coat is macerated in dilute hydrochloric acid (about 2 per cent.), and to the filtered solution common salt is added; the floating precipitate which results is carefully washed, then dried, and the dried residue mixed with sugar of milk until the strength of the article is such that 1 grain will dissolve 3000 grains of coagulated albumen, the strength directed by the United States Pharmacopoeia.

(3) A scale pepsin is made by digesting the mucous lining at the temperature of about 100°C. with about 0.2 per cent. of HCl (or water acidulated with other acids to the same degree of acidity) until the membrane is completely or nearly all dissolved. The solution is neutralized by a suitable alkali and the filtered product, after reduction by evaporation at a low temperature (sometimes in vacuo) to a syrupy consistence, is spread on plates of glass and dried in a current of warm air, care being taken not to allow the temperature to exceed 40°C. (104°F.). The dried, transparent film is then scraped from the plates and

broken into more or less fine lamellæ.

DESCRIPTION.—A yellowish-white amorphous powder or thin, pale yellowish, somewhat transparent scales, with faint odor and slight saline or acidulous taste, but no indication of decomposition; should not be hygroscopic. It invariably contains some rennin; its solutions, therefore, will coagulate milk. Incompatible with alkalies, alcohol, and heat renders it inert.

ACTION AND USES.—Pepsin has a digestive action upon the food taken into the stomach, and is employed as an artificial agent to assist digestion when there is functional derangement of the stomach. Dose: 10 gr. (0.6 Gm.).

630. PANCREATINUM.—PANCREATIN

A mixture of enzymes (Amylopsin, Trypsin, Steapsin) existing in the pancreas of warm-blooded animals capable of converting at least twenty-five times its weight of starch into sugars.

SOURCE.—Prepared from the pancreas of the hog or ox, by mixing finely chopped pancreas with half its weight of cold water and straining the liquid by pressure through cheese-cloth or flannel. To the filtrate, alcohol is added (about one volume), and the resulting precipitate collected, purified, and dried.

DESCRIPTION.—Yellowish-white amorphous powder with but slight odor and meat-like taste; slowly soluble in water, insoluble in alcohol. See U.S.P.

TEST.—Pancreatin acts best in alkaline medium (is injured by acids). If there be added to 4 fl. oz. of tepid water contained in a suitable flask or bottle, first 5 gr. of pancreatin, 20 gr. of bicarbonate of sodium, and afterward one pint of fresh cow's milk previously heated to 38°C. (100.4°F.), and if this mixture be maintained at the same temperature for thirty minutes, the milk should be so completely peptonized that, upon adding to a small portion of it transferred to a test-tube a slight excess of nitric acid, coagulation should not occur. This test we have found quite satisfactory as a convenient one. An alternate method of assay is based on the property of an aqueous solution of the principle to digest (or liquefy) starch paste. The U.S.P. IX furnishes the two

tests—one indicating its power in peptonizing milk, the other its power in digesting starch. A limit of fat is adopted as one of the standards: Two grammes of pancreatin should not yield to ether more than 0.6 Gm. of fat.

ACTION AND USES.—Used as a digestive agent, especially for “peptonizing” milk. Dose: 10 gr. (0.6 Gm.).

RENNINUM.—Rennin, N.F. Partially purified, milk-curdling enzyme from the calf's stomach, capable of coagulating not less than 12,500 times its weight of fresh cow's milk. For assay see N.F.

631. ADEPS LANÆ HYDROSUS.—LANOLIN

HYDROUS WOOL-FAT

The purified fat of the wool of sheep, **Ovis aries** Linné (Fam. Bovidae), mixed with not more than 30 per cent. of water. For Tests see U.S.P.

DESCRIPTION.—A yellowish-white unctuous mass. Faint, peculiar odor. Insoluble in water, but miscible with twice its weight. Melts at about 40°C. (104°F.). **Adeps Lanæ**, U. S., is the above freed from water.

CONSTITUENTS.—Cholesterin, palmitin, olein, the first mentioned being largely represented.

USES.—As an inunction and vehicle for substances the medicinal action of which can be obtained by local application. It is employed in several official ointments.

631a. **HYDROCARBON FATS AND OILS.**—(**Petrolatum**, etc.).

DESCRIPTION, SOURCE, ETC.—As a most valuable addition to the list of ointment bases and oleaginous liquids there has been officially recognized: **Petrolatum album** (White **Petrolatum**); **Petrolatum Liquidum** (oil); **Petrolatum Molle** (soft **Petrolatum**); and **Petrolatum Spissum** (Hard **Petrolatum**). These are mixtures of the harder and softer members of the paraffin series of hydrocarbons, having different melting and congealing points, etc. Hard paraffin consists chiefly of hydrocarbons ranging from $C_{20}H_{42}$ to $C_{30}H_{62}$; soft paraffin consists chiefly of $C_{15}H_{32}$ to $C_{20}H_{42}$; liquid consists chiefly of heptane, C_7H_{16} , and octane, C_8H_{18} .

USE.—As a vehicle for medicinal substances applied locally. As such it is much less permeable through the skin than other fats.

632. **HYDRACEUM**—A plaster mass of a blackish-brown color, occasionally used medicinally as a stimulant and antispasmodic. When warmed, it emits the odor of castor. It is an animal excretion found in Africa.

633. **CASTOREUM**.—CASTOR.

SOURCE.—The preputial follicles of both sexes of *Cas'tor fiber* Linné. These follicles are not perceptible until the outer skin is removed, when they are seen to lie between the cloaca and pubic arch of the animal. This species of animals is commonly known as the beaver, and is found more or less throughout the Temperate and North Temperate Zones.

DESCRIPTION.—The dry, resinous, brownish contents of the fig-shaped sacs or follicles have a strong and peculiar odor, an acrid, nauseous taste, and are soluble in alcohol and ether. An aqueous decoction of castor is of a light yellowish-brown color which becomes turbid on cooling, and changes to a dark color when ferric chloride is added.

VARIETIES.—American or Canadian, and Russian or Siberian Castor. The Russian variety differs from the American in the size of the inclosing follicles; in the former the size varies from 2½ oz. to 8 oz. (75 to 240 Gm.) in weight, and in the latter from 1 to 4 oz. (30 to 120 Gm.). There is also a difference in the composition of the product from the different varieties, the American probably containing a larger percentage of resin.

ADULTERATIONS.—Earthy matters, as well as resin and blood, are sometimes used for this purpose, but not frequently. The product from diseased animals is also met with; this often contains as much as 50 per cent. of inert material and is of a brownish-gray color.

CONSTITUENTS.—A bitter resinous substance 14 to 58 per cent., 1 to 2 per cent. of volatile oil containing carbolic acid, a small quantity of castorin (a colorless, odorless and tasteless, crystalline, non-saponifiable fat, soluble in ether and boiling alcohol), together with salicin, cholesterin, and about 3.5 per cent. ash. The resin is dark brown, slightly acid, soluble in alcohol but not in ether. The volatile oil contains the odoriferous principle and is generally colorless, having an acrid, bitter taste.

ACTION AND USES.—Castor enjoys some reputation as a stimulant, antispasmodic, and emmenagogue, and is employed in cases of hysteria, chorea, and epilepsy, associated with sexual disorders. On account of its disagreeable taste it is best administered in the form of a pill.

DOSE.—5 to 10 gr. (0.3 to 0.6 Gm.) in the form of a pill; 1 to 4 fl. dr. (4 to 15 mils) of the tincture.

634. **CIVETTA**.—CIVET.

SOURCE.—The glandular pouch between the genitals, and anus of the male and

female animals belonging to the two species **Viver'ra zibe'tha** Schreber, and **V. civetta** Schreber, the first of which is found in Southern Asia and the other in Africa.

DESCRIPTION.—The secretion, when fresh, is yellowish, becoming brown with age, soluble in hot absolute alcohol, partly soluble in ether, and insoluble in water; odor musk-like; taste acrid and nauseous.

ADULTERATIONS.—Butter or lard is not infrequently used as an adulterant of the commercial article.

CONSTITUENTS.—Resinous and coloring matters are the chief components, together with volatile oil and fat.

ACTION AND USES.—The manufacture of perfumery is the principal use of civet, but it is also sometimes administered as a stimulant and antispasmodic in doses of 5 to 15 gr. (0.3 to 1 Gm.). As a perfume it is superior to musk, as the odors of various kinds of flowers can be successfully imitated with it.

PART III

INSECTS INJURIOUS TO DRUGS

The introduction of this brief appended section on insects injurious to drugs into a text-book of materia medica, while an innovation, seems desirable to the author of the text-book on the ground of the importance of the subject. It is a fact that stored drugs are attacked by a considerable number of insects, and that a varying amount of loss from this cause is sustained by practically every druggist, wholesale and retail, in the land. If, by the acquiring of a little knowledge of the appearance and habits of these pests, and by the exertion required in a little preventive or remedial care, this loss can be lessened, the introduction of this section, which attempts to furnish the information necessary for the little knowledge and the little care, will be justified.

The necessary entomological knowledge of the pharmacist who would make some show of resistance to the insect enemies of his drugs may be limited to an acquaintanceship with these insect enemies, and a knowledge of the means of fighting them. As a basis for this acquaintanceship, however, it is necessary to glance hastily at the great class of insects in general. More numerous in species and individuals than all other animals combined, the insects are conveniently divided into several great groups or orders. All the butterflies and moths, whose wings are covered with fine scales, and who obtain their food by sucking the nectar from flowers, constitute one order; the beetles, with their horny fore-wings and their powerful jaws for biting, compose another order; the two-winged flies, of which the familiar house-fly is an example, constitute a third order; the ants, bees, and wasps, and some other highly intelligent insects are grouped together in a fourth order; the true bugs, as the chinchbug and squashbug, with their sucking beaks, are comprised in a fifth order; the grasshoppers, crickets, cockroaches, and katydids compose a sixth order; and, finally, the gauzy-winged dragon-flies, the short-lived May-flies, and the wonderful white ants constitute a seventh order. But a simpler division of insects into two great groups is that often made, for convenience' sake, especially by the economic entomologist; namely, a division made according to mouth parts, all insects in the adult stage having mouth parts fitted for biting or mouth parts fitted for sucking. It is evident at once that the pharmacist will be especially interested in the biting insects, the ones which can attack roots and leaves, and all dry preparations. There will be little opportunity for the sucking insects to

injure the pharmacist's stores. The insects may be divided according to this distinction as follows: The orders containing the beetles, the cockroaches, the dragon-flies, etc., compose the group of biting insects; the orders containing the true bugs, the butterflies and moths, and the flies, compose the group of sucking insects; while the order of the ants, bees, and wasps, and the order of mites (which are not true six-footed insects, but are closely related to them) may be said to compose a third group, in which the mouth parts are arranged for both biting and sucking, or piercing and sucking.

But we can not thus dismiss certain of the sucking insects from our pharmaco-entomological consideration; for with wonderful adaptiveness, nature has arranged that the young of certain sucking insects shall be provided with jaws for biting. The common worm-like caterpillars, which are the larval forms, or young, of butterflies and moths, are familiar to all; most children know that the strong-jawed, foliage-eating "worm," now feeding so voraciously on the green leaves of plant or tree, will in time change into some beautiful four-winged butterfly or moth, incapable of injuring a green leaf, and taking its food only in dainty sips, by means of its sucking tubular mouth parts, from some bright flower. And most housewives know that the dreaded clothes-moth—little, brown, delicate flutterer—is, in its moth or winged stage, harmless to furs or woollens, but that the dreaded little white grub, with its sharp jaws and voracious appetite, which really does the damage, is only the young of the innocent-looking moth, and that the moth, after all, is not so innocent.

So, then, it behooves the pharmacist to keep an eye on not only those insects which all their lives are truly biting insects, but also on those insects, as the moths, which, while harmless as adults, yet in their young stages, with strong biting mouth parts, appear as ravaging caterpillars.

In setting out to fight an insect pest, the economic entomologist asks first, "What is it? Is it a beetle, or a fly, or a moth?" This question answered, he already knows much about it; whether, for example, it is a biting or a sucking insect; he knows in a general way what sort of damage it does and how it does it, and he knows, too, in a general way, what remedies are most likely to be effective in fighting it. But it is always better and usually necessary to know the exact life history of the particular pest he must fight; he must discover where and when its eggs are laid, how long it remains in the larval or grub stage, what are its

times and places of feeding, and what are its favorite articles of diet. From this life history he can decide on the character of the remedy to be applied, and when and where the remedy can best be used. Therefore the pharmacist may wisely turn to his jars and boxes, his store-rooms and laboratories, and try to discover what manner and number of insects he is to array himself against.

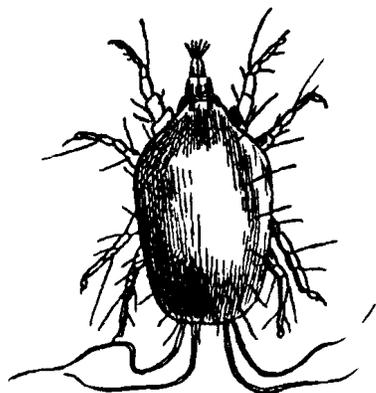


FIG. 263.—Sugar Mite.

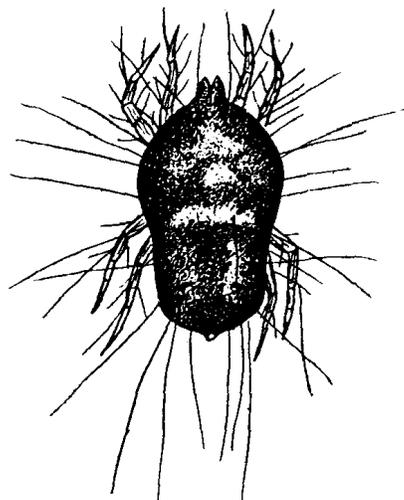


FIG. 264.—A Cantharid-eating Mite (*Glyciphagus spinipes*).—(Fum. and Rob.)

Referring to some of the more common and destructive pests attacking stored drugs, the mites (order, Acarina) may first be noted. The mites, commonly enough represented and known in the case of the familiar flour or cheese mite, are minute, rounded-oval, eight-legged insects, with the mouth parts arranged to form a piercing beak. The body is not divided into head, thorax, and abdomen, as is the case with other insects, but all these parts are coalesced or merged into a single mass. While many mites suck the blood from animals or the juices from plants, many others feed on "dry food." Among these are the flour and cheese mites, and sugar mites with soft, smooth, whitish body (see Fig. 263), and belonging to the genera *Tyroglyphus*, *Rhizoglyphus*, and *Glyciphagus*. Many species of these genera of mites, besides being found in sugars, meals, and other vegetable products in the store-room, attack dried animal remains, cantharides suffering severely from the ravages of several species of *Glyciphagus* (see Fig. 264). The presence of the mites in the cantharides jars is indicated by much powder and broken bits of the beetles gathering on the bottom of the jars. In this mass of powder and fragments can be seen with the naked eye many small, moving, whitish specks, the mites. These specks, examined under the microscope, will reveal the characteristic shape and appearance of the mites.

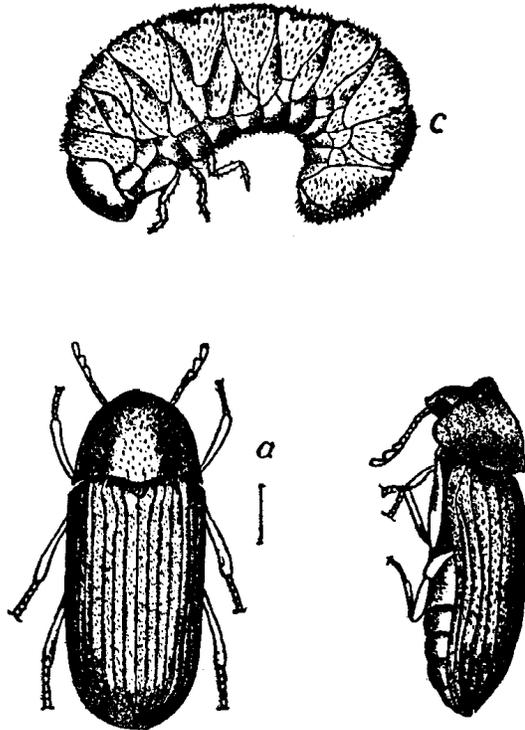


FIG. 265.—*Sitodrepa panicea* Linné. The common drug-eating insect. *a*, Dorsal view of adult beetle. *b*, Side view of adult beetle. *c*, Larva.—(Smith.)

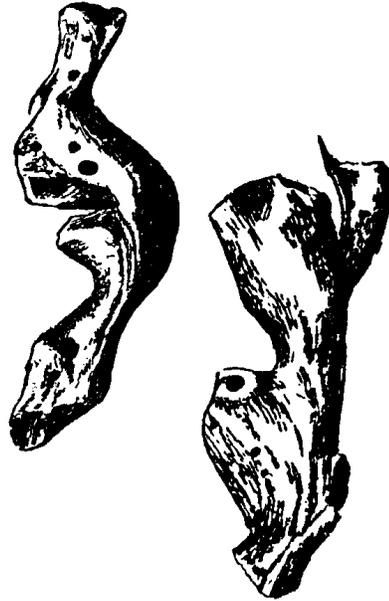


FIG. 266.—Ginger root attacked by *Sitodrepa panicea* Linné.—(Original.)

The most abundant pest in the pharmacial store-rooms appears to be a small, brown beetle, *Sitodrepa panicea*, belonging to the family Ptinidæ, a family whose members, in both larval and adult stages, feed on dead, dry vegetable and animal matter. This family comprises a number of small beetles, rarely exceeding a quarter of an inch in length, and usually brownish in color. A conspicuous and distinctive character is the hoodlike prothorax, the head being so bent or drawn back under it as to be almost concealed (see *b*, Fig. 265). *Sitodrepa panicea*, the especially abundant species of this family, is from 2 to 3 mm. long, with a brown, subcylindrical body. It is almost entirely covered with many fine, short, yellowish hairs, which, on the upper surface of the body, are arranged in parallel longitudinal lines; the upper surface of the body (strictly, only the wing-covers) is finely striated (see *a*, Fig. 265). The head is almost concealed by the thorax, the front margin of the thorax reaching to the eyes. The head is also bent strongly downward. The young, or larva, of this beetle is a small white grub with three pairs of legs, and strong, dark brown jaws. The grub when lying at rest usually assumes a semicircular position (see *c*, Fig. 265). They feed voraciously on the drug, grow rapidly, and, after two or three weeks, pupate, and soon change into the perfect beetle. The beetle also feeds upon the drug by means of

strong biting jaws, and the females soon lay eggs, from which another generation of larvæ, or grubs, hatch. The whole life of the insect is thus passed in the can or jar containing the drug. The presence of the pest is shown by the collecting of a considerable amount of powder on the bottom of the can or jar (if the drug is a root, stem, or leaf), and by the presence in the drug of many small holes eaten by the insects (see Fig. 266). Often the little brown beetles may be seen crawling about in the jar. If the drug is a powder, this is the easiest means of detecting their presence. *Sitodrepa panicea* is almost omnivorous in the pharmacal store-room. In the store-rooms of the department of pharmacy, University of Kansas, *Sitodrepa panicea* has been found feeding on such drugs as the following: Columbo, aconite, mustard, althæa, belladonna, poke root, ginseng, angelica, etc.

Still other species of the family Ptinidæ feed on drugs: *Lasioderma serricorne*, a small brown beetle very like *Sitodrepa panicea*, but more

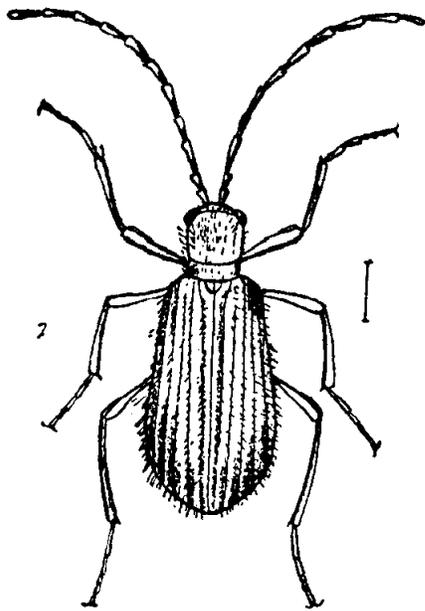


FIG. 267.—*Ptinus brunneus*
Duft.—(Riley.)

robust, and with the wing-covers smooth and not striated, although covered with fine hairs as in *Sitodrepa*, is not uncommon. The larva or grub is like the grub of *Sitodrepa*, and the habits are about the same. I have found *Lasioderma serricorne* attacking powdered ergot, and Prof. J. B. Smith, entomologist of Rutgers College, has found it attacking belladonna root. *Plinus brunneus*, another species of the family, which I have found attacking musk root, powdered senna, and powdered jaborandi leaves, differs considerably in appearance from the other two members of the family just referred to. It is slightly larger, being about 4 mm. long, and it has long, slender antennæ or feelers which project forward from the head (see Fig. 267). The antennæ of *Sitodrepa* and *Lasioderma* are usually bent back upon

the body. The body of *Ptinus* is not subcylindrical, but tapers toward the head, the head itself being much narrower than the body. *Bostrichus dactilliperda*, another member of the family Ptinidæ, attacks sweet almonds.

Another family of beetles which includes several drug-attacking species

is the Dermestidæ. To this family belongs the common buffalo bug (*Anthrenus scrophulariaceæ*) of the house. The Dermestidæ comprise a number of beetles, mostly small, which feed on skins, furs, various dried animal substances, and, to some extent, on dried vegetable substances. *Anthrenus varius*, which I have found in jars of powdered cramp bark and fenugreek, is small, rounded-oval, with transverse black, white, and reddish-brown waved stripes (see a, Fig. 268). The grub differs from the larvæ of the Ptinidæ in bearing many long, bristly hairs (See c, Fig. 268). The adult beetle lives chiefly upon the pollen of certain plants, but the larva or grub lives indoors, and, feeding on rugs, woolen goods, collections of natural history, furs, hairs, and drugs, is a serious pest.

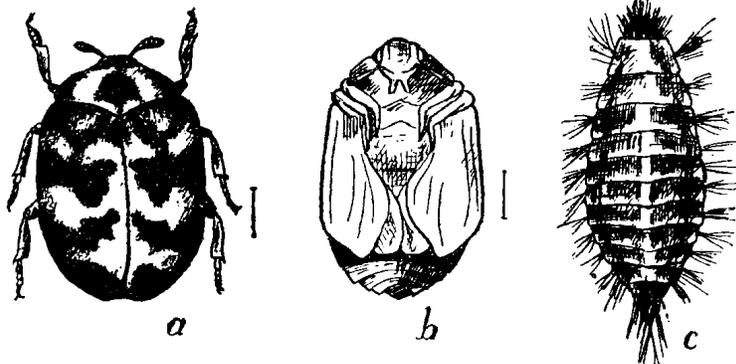


FIG. 268.—*Anthrenus varius* Fab. a. Adult beetle. b. Pupa. c. Larva.—(Original.)



FIG. 269.—*Silvanus surinamensis* Linné. —(Original.)

Another family of small beetles, the Cucujidæ, is represented among drug pests by several species of the genus *Silvanus*. The beetles belonging to this genus are about one-tenth of an inch long, light brown, flattened, and with antennæ clubbed at the tip (see Fig. 269). I have found *Silvanus surinamensis* attacking almond meal, *Silvanus advena* feeding on aconite root, and another species of *Silvanus* attacking angelica seed, quince seed, bitter-sweet, senega root, hyoscyamus, pellitory root, etc.

A large black beetle, *Tenebrio obscurus* (family Tenebrionidæ), is sometimes found attacking drugs. I have taken it in jars of parsley root. It is three-quarters of an inch long, dull black all over, with bead-like antennal joints, and with narrow, parallel, longitudinal ridges along the wing-covers. A small, shining, black beetle (genus *Paromalus*), belonging to the family Histeridæ, has been found in powdered poke root. Two species of *Ceutorynchus*, small snouted beetles or weevils,

infest poppy and other seeds. Another weevil, *Calandra oryza*, imported from Europe, infests rice and ground roasted acorns.

The beetles comprise the chief drug pests, but some other orders of insects are represented by a lesser or greater number of pests.

The Lepidoptera or butterflies and moths, while possessing, in the adult stage, mouth parts adapted for sucking, have, in the young stages, strong biting-jaws. The young are the well-known caterpillars, and may be distinguished from the young or grubs of beetles by the number of legs. The larva or grub of the beetle has but three pairs of legs, and these are attached to the first three segments of the body lying just behind the head; the larva or caterpillar of a moth has, in addition to these three pairs of so-called thoracic legs, usually five more pairs of legs, four of these pairs being attached to segments in the middle region of the wormlike body, and the fifth pair being attached to the last segment of the body. The grubs of beetles sometimes have in addition to their three pairs of thoracic legs a *single* leg on the last segment of the body.

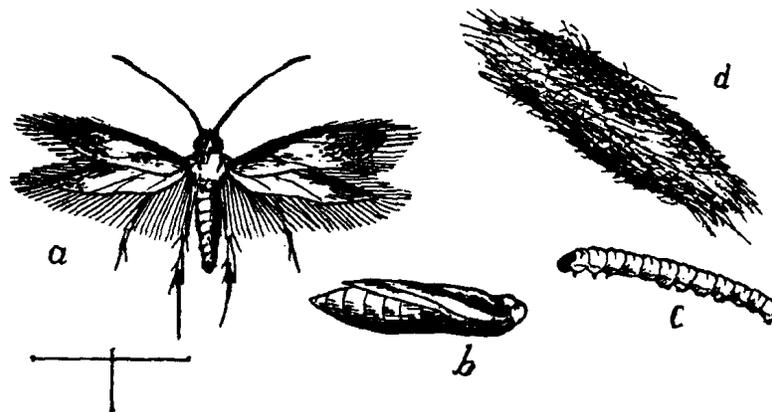


FIG. 270.—*Tinea penionella* Linné. a. Adult moth. b. Pupa. c. Larva. d. Case.—(Original.)

Every one knows of the clothes-moth, dread foe of the housewife, which, as a small white caterpillar, living in a cylindrical roll or case (see d, Fig. 270) made from the woolen cloth or fur on which it is feeding, does irreparable injury to the choicest fabrics and costliest furs. This moth belongs to the genus *Tinea*, of which one or more species attack drugs. Fig. 270 illustrates the life history of the moths of this genus; *c* is the larva or caterpillar; *b* is the pupa or resting stage; and *a* is the adult moth. The moth is very small and light brown in color. I have found a Tineid attacking aconite root. Another moth, known as the Angoumois grain moth (*Gelechia cerealella*), attacks, in the caterpillar stage, all

kinds of stored grain. It bores holes into the grain kernels and eats out the starchy interior, leaving only a delusive hollow shell. Figure 271 shows the appearance of the infested grain kernels. The larva of *Carpocapsa amflana*, a moth of the same genus as the codlin moth, the greatest insect pest of the apple, infests the seeds of *Corylus avellana*, *Juglans regia*, and *Castanea vesca*. The larva of *Mylois ceratonia* feasts on the fruits of *Ceratonia siliqua* and *Castanea vesca*. The larva of the moth *Æcophaga olivella* inhabits the kernels of the olive, causing the dropping of the fruit and a smaller yield of oil.



FIG. 271.—Grain kernels attacked by *Angoumois grain moth*. *a*. Infested kernel of corn. *b*. Kernel of corn cut open showing feeding larva within. *c*. Infested kernel of wheat.—(Original.)

Passing now to another order of insects, the two-winged flies, we find that while the mouth parts of the adult flies are adapted for sucking or lapping, the young flies, which appear as grubs or maggots, are in many cases better prepared to partake of solid food. The olive in southern France and Italy is infested by a larva of a fly known as *Dacus oleæ*; in the kernels of fresh hazelnuts are often found the larvæ of a fly which belongs to the same genus as that notorious wheat pest, the Hessian fly. The fly *Trypeta arnicivora* is often gathered in its youthful state with arnica flowers, and becomes developed later on, after feeding on the flowers in the pharmacist's canisters.

The book-louse insects (genus *Atropos*) have at least one representative in the list of drug pests. I have found a species (probably *divinatoria*) of this genus attacking golden seal and hyoscyamus. The insect is very small, hardly a twentieth of an inch long. When examined with a microscope it is found to be wingless, and of a general appearance as shown in Fig. 272. This insect represents the family Psocidæ, of the order Pseudoneuroptera.

The order of wingless insects *Thysanura*, which includes the "fishmoths," those active scale-covered little creatures of the household, is represented by a member of the genus *Lepisma* (probably *saccharina*) (see Fig. 273), which I have found in jars of mezereon bark and Socotrine aloes.

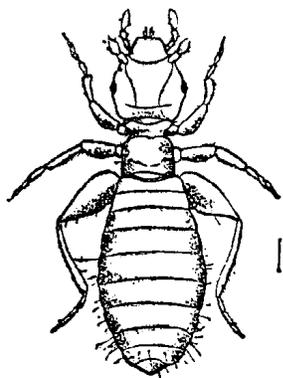


FIG. 272.—*Atropos divinatoria* Fab.—(Original.)

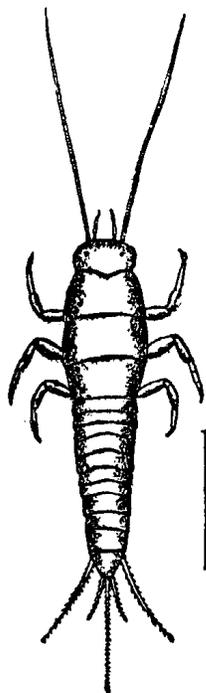


FIG. 273.—*Lepisma saccharina* Linné.—(Walker.)

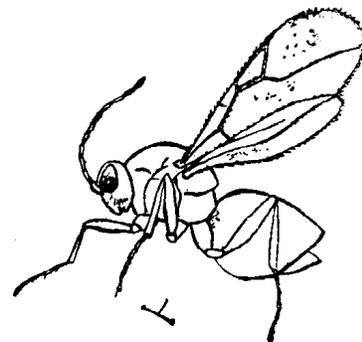


FIG. 274.—*Cynips*.—(Original.)

Finally, in jars of gall the pharmacist may find numerous little fourwinged, compact-bodied “flies,” which are not, however, attacking his stores, but which are only the insects which produced the galls, now issuing from them. These little insects (see Fig. 274) are Hymenoptera, belonging to the genus *Cynips*. The pharmacist may find other Hymenoptera (distinguished by having four clear membranous wings with almost no veins in them, see Fig. 274) in his jars and cans; but these insects are his benefactors. They are parasitic on the beetles and other insect pests which are feeding on the drugs, and thus do much good. Their eggs are laid on the body of the grub of the drug-eating beetle, and the young hymenopteron, on hatching, eats its way into the beetle-grub and lives there at the expense of its host.

REMEDIES

Coming now to the matter of remedies, a reviewing of the notes thus far presented shows that beetles are the most serious and numerous of drug pests, and that practically only insects which have biting mouth parts are injurious. In fighting insects with biting mouth parts the common means employed by entomologists is to cover the substance attacked (usually the green foliage of plants) with a thin coating of arsenic, by

means of spraying. In the nature of the case this method is out of the question in fighting drug pests, but, because the drugs are capable of being easily handled and subject to treatment in air-tight vessels, a very convenient, effective, and universally applicable method is possible, namely, treatment with vapor of bisulphide of carbon. The vapor of bisulphide of carbon is deadly to all insects in all stages, except the egg stage. The infested drug should be placed in a tight vessel (after having removed the dust and debris caused by the attacks of the insects) and a quantity of bisulphide of carbon, sufficient to charge the vessel with vapor, introduced. Any insect in the vessel will be killed. The remedy is simple, effective, and is feasible in the case of almost any drug.

Prevention of attack may be accomplished in some degree by the use of tight cases, though often the insects are introduced into the case with the drug, the drug specimens having come from an infested lot. Occasionally inspection of the jars and cans will detect the insects before they have had time to do much damage.

The ease of the detection of the presence of insects, and the ease with which the pests may be killed, makes it certainly worth the while of any druggist to devote a little time required for the effective prevention of insect damage to his stores.

PART IV

POWDERED DRUGS

A.—METHODS FOR IDENTIFICATION

Vegetable drugs frequently, perhaps in the majority of cases, reach the pharmacist in the form of powders, and it is necessary not only to identify them, but to determine their quality in this form. The old and laborious method of making powders in small quantities, by the pharmacist in his own store, has been supplanted by the specialized industry of drug milling. Thus it is that adulteration is made easier and its detection more difficult. Formerly it was considered sufficient for identification of vegetable drugs to describe gross characteristics, such as, color, odor, taste, and such other characteristics as might be brought out by hand lens; but this method is wholly inadequate, and a more detailed examination, microscopical and chemical, now is required. The enforcement of the drug and food laws will require workers skilled in microscopical technique.

Pulverization and Powdering.—Prerequisite to the microscopical study of vegetable powders is a knowledge of the processes of pulverization and drug mills, such as may be found in any well illustrated work on pharmacy, and elements of plant anatomy.

The degree of fineness of the powders is of first importance in microscopical examinations. Coarse powders can not be used and if they are too fine the fragmentary tissues and products are too small to be recognized. These degrees of fineness are represented by certain numbers. A No. 80 powder, as defined by the U.S.P. VIII, for example, is one that will pass through a sieve having 80 meshes to the inch. In the U.S.P. IX No. 60 powder is defined as "Very fine powder, has a fineness in diameter of particles less than 0.17 millimeters," and it is specified also that the larger proportion of this must not pass through a sieve of lower degree of fineness (See U.S.P. IX, Part II). To obtain the best results, microscopically, powders may vary in fineness from No. 60, a fine powder, to No. 80, a very fine powder.

During the process of pulverization the less resisting tissues, such as thin-walled parenchyma cells, which, for the most part, contain starch, proteids and crystals, are reduced rapidly to powder, while the woody and fibrous parts together with the tracheids and vessels are quite

difficult to pulverize. Accordingly, frequent sifting should be resorted to during the process, so that as the broken fragments are reduced to the proper size to pass through the sieve they may be removed. The process of grinding and sifting must be continued until all the tissues have passed through the sieve. Powders in small quantities may be made by means of a mortar and pestle, and if the material is thoroughly dry the time and labor need not be great. A mortar and pestle made rough by the use of coarse carborundum powder has proved very efficient. Coarse powders in considerable quantity may be made in an ordinary small coffee mill. The process of grinding may then be continued by means of mortar and pestle and the fineness carried to any degree desired.

Color.—Vegetable powders are liable to vary greatly in color. Some of the common factors which cause this variation are light, moisture and increasing fineness. Exposure to light deadens the color, in some cases very rapidly, a light or reddish-brown soon becoming a dark or dull brown, etc. By exposure to moisture most powders grow dark in color. Increasing fineness produces varying tints and, in some instances, the quality of the color is wholly changed; for example, Spanish Licorice, in coarse powder, is yellow showing considerable portions of brown cork, while a very fine powder is almost lemon color. If the process be carried on by alternate grinding and sifting, as described above, tints from yellow to light lemon yellow will be obtained. The aging of powders, even when not exposed to light, changes them to darker tints. Powders made from plant parts, rich in oil, are likely to be dark in color and the darkening may become marked if heating is allowed to occur during the grinding. They darken rapidly on exposure to light and are likely to become rancid.

Various systems of classification by colors have been worked out for the vegetable drugs. Doctor Schneider has divided them into six groups as follows: 1, Very light; 2, Yellow; 3, green; 4, gray; 5, brown; 6, very dark. Professor Henry Kraemer forms them into five main groups: 1, Greenish powders; 2, yellowish powders; 3, brownish powders; 4, reddish powders; 5, whitish powders. These groups are subdivided according to the forms of cells, nature of the cell wall and cell products. All such systems as these are more or less artificial, and although useful in many cases, have not proved wholly satisfactory in the laboratory.

Identification by Odor.—The odors from drugs are exceedingly difficult to describe, largely because we have no odor standards at command for comparing them qualitatively or quantitatively. We can

understand such terms as aromatic, pungent, fragrant, agreeable, disagreeable, etc. These terms serve in a measure to indicate odor qualities.

The student is recommended to acquaint himself with such aromatic odors as cinnamon, cloves, nutmeg; with the mint family odors, such as peppermint, spearmint, pennyroyal, etc. He should acquaint himself with such odors as are furnished by the odorous fruits, of the Umbelliferæ, such as caraway, fennel, etc.; with camphoraceous odors, as eucalyptus, rosemary, and camphor; with pronounced and characteristic odors of wintergreen, sassafras, etc.; with the delicate and fragrant odors derived from the lemon, orange, orange flowers, etc. He should not omit the study of the disagreeable odors, as we find in conium, valerian, stramonium, garlic, civet, castor fiber, etc. All such odors serve as a means of comparison.

It will be seen that in order to describe an odor it becomes necessary to have some prominent characteristic odor with which to compare. The Pharmacopoeia (viii) states that conium has a mouse-like odor; sumbul, a musk-like odor; lactucarium, a heavy odor; senna is described as having a tea-like odor, etc. Tarry substances that have a creosote or smoky odor are said to have an "empyreumatic odor."

Identification by Taste.—What has been said of the odor of drugs applies also to their taste. Taste is not a very distinctive property. There are some drugs that have a distinctive taste, such as gentian root, which has a *simple bitter taste*; senega, an *acid taste*; ginger, a *pungent*; geranium, *astrigent*; elm bark, *mucilaginous*, etc. Many drugs have what may be termed a mixed taste. Hence we find in descriptions such terms as: *bitter-astrigent* applied to cinchona; *bitter-pungent* applied to orris root; *pungent-astrigent* applied to cotton-root bark; *bitter-sweet*, applied to dulcamara; *sweetish-bitter-pungent*, applied to spigelia, etc. Many drugs are tasteless, such as lycopodium, kamala, physostigma, etc.

It is plain to be seen from the foregoing that the taste, as well as the color and odor of powders, is not distinctive enough to identify them with certainty; still, these physical properties serve in many cases as a valuable aid in their identification.

Adulterants and Their Identification.—As stated above, adulteration of drugs is made easier and the detection of adulterants is

more difficult when the drugs are reduced to powders. Great skill is required in the identification of adulterants; for the art of drug adulteration is an old one and the materials employed have been selected, often ingeniously, on account of their very close resemblance to the true articles they replace. In the case of whitish powders, foreign starches, especially the common cereal starches, have been used, and not infrequently have the "scrapings" from bakeries been parched or browned to the proper degree and employed in drug and food adulteration. The endocarp of the olive, cocoanut, and walnuts; exhausted coffees; cocoa shells; and other similar substances, which are composed chiefly of stone cells, have been employed to a large extent in admixture with brownish powders. The use of wheat bran or middlings in ginger has been a common practice. Sometimes inorganic substances such as talc, chalk, clay, sand, etc., are employed. One of the most difficult means of adulteration to detect is the use of exhausted powders (the dregs left from drugs extracted by percolation). These are first dried and repowdered and mixed in various proportions with the pure article. Deteriorated drugs have been used in the same way. It goes without saying that these latter forms of adulteration can not readily be detected microscopically, but a microscopical examination in connection with careful chemical tests is of the greatest value.

A thorough knowledge of the histology of the plant part supposed to constitute the powder is necessary. And for this purpose cross and longitudinal sections, which may be prepared after soaking the dried drug materials in water, may, in many cases, be used to great advantage. By careful comparisons of sections and broken fragments, and the employment of proper reagents upon cell-products, identification is made positive. For a full account of cell-products and reagents, see Part IV, Chapters II and III.

Mounting Powders for Examination.—Powders for microscopical examination should be thoroughly mixed, so that the large and small particles will be uniformly distributed throughout the entire specimen, as before stated. In powders that have been standing for a considerable time the larger particles will be separated from the finer, so that great difficulty may be encountered in obtaining a typical mount from such a powder, unless it has been thoroughly mixed. Only a small portion of powder should be used in making a mount, the amount depending upon the size of the cover-slip to be used. When the mount is ready for examination, the particles should be spread out evenly and should not come in contact one with another so that the large ones might obscure

the smaller.

Powders for examination may be mounted directly on the slide, using the proper medium, or the powder may be mixed with the mounting medium in a small test-tube, specimen tube, or homeopathic vial. If a small portion of powder be transferred to a slide, a drop of the desired mounting medium added, and the whole thoroughly mixed and covered with a coverslip, it will furnish a mount ready for examination. However, it is frequently desirable or even necessary to use some clearing agent in order to render dark colored or opaque powders transparent. In such cases the powder should be thoroughly mixed with the reagent and left standing for twelve hours or more, when a portion may be taken up with a pipette and a drop of the mixture transferred to a slide.

Clearing Agents and Mounting Media.—For making temporary mounts of powders water is the best general medium, and should be used whenever a clearing agent is not required. In this medium delicate markings are clearly brought out, and it is especially recommended for the examination of starches. Frequently specimens are filled with air, which must be removed before a satisfactory examination can be made. For driving out air 70 per cent. or stronger alcohol should be used, but this is not a desirable medium for general use, as it evaporates rapidly and allows the specimens to dry up. However, this medium is excellent for bringing out details of structure, and may be profitably employed when a hasty examination is to be made. It can be replaced by water or other media as desired.

Equal parts of water and glycerine furnish one of the best and most useful mounting media. This mixture is especially desirable when delicate markings are not brought out in water. It acts as a clearing agent, and although the action is somewhat slow, it will render most specimens clear enough for examination. Equal parts of water, glycerine, and alcohol make a reagent to be preferred to the above in many respects, and is the most useful of the simple and cheap reagents. This mixture penetrates tissues well, acts as a clearing agent, and does not dry up. Specimens may be kept in it for days or even weeks.

In the examination of many specimens it is necessary to use a strong clearing agent, and it is frequently desirable to have one that acts rapidly. Chloral hydrate, made by dissolving five parts of chloral hydrate crystals in two parts of water, is one of the most common and

useful clearing agents. Its action is rapid, but it is not a good medium for mounting in many cases, since delicate markings are not clearly brought out by it. In many specimens starch is dissolved by this reagent, and it should never be used when accurate measurements of starch grains are to be made. However, chloral-hydrate solution with iodine added is the best and most reliable agent for the detection of starch, and is especially recommended where starch occurs in small quantities or is likely to be obscured, as in chloroplasts or by proteid substances.

A clearing agent to be preferred to the above for general purposes may be made by mixing 1 part of 95 per cent. alcohol, 1 part glycerine, 1 part water, and 4 parts saturated aqueous solution of chloral hydrate. This mixture gives a reagent fairly rapid in action, and also serves well as a mounting medium. It is the most useful clearing agent and can be employed in more cases than any other.

Potassium hydrate in 2 to 10 per cent. aqueous solution is valuable as a clearing agent, and also serves well as a macerating agent. It is rapid in action, and dissolves starch. Acetic acid, 20 per cent., and hydrochloric acid, 10 to 20 per cent., may be found exceedingly useful as clearing agents in many cases. They are often valuable in removing starch from specimens where it may interfere in an examination.

In the preparation of specimens which are exceedingly difficult to clear, or in handling coarse powders where the fragments are so large that they must be broken up by macerating before mounting, javelle water and Schultz's macerating fluid will be found useful.

The action of any of the clearing agents mentioned above may be hastened or increased by the application of heat. By holding a mounted specimen over the flame of an alcohol lamp or a Bunsen burner it can be heated without injury, even to boiling, if proper care be exercised.

Measurements.—The fragments of powders should be carefully measured, and the measurements used for comparison wherever it is possible to do so. Measurements should be made with an eye-piece micrometer. In preparing specimens for measurement the greatest care should be exercised in the use of reagents so that objects may not be swollen abnormally or distorted before measurements are made.

On the following pages are given a few examples to show the diagnostic characteristics of some powders which frequently, either by mistake or

intentionally, are substituted one for the other.

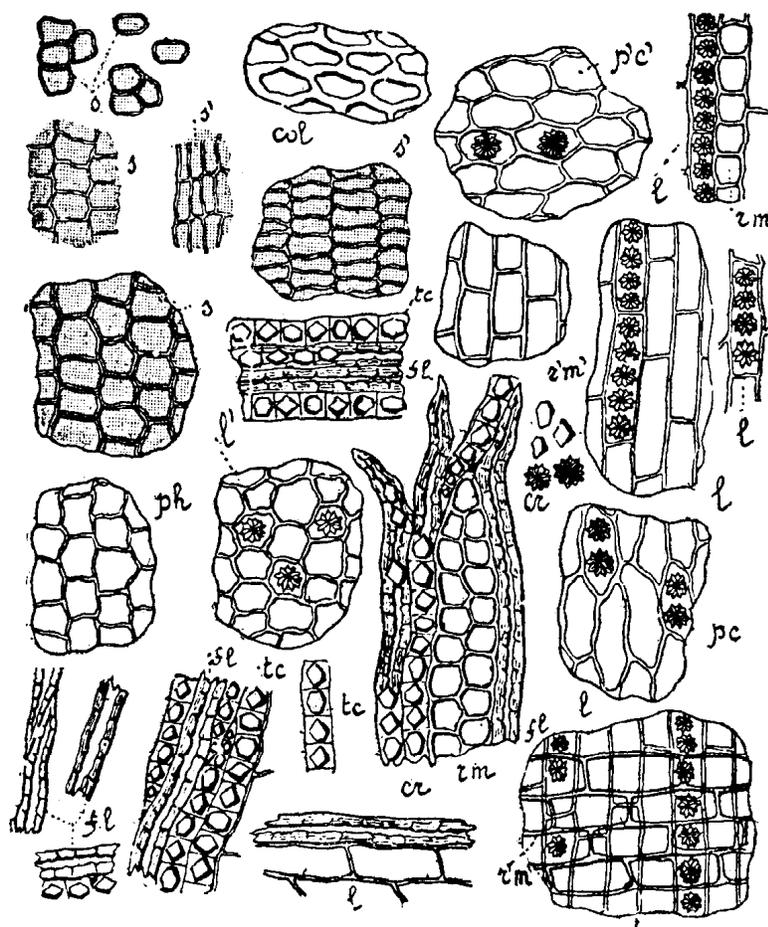


FIG. 275.—Powdered *Rhamnus Frangula*—Bark. ($\times 210$.) *col*, Collenchyma of the cortex. *cr*, Prismatic and rosette crystals. *fl*, Bast fibers with pitted walls. *l*, *l'*, Bast in longitudinal and transverse section. *pc*, *p'c'*, Cortical parenchyma, in longitudinal and transverse section. *ph*, Phelloderm. *rm*, *r'm'*, Medullary ray in tangential and radial section. *s*, *s'*, Cork in tangential and transverse section. *tc*, Rows of crystal cells.—(From Greenish and Collin.)

The first example is illustrated by the barks taken from the same genus—*Frangula*, Fig. 275, and *Cascara sagrada*, Fig. 276. A comparison of the fragments composing these two powders shows them to be very similar in structure. *Cascara* presents one striking difference, as shown by the sclerenchymatous cells, *sc*, Fig. 276, which occur quite commonly, but occur rarely, if ever, in *Frangula*. In each of the specimens are bast fibers, but in *Frangula* the fibers have thicker walls and contain more numerous and well-defined pits than do the fibers of *Cascara*. Also the cork cells and the large parenchyma cells of the cortex show characteristics which are of diagnostic value. In *Frangula* the cork cells contain a deep red or purplish coloring substance, while those of

Cascara have a reddishbrown coloring substance.

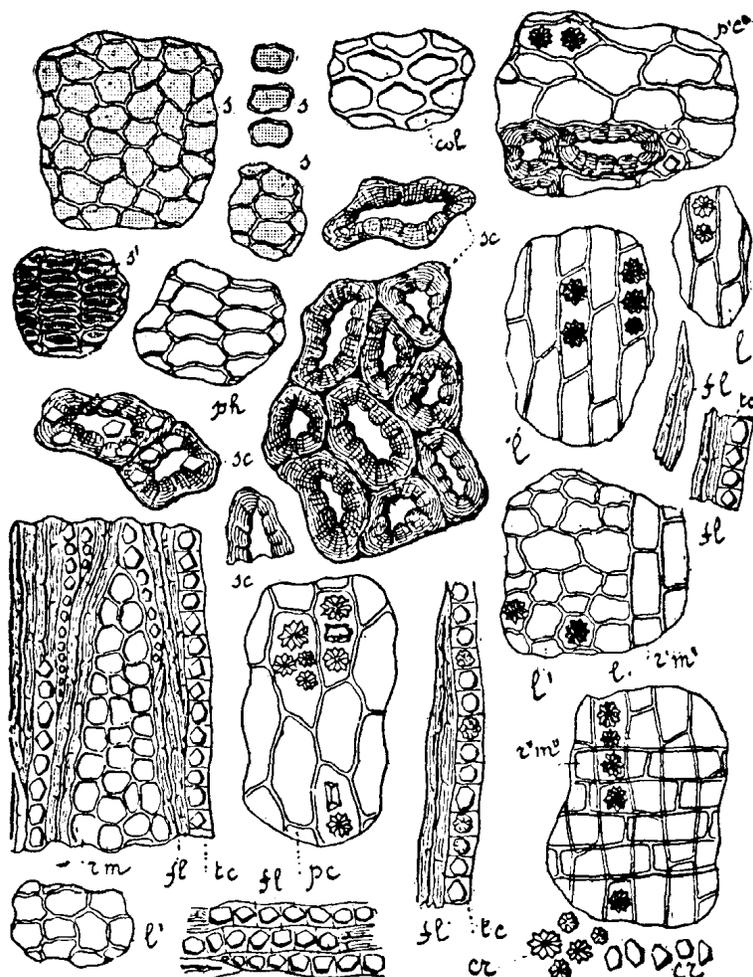


FIG. 276.—Powdered Cascara Sagrada Bark (*Rhamnus Purshiana*). (X 210.) *col*, Collenchyma of the cortex. *cr*, Prismatic and rosette crystals. *fl*, Bast fibers. *l*, *l'*, Bast in longitudinal and transverse section. *pc*, *p'c'*, Cortical parenchyma in longitudinal and transverse section. *ph*, Phelloderm. *rm*, Medullary rays, tangential section. *r'm'*, The same, transverse section. *r''m''*, The same, radial section. *s*, *s'*, Cork, in surface view and section. *sc*, Sclerenchymatous cells. *tc*, Rows of crystal cells.—(From *Greenish and Collin*.)

In the large parenchyma cells of Cascara is found a substance yellowish in color which changes to orange upon the addition of potassium-hydrate solution, while in *Frangula* the large parenchyma cells contain a coloring substance of a much brighter yellow, which upon the addition of potassium-hydrate solution changes to a red or deep purplish color.

The second example is illustrated by two roots taken from closely related species—Brazilian Ipecac, Fig. 277; *Psychotria Ipecacuanha* (Stokes) of the British Pharmacopœia; *Cephælis Ipecacuanha* (A. Richard) of the

U.S.P.; and undulated Ipecac (Fig. 278), which represents species from several different genera, such as *Richardsonia*, *Psychotria*, *Ionidium*, etc. The starch grains from each specimen are similar in form and structure, the only difference being that the starch grains from Brazilian Ipecac, ranging in size from 4 to 15 microns, are uniformly smaller than are those of undulated Ipecac. The elements of the xylem, however, furnish a ready and reliable means of distinguishing between these two powders. The xylem of Brazilian Ipecac consists of tracheids, *tra*, Fig. 277; and of peculiar strongly pitted wood parenchyma, which somewhat resembles tracheids, *fl*, Fig. 277. Undulated Ipecac shows the presence of strongly pitted water tubes (pitted vessels), *v*, Fig. 278, and quite typical wood fibers, *fl*, Fig. 278. Brazilian Ipecac does not show water tubes, unless fragments of the stems become mixed with the roots.

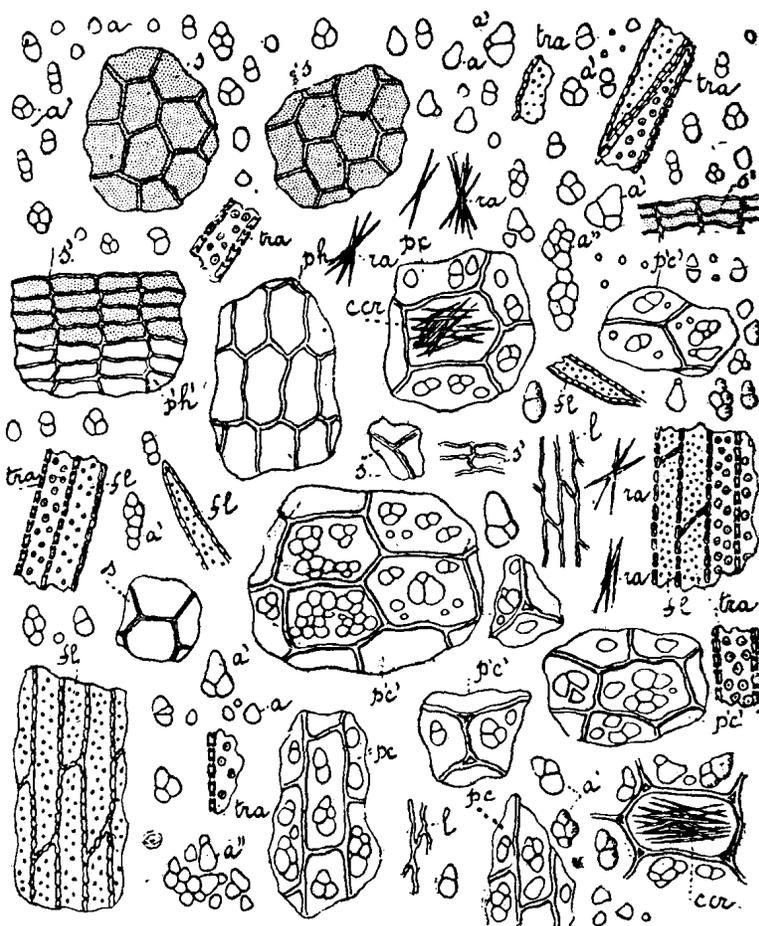


FIG. 277.—Powdered Ipecacuanha Root (*Cephalis ipecacuanha*). (X 210.) *a, a', a''*, Starch grains, simple and compound. *ccr*, Cells with calcium oxalate. *fl*, Fibrous cells. *l*, Bast. *pc, p'c'*, Cortical parenchyma in longitudinal and transverse section. *ph, p'h'*, Phelloderm in surface view and section. *ra*, Raphides. *s, s'*, Cork in surface view and profile. *tra*, Tracheids.—(From Greenish and Collin.)

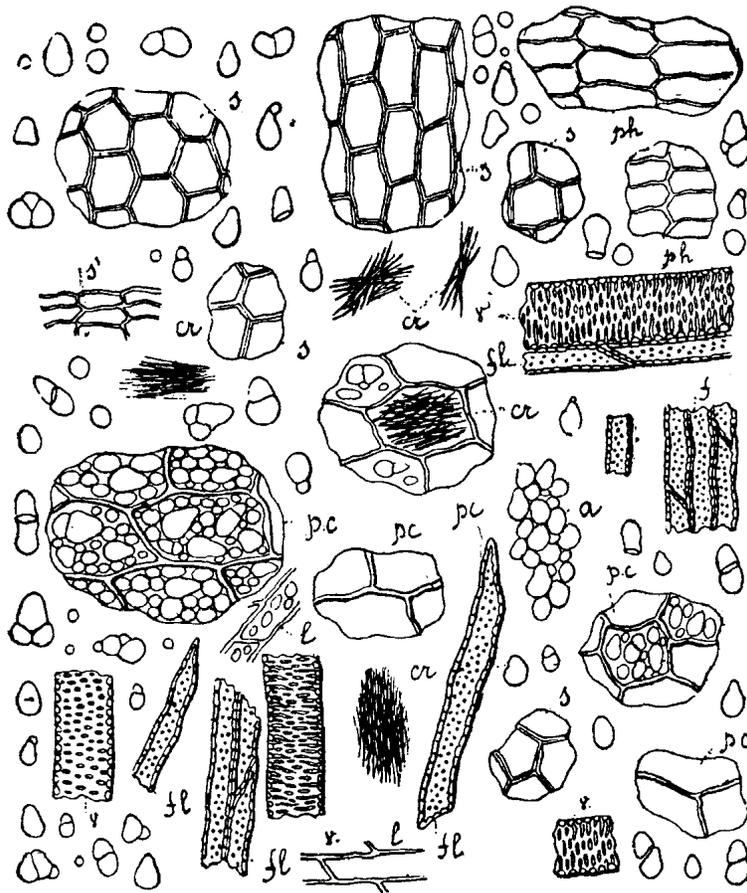


FIG. 278.—Powdered Undulated Ipecacuanha. (X 210.) *a*, Starch grains. *cr*, Acicular crystals. *fl*, Pitted wood fibers. *l*, Bast. *pc*, Cortical parenchyma. *ph*, Phelloderm. *s*, *s'*, Cork, in surface view and section. *v*, Pitted vessels.—(From Greenish and Collin.)

As a third example, the leaves of Belladonna, Fig. 279, and Hyoscyamus, Fig. 280, furnish an excellent illustration. The epidermal cells of Belladonna are large with wavy walls and the cuticle is striated, *es*, Fig. 279; while Hyoscyamus has epidermal cells similar in every respect excepting the striated cuticle, *ei* and *es*, Fig. 280. The spongy parenchyma of Hyoscyamus contains numerous crystals of calcium oxalate, usually in the form of prisms, *cr*, *ccr*, Fig. 280, while Belladonna is without calcium oxalate excepting for crystal sand, which is contained in a few large cells of spongy parenchyma adjoining the palisade parenchyma—*c*, *cr*, Fig. 279. The presence of prismatic crystals in Hyoscyamus is the most striking diagnostic character of these two powders.

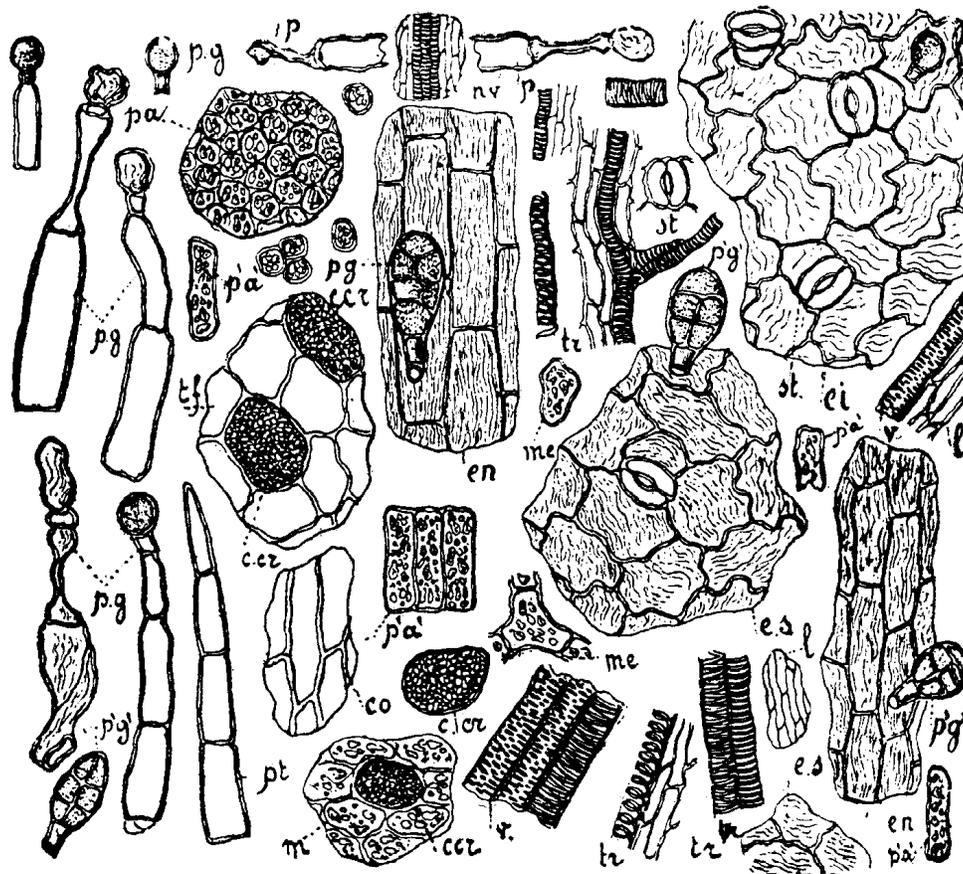


FIG. 279.—Powdered Belladonna Leaves. ($\times 210$.) *c, cr*, Cells with sandy crystals. *co*, Collenchymatous cells from cortical tissues of midrib. *ei*, Epidermis of under surface. *en*, Epidermis over the veins, with striated cuticle. *es*, Epidermis of the upper surface, with striated cuticle and occasional stomata. *l*, Bast. *me*, Branching cells of spongy parenchyma. *nv*, Fragment of small vein. *pa*, Palisade cells, surface view. *p'a*, Palisade cells, in longitudinal section. *pg*, Glandular hairs, long and short, with unicellular and pluricellular glands. *st*, Stomata, surrounded by three or four cells, one of which is smaller than the others. *tf*, Cortical tissues of the midrib. *tr, v*, Tracheids and vessels.—(After Greenish and Collin.)

The trichomes furnish other valuable diagnostic characters, but they are not always reliable, since Belladonna leaves that are almost glabrous, and consequently almost devoid of trichomes, are sometimes found. Either specimen may contain both simple and glandular hairs. The simple hairs are conical and may be composed of one or more cells. In *Hyoscyamus* the glandular heads, which may be either bicellular or multicellular, *pg*, Fig. 280, are borne on a stalk composed of two or more cells. The glandular hairs of Belladonna are found with heads either unicellular or multicellular. The larger multicellular glands are usually borne on a stalk consisting of one or two cells, *pg*, Fig. 279, while the smaller ones are likely to have a stalk composed of several superimposed cells. The unicellular glands are rounded in form and are borne on stalks of several Cells, *pg*, Fig. 279.

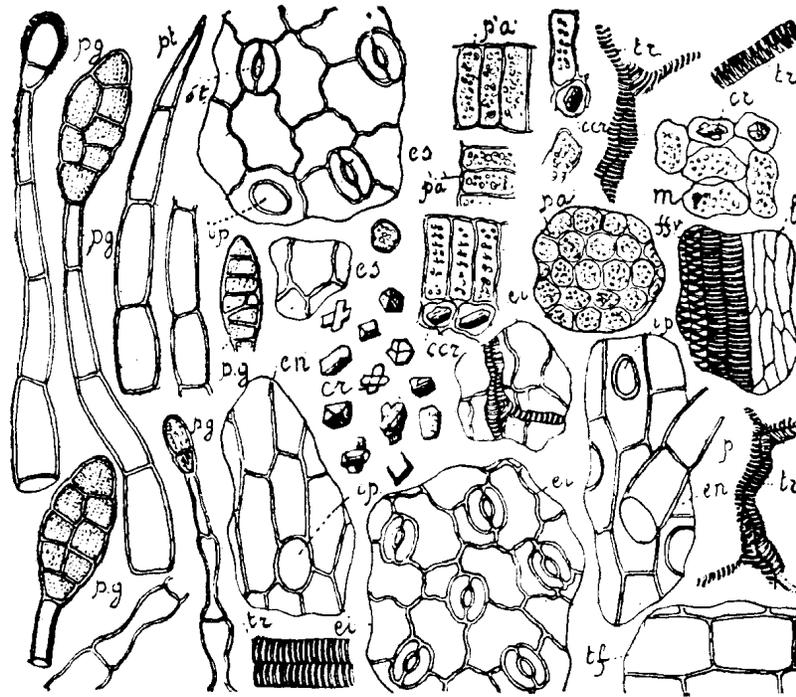


FIG. 280.—Powdered Henbane Leaves (*Hyoscyamus niger*.) (X 210.) *ccr*, Crystal cells. *cr*, Crystals of calcium oxalate. *ei*, Lower epidermis. *es*, Upper epidermis. *fv*, Portion of fibrovascular bundle of midrib. *ip*, Scar of fallen hair. *m*, Spongy parenchyma. *pa*, *p'a'*, Palisade cells. *pg*, Glandular hairs. *st*, Stomata. *tf*, Cortical parenchyma of midrib. *tr*, Tracheid, and vessels.—(After Greenish and Collin.)

It should be stated that each drug has its own peculiar microscopical elements. Some of these, it is easy to see, are of special value in the identification of drug powders.

GENERAL DIRECTIONS

As a general direction for the detection of adulteration or admixture it cannot be too strongly emphasized, that authentic samples of the pure drug, and of the suspected adulterant or admixture, should be carefully studied, macroscopically, and microscopically, as a preliminary process. This laboratory method supersedes all the aids in the form of representation by drawings and figures on paper.

An examination of a drug powder should never be considered complete until the sample, has been compared with authentic specimens of the same drug or drugs of the same degree of fineness.

FIG. 281.—Shows Starch-granules of Ipecac. (X 750.) The cells of the bark are filled with starch. The granules are spherical, oblong, or angular, and vary much in size. The hilum is located near the center, and is often seen to be fissured. The grains are smooth, and show no concentric markings. They are often in groups of two, three, and sometimes even more grains joined together.

FIG. 282.—Shows Starch-granules of Jalap. (X 250.) The grains are very numerous in the cells; are large and have characteristic markings. They are rounded or broadly ovate, having the hilum located near the small end and surrounded by excentric lines.

FIG. 283.—Shows the Starch-grains of *Veratrum viride* (X 350), which so closely resemble those of *Veratrum album* that it would be impossible to distinguish the two by their starch-grains. Those of the former are often found in groups of twos, threes, fours, and sometimes even more. They are small, rounded, or angular, with the hilum in the center.

FIG. 284.—Represents Starch as it appears in Calumba. (X 350.) The grains are large, and in shape they are circular or oval. A few double or compound grains are found, but they do not occur frequently. The hilum is rather excentric, and is often seen to be fissured in a radial direction. The grains are smooth, and occasionally a curved line or two is to be found.

FIG. 285—Shows Starch-grains as they appear in Galengal. (X 350.) The grains are large and mostly long ovate, but sometimes they are irregular. The hilum is located near the larger end, and is sometimes fissured. The stratification lines are plainly seen on the larger grains and but faintly, if at all, on the smaller ones.

FIG. 286.—Illustrates Starch-grains as seen in a specimen of *Iris florentina*. (X 500.) These grains are quite characteristic and very abundant. They are rather elongated, rounded or truncate at one end, and usually tapering toward the other end. Occasionally a three-lobed grain is seen. As a rule, the grains are irregular in shape. The hilum is located near the large end, and is slightly fissured. (a) is the most common form. A very prominent characteristic is a double line branching from the hilum and extending toward the other end.

MICROSCOPICAL EXAMINATION

PLATE III.

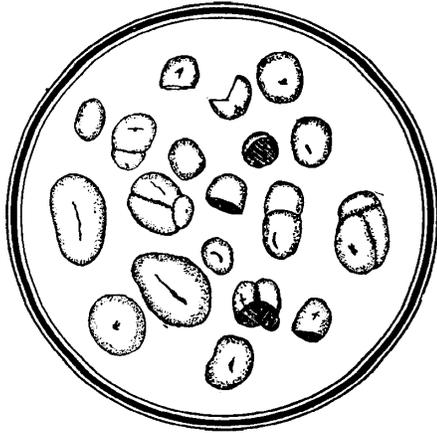


FIG. 281.



FIG. 282.

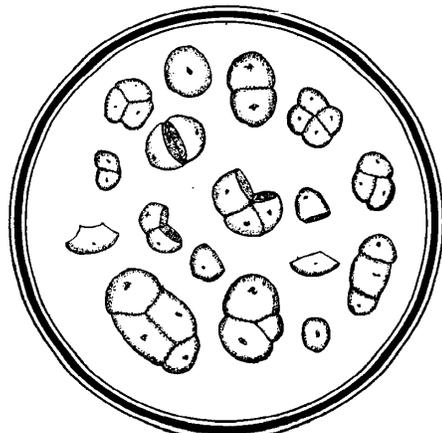


FIG. 283.

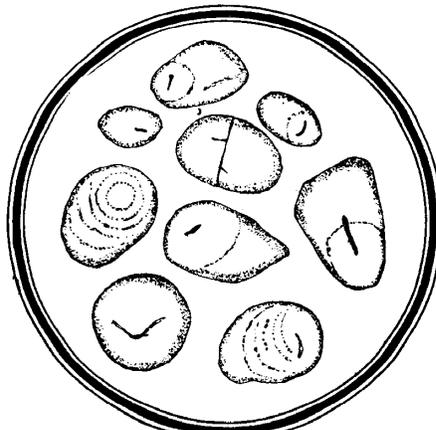


FIG. 284.

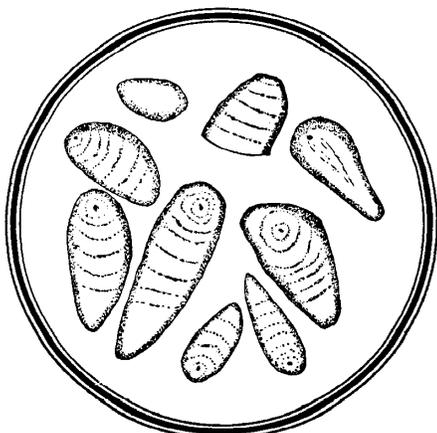


FIG. 285.

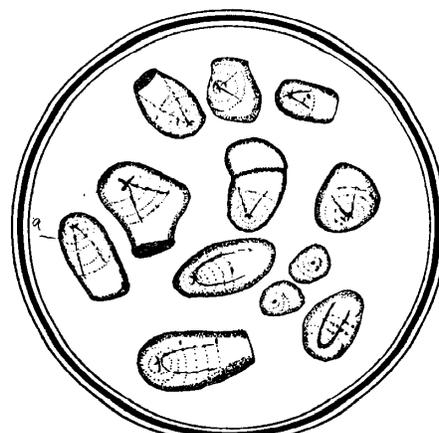


FIG. 286.

FIG. 287.—Shows Starch-grains as they appear in *Caulophyllum*. (X 250.) The grains are small, but quite characteristic. They are mostly gathered together in large and roundish masses, consisting of twenty-five to fifty grains. The single grains are globular, or more commonly many-sided, and without hilum or stratification lines.

FIG. 288.—Shows the Grains as they appear in *Aconitum napellus*. (X 850.) This drug is very rich in starch. The starch-grains are rather large. There are a great many compound grains composed of from two to eight granules. The single grains are round, long, and in some cases have flat faces. The hilum is located centrally, and is seen at times to be fissured slightly. The concentric markings are not discernible.

FIG. 289.—Shows Starch-grains as they appear in *Geranium*. (X 1200). There are specimens of *Geranium* in the market that contain little or no starch. This somewhat singular fact is said to be due to the season in which it is gathered. The drug usually contains starch in abundance. The grains are rather long, and appear to be thicker at one end than at the other. The hilum is located generally at the larger end, but sometimes central, and it occasionally appears at the smaller end. The stratification lines are very faintly seen at times.

FIG. 290.—Shows Starch-grains as they appear in *Honduras Sarsaparilla*. (X 500.) Many of the grains are seen to occur in groups of two, three, and sometimes four. The single grains are spherical or angular, with a hilum located near the center. The hilum in the larger grains is angular fissured. No concentric markings can be seen.

FIG. 291.—Shows Starch as it appears in *Podophyllum*. (X 550.) The grains are small and mostly single, but sometimes they are double or triple. They are spherical with a central hilum, and are seldom fissured. The hilum can hardly be seen in the smaller grains.

FIG. 292.—Shows Starch as it appears in the rhizome of *Hydrastis*. (X 1300.) The starch is very abundant. The grains are most commonly joined together in groups of from two to six. The grains, when single, are rounded in form. The hilum is indistinct and unfissured.

NOTE.—The drawings of the starches were made from authentic specimens of the crude drug of the market.

PLATE IV.

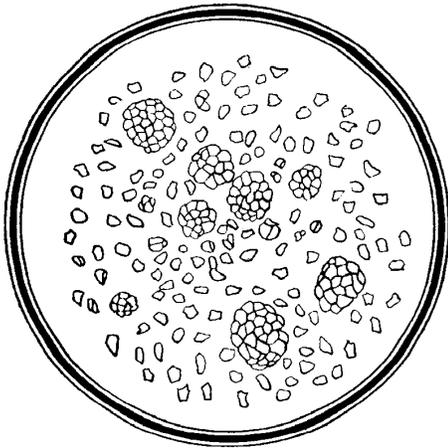


FIG. 287.

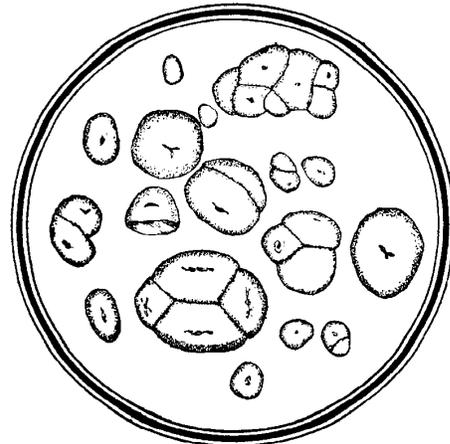


FIG. 288.

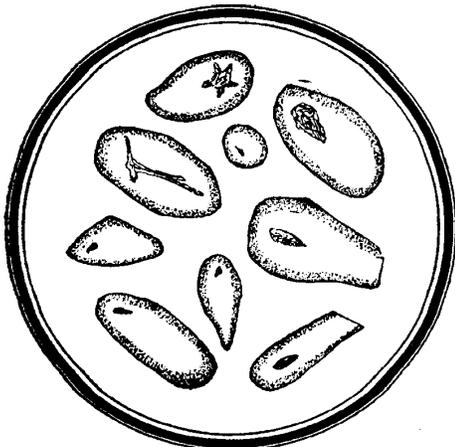


FIG. 289.

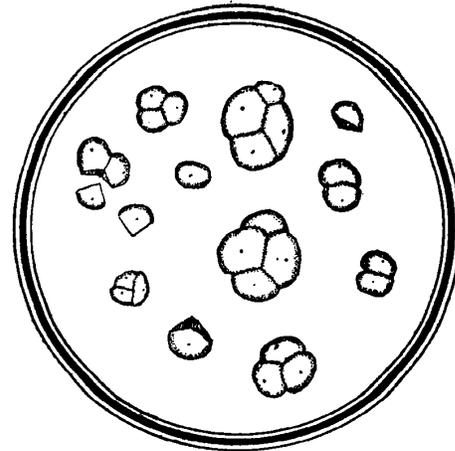


FIG. 290.

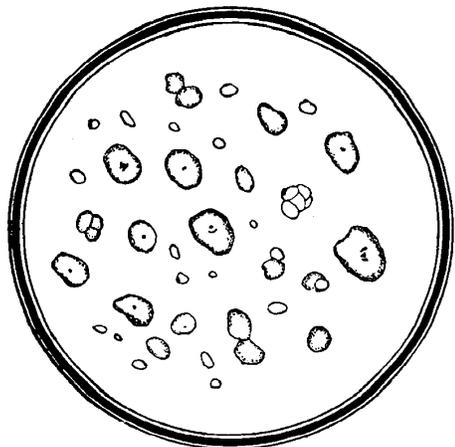


FIG. 291.

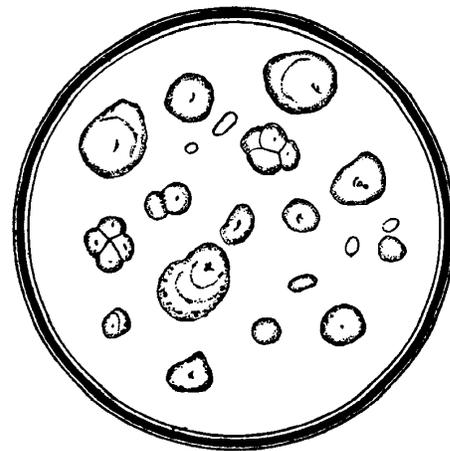


FIG. 292.

TYPES OF DRUG POWDERS

The following pages <512-519> are illustrations of some of the more important drug powders of the National Formulary and of the Pharmacopœia, designed to illustrate how characteristic elements may be selected for purposes of microscopical identification.

On pages <520-528> will be found condensed descriptions of the characteristic elements of some of the more important drug powders selected mainly to give as wide a range as possible for purposes of identification.

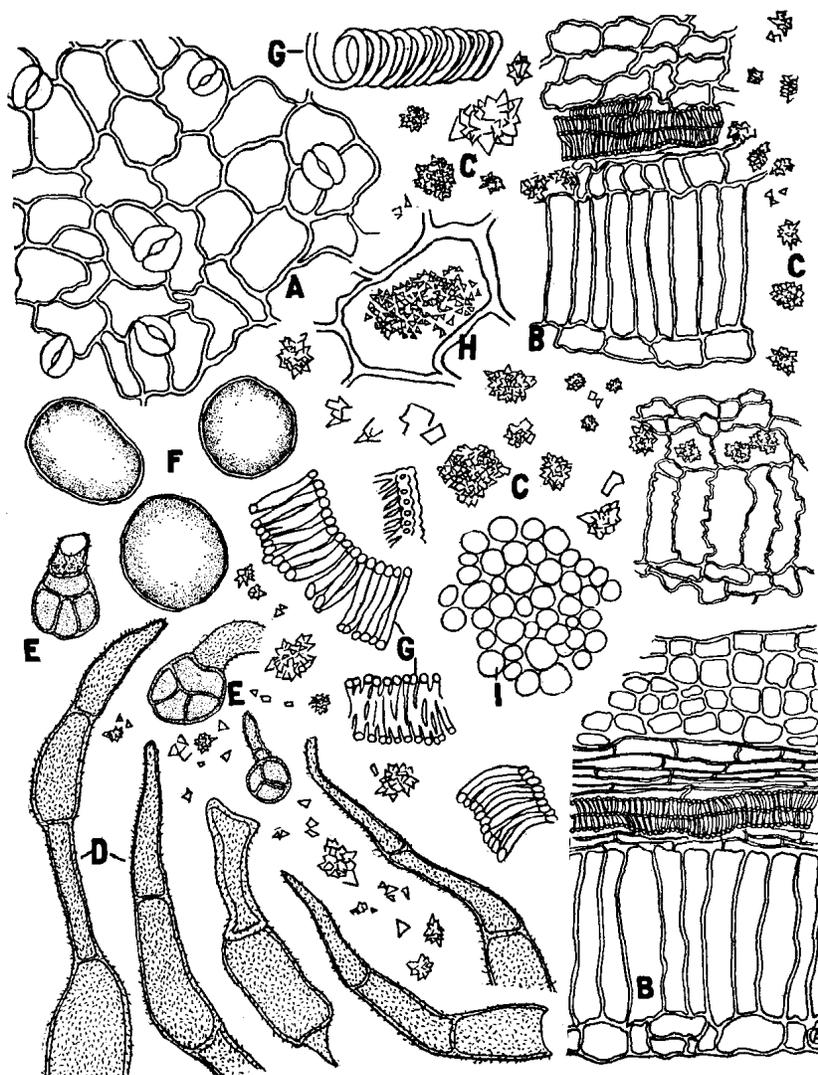


FIG. 293.—Powdered Stramonium. ($\times 183$.) A, Epidermis, surface view. B, Transverse section of leaf. C, Aggregate crystals of calcium oxalate. D, Non-glandular trichomes. E, Glandular trichomes. F, Pollen grains. G, Water tubes. H, Mesophyll cell, containing sphenoidal crystals of calcium oxalate. I, Palisade parenchyma, surface view.

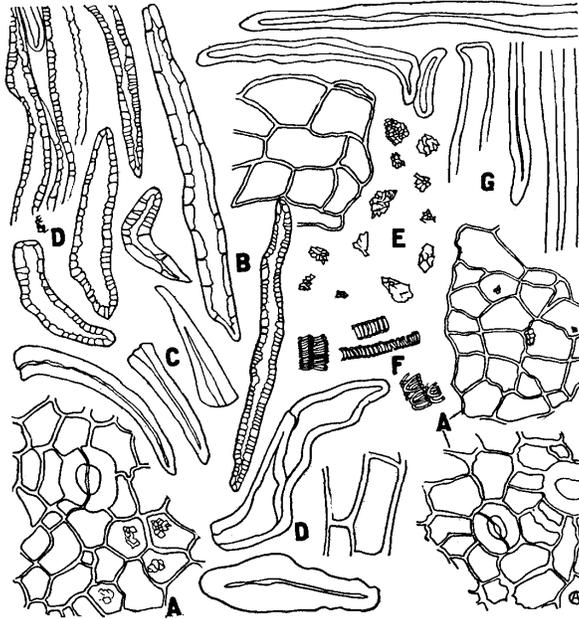


FIG. 294.—Powdered Buchu (Short). ($\times 183$.) A, Epidermis showing crystals of carbohydrate. B, Sclerenchyma fibers. C, Trichomes. D, Sclerenchyma cell, water storage tissue near the ultimate ends of the veins. E, Aggregate crystals of calcium oxalate. F, Water tubes. G, Sclerenchyma fibers.

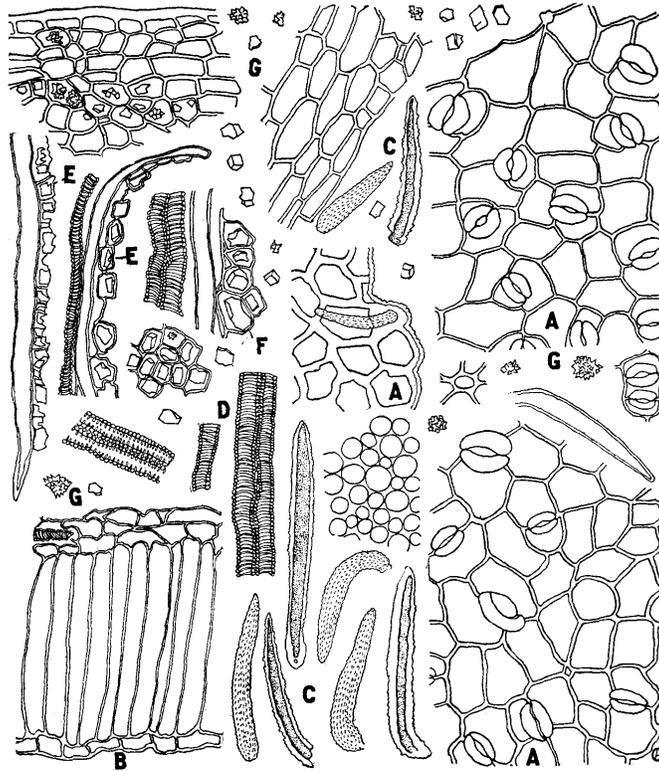


FIG. 295.—Powdered Senna (India). ($\times 183$.) A, Epidermis, surface view. B, Part of transverse section of leaf. C, Trichomes. D, Water tubes. E, Crystal fiber. F, Parenchyma cells containing prisms of calcium oxalate. G, Aggregate crystals of calcium oxalate.

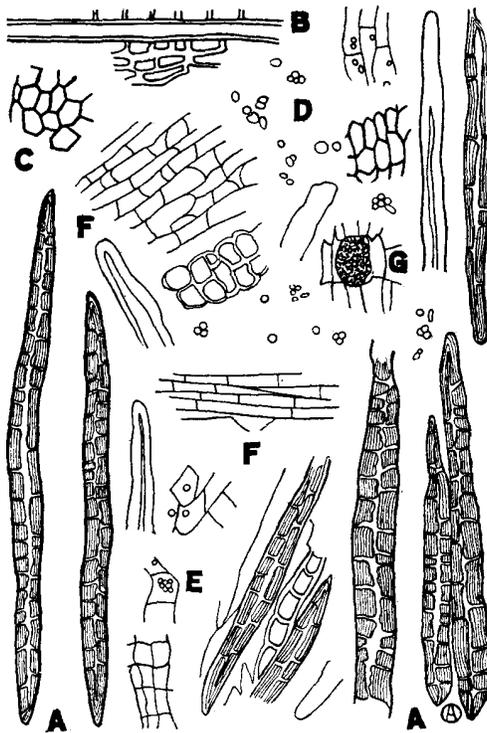


FIG. 296.—Powdered Yellow Cinchona. (X 60.) A, Bast fibers. B, Bast fibers with adjacent parenchyma cells. C, Cork, surface view. D, Starch. E, Parenchyma containing starch. F, Fragments of the phloem. G, Parenchyma containing fine crystals of calcium oxalate.

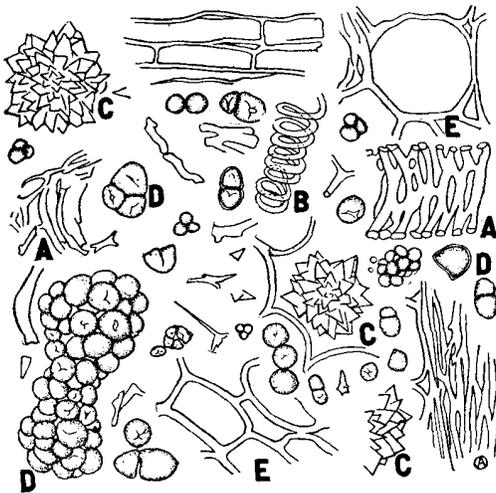


FIG. 297.—Powdered Rhubarb. (X 183.) A, Fragments of reticulate water tubes. B, Spiral water tube. C, Aggregate crystals of calcium oxalate. D, Starch. E, Parenchyma. F, Phloem.

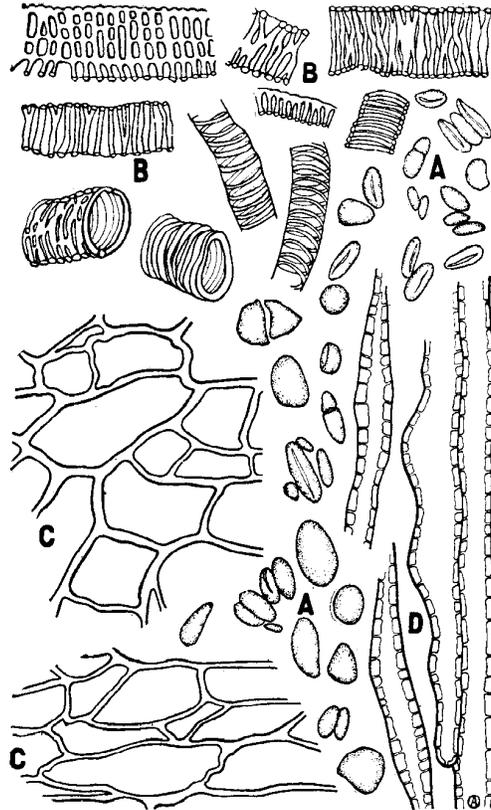


FIG. 298.—Powdered Zingiber, Jamaica Ginger. (X 183.) A, Starch. B, Water tubes. C, Parenchyma cells. D, Sclerenchyma fibers.

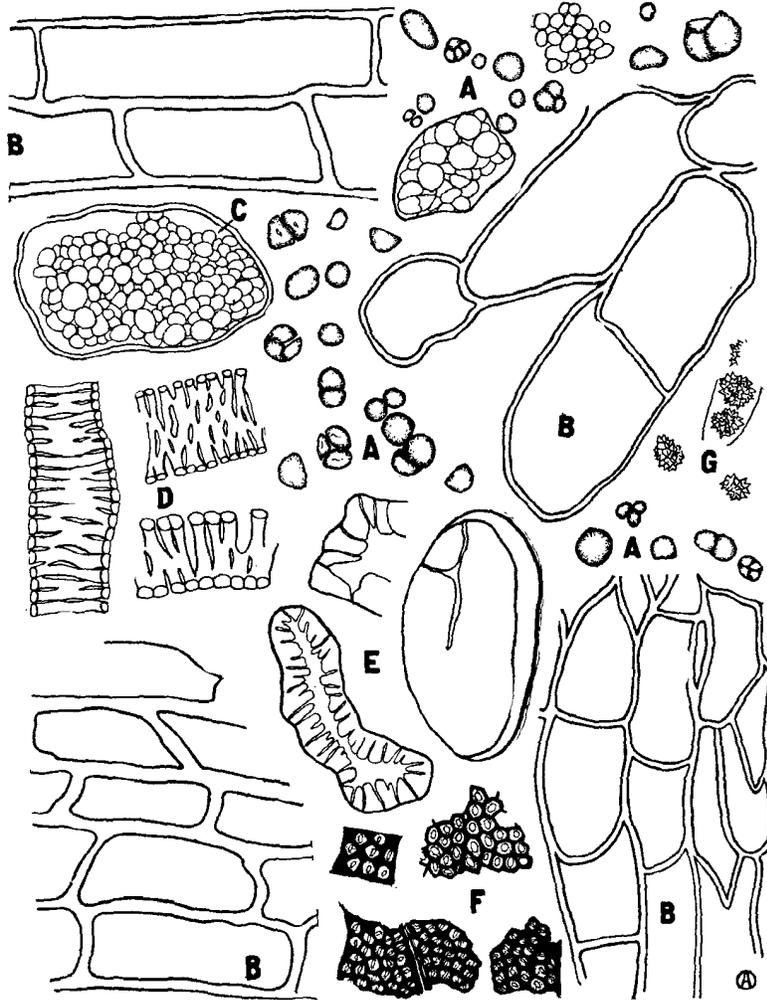


FIG. 299.—Powdered Jalapa. (X 183.) A, Starch grains. B, Parenchyma cells. C, Parenchyma cell filled with starch. D, Water tubes. E, Stone cells. F, Fragments of porous water tubes. G, Aggregate crystals of calcium oxalate.

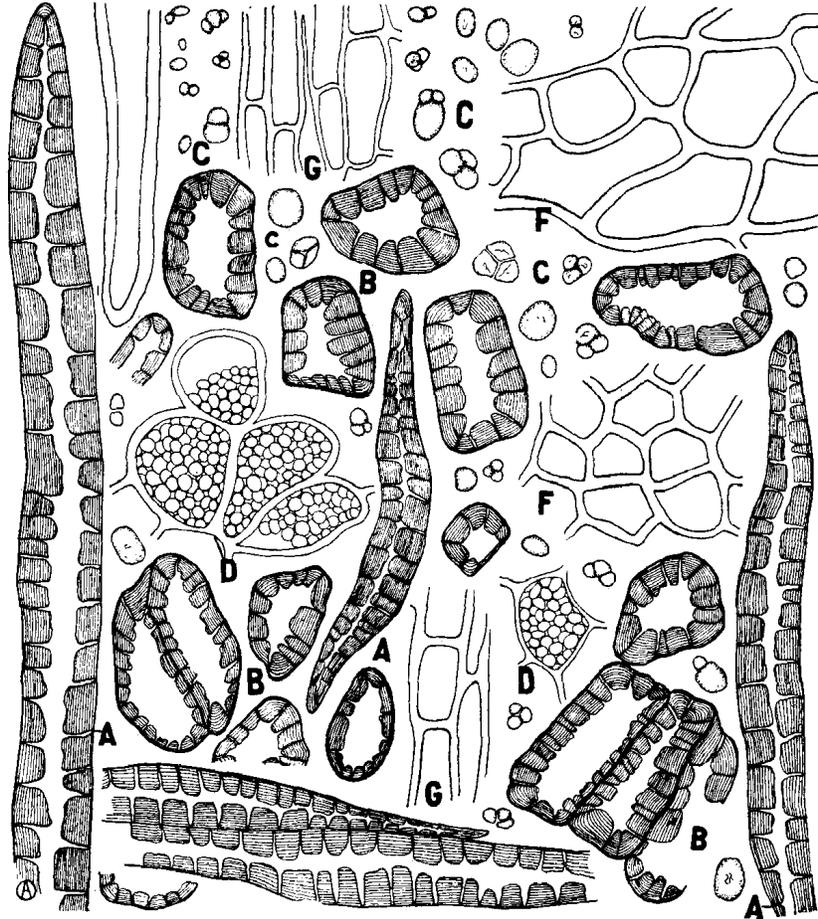


FIG. 300.—Powdered Saigon Cinnamon. (X 183.) A, Bast fibers. B, Stone cells. C, Starch. D, Parenchyma cells containing starch. F, Cork, surface view. G, Fragments of phloem.

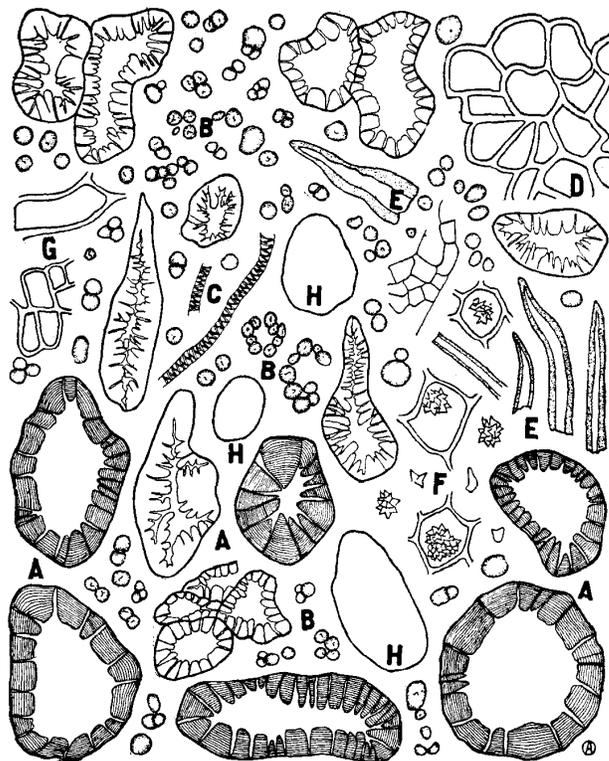


FIG. 301.—Powdered Pimenta. (X 183.) A, Stone cells. B, Starch. C, Spiral water tube. D, Epidermis. E, Trichomes. F, Aggregate crystals of Calcium oxalate. G, parenchyma. H, Parenchyma cells containing red color. See N.F., p. 329.

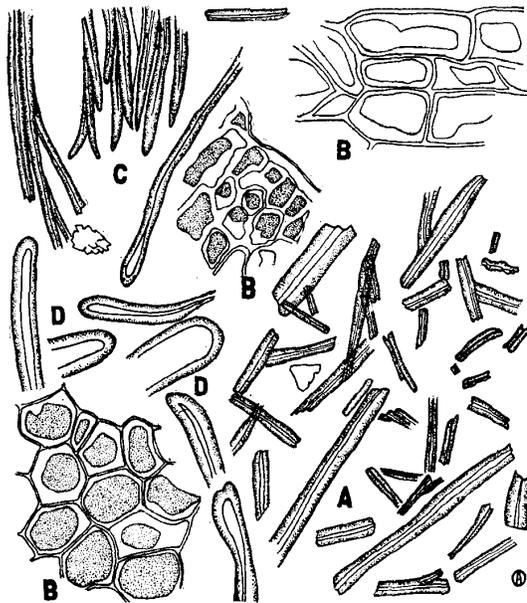


FIG. 302.—Nux Vomica. (X 183.) A, Fragments of trichomes. B, Thick-walled cells of the endosperm, containing granular proteid. C, Fragments of trichomes showing the pointed tips. D, Fragments of trichomes showing the rounded bases.

B-ALPHABETICAL LIST OF DRUG POWDERS WITH SYNOPSIS OF ESSENTIAL MICROSCOPICAL ELEMENTS

(For more detailed description of the microscopical elements see U.S.P.)

146.² ACONITE

Powder.—Grayish- brown; starch grains, nearly spherical, simple or 2 to 5 compound (3 to 15 μ in diam.); stone cells, large, tabular, irregular, or elongated to fibers; yellowish-brown cork fragments, few; tracheae, spiral, reticulate or with bordered pits; parenchyma, relatively thick-walled, filled with starch.

341. ALTHÆA

Powder.—White or light yellow; starch grains, numerous (5 to 20 μ in diam.), calcium oxalate crystals in rosette aggregates (15 to 35 μ in diam.); bast fibers in groups, sometimes not strongly lignified, tracheae scalariform or with bordered pits; numerous parenchyma fragments with large mucilage cells.

381. ANISUM

Powder.—Yellowish- brown, fragments of pericarp showing portions of yellow oil reservoirs numerous; small tracheae accompanied by sclerenchyma fibers; endosperm cells filled with aleurone (about 6 μ in diam.), each containing a rosette crystal of calcium oxalate (about 2 μ in diam.); 1-celled hairs up to 2000 μ long, having slight projections on the surface; the endocarp is characteristic.

565. ARNICA

Powder.—Yellowish-brown, pappus consists of multicellular axis with unicellular branches; non-glandular hairs 1- to 6-celled, glandular hairs of three kinds, with unicellular stalk and unicellular head; a 4-celled stalk and unicellular head, or a 10-celled stalk of a double row of cells with a 2-celled head; pollen grains numerous, spherical (25 to 35 μ in diam.)

42. AMYLUM

Powder.—White, starch grains, polygonal, rounded or spherical (3 to 35 μ in diam.) with central cleft 3 to 5 rayed.

12. ASPIDIUM

Powder.—Greenish or brown; starch grains, numerous, oval or oblong (5 to 15 μ in diam.) in characteristic clumps; fragments of parenchyma sclerenchyma fibers and tracheids numerous; and characteristic brown fragments of the endodermis.

² Numbers refer to No. of drug in Part II.

447. ASPIDOSPERMA

Powder.—Reddish-brown,; starch grains, spherical, ovoid or plano-convex (3 to 25 μ in diam.); bast fibers, long accompanied by crystal fibers; stone cells in large groups; cork cells sometimes lignified; calcium oxalate in prisms or pyramids (8 to 30 μ long).

278. AURANTII AMARI CORTEX

Powder.—Yellowish to light brown, consists mostly of parenchyma with occasional membrane crystals of calcium oxalate (4 to 30 μ long); tracheæ, few small, spiral or with simple pores.

504. BELLADONNÆ FOLIA

Powder.—Green, consists mostly of irregular leaf fragments; calcium oxalate small in small aggregates or wedge-shaped micro-crystals; hairs, few, the nonglandular 2 to 5 cells, the glandular with 1- to 3-celled stalks and heads one to many celled; trachea-, annular, spiral, reticulate or with bordered pits; few long thinwalled bast fibers and few pollen grains. (See Fig. 279.)

503. BELLADONNÆ RADIX

Powder.—Light brown; starch grains, numerous, spherical, polygonal or plano-convex (3 to 30 μ in diam.) 2 to 8 or more compound; micro-crystals of calcium oxalate numerous (3 to 10 μ); cork cells, few; tracheæ, few and large, usually associated with wood fibers; long bast fibers from stem bases are often present.

274. BUCHU

Powder.—Pale green, consists mostly of parenchyma, often containing sphaerocrystals of inulin (25 to 40 μ in diam.) and numerous globules short and unicellular; aggregate crystals of calcium oxalate (15 to 25 μ in diam.); tracheids and bast fibers, few. (See Fig. 294.)

156. CALUMBA

Powder.—Yellowish to greenish-brown; starch grains, numerous (8 to 85 μ in diam.) few 2 to 3 compound, ovoid, ellipsoidal or irregular usually with excentral hilum; stone cells, few, usually containing one or more prismatic crystals of calcium oxalate, sometimes having micro-crystals; tracheæ, few, reticulate or with bordered pits; occasionally, wood-fibers with long, oblique, slit-like pits; cork cells, yellow in regular radial rows and tangentially stretched.

112. CANNABIS

Powder.—Dark green, consists of fragments of leaves, and bracts showing yellowish lacticiferous vessels, rosette aggregates of calcium oxalate (6 to 30 μ in diam.), and fragments of fruits and stems; non-glandular hairs, unicellular, pointed, usually

containing some calcium carbonate which gives a strong effervescence with dilute HCl; glandular hairs, short with 1-celled stalk, or long multicellular, the head consisting of 8 to 16 cells; palisade-like, thick-walled cells from the fruits; tissues of embryo and endosperm with numerous aleurone grains (5 to μ in diam.) and oil globules.

CANTHARIS (See animal products)

Powder.—Grayish-brown, showing conspicuous shining green particles and numerous long, pointed hairs.

516. CAPSICUM

Powder.—Yellowish-brown to brownish-red, cells of epidermis of uniform size and regular arrangement; parenchyma containing numerous reddish oil globules, and chromoplasts; stone cells of endocarp with yellowish wavy, moderately thickened porous walls, those of the seed coat, yellowish, irregular, strongly thickened and much more strongly lignified than those of the endocarp.

82. CARDAMOMI SEMEN

Powder.—Greenish-brown, fragments of seed with dark brown stone cells (20 μ in diam.); polygonal in surface view; cells of endosperm and perisperm containing compound starch grains (1 to 4 μ in diam.); a few small tracheæ may be present.

385. CARUM

Powder.—Yellowish-brown; fragments of pericarp with light yellow oil ducts; tracheæ often accompanied by sclerenchyma fibers which are slightly lignified and have oblique pits; endosperm cells contain aleurone grains which usually include a rosette of calcium oxalate about 1 μ in diam.

371. CARYOPHYLLUS

Powder.—Dark brown to reddish-brown; thin-walled parenchyma showing large oil reservoirs; a few small spiral tracheæ and thick-walled spindle-shaped bast fibers, rosettes of calcium oxalate (2 to 15 μ in diam.); pollen grains (15 to 25 μ in diam.).

334. CASCARA SAGRADA

Powder.—Light or dark brown; bast fibers, usually in groups accompanied by crystal fibers; thick-walled stone cells in large groups; parenchyma and medullary ray cells have numerous nearly spherical starch grains (3 to 8 μ in diam.); calcium oxalate in prisms or rosettes (8 to 20 μ in diam.); reddish-brown cork fragments. (See Fig. 276.)

133. CIMICIFUGA

Powder.—Light or dark brown; starch grains, numerous, simple or compound,

spherical or polygonal (2 to 15 μ in diam.); tracheæ, mostly with bordered pits and usually associated with lignified wood fibers; yellowish-brown fragments of epidermis.

532. CINCHONA

Powder.—Reddish-brown, bast fibers, large spindle-shaped (300 to 1500 μ long) often showing lamellated walls; starch grains, simple or 2 to 5 compound, nearly spherical (3 to 12 μ in diam.); calcium oxalate in wedge-shaped micro-crystals; reddish-brown fragments of cork. (See Fig. 296.)

532. CINCHONA RUBRA

Powder.—Light brown to brown; elements similar to those of Cinchona, but starch grains are usually fewer and smaller.

169. CINNAMOMUM SAIGONICUM

Powder.—Yellowish or reddish-brown; starch grains simple or compound, ellipsoidal or polygonal (3 to 20 μ in diam.); stone cells, irregular colorless or filled with a reddish-brown amorphous substance; bast fibers having thick slightly lignified walls, single or in groups (300 to 1500 μ long); reddish-brown cork fragments. (See Fig. 300.)

167. CINNAMOMUM ZEYLANICUM

Powder.—Light or yellowish-brown; starch grains simple or compound, ellipsoidal or polygonal (3 to 20 μ in diam.); stone cells, numerous, irregular, colorless or containing reddish-brown amorphous substance; bast fibers, with thick, slightly lignified walls, spindle-shaped (300 to 1000 μ long). Calcium oxalate raphides (5 to 10 μ long) sometimes present.

68. COLCHICI CORMUS

Powder.—Light to grayish-brown; starch grains numerous, simple or 2 to 6 compound, spherical or polygonal (3 to 30 μ in diam.); few spiral or scalariform tracheæ; few fragments of reddish-brown epidermis.

69. COLCHICI SEMEN

Powder.—Light brown; parenchyma of endosperm thick-walled with simple pits and containing aleurone grains (3 to 15 μ in diam.) and oil globules; cells of seed coat somewhat collapsed, having thin reddish-brown walls; and a few small ellipsoidal starch grains (5 to 16 μ in diam.).

544. COLOCYNTHIDIS PULPA

Powder.—Yellowish-white or buff; consists chiefly of parenchyma cells usually in fragments; tracheæ only occasional; from the seed coats few stone cells which are nearly isodiametric or irregular; few oil globules and aleurone grains.

386. CORIANDRUM

Powder.—Light brown; fragments of endosperm, filled with aleurone grains usually containing aggregates of calcium oxalate, and oil globules; sclerenchyma fibers, yellowish thick-walled, irregularly curved; few fragments of yellow oil reservoirs, and polygonal epidermis; calcium oxalate aggregates (3 to 10 μ in diam.) may be separated from the aleurone grains.

368. EUCALYPTUS

Powder.—Green; epidermis, thick-walled and strongly cuticularized: palisade, very numerous, 3 to 4 rows deep, in which occur large oil reservoirs containing yellowish contents. Calcium oxalate of rosettes or mono-clinic prisms (15 to 30 μ in diam.), in the spongy parenchyma are vascular tissues and few slightly lignified bast fibers.

382. FÆNICULUM

Powder.—Yellowish-brown; endosperm cells filled with aleurone grains each with a rosette of calcium oxalate (about 2 μ in diam.); yellowish-brown fragments of oil reservoirs; sclerenchyma fibers few, strongly lignified; spiral or annular tracheæ, few; parenchyma cells, numerous; sometimes with thickened walls.

333. FRANGULA

Powder.—Yellowish-brown; stone cells are absent, otherwise the elements are almost identical with those of Cascara Sagrada (see page 295). Frangula gives a deeper orange color than does cascara when treated with alkalies.

105. GALLA

Powder.—Brownish-gray; starch-bearing parenchyma cells numerous; starch spherical to polygonal (11 to 35 μ in diam.); stone cells few, variable (25 to 250 μ long); tracheæ spiral or reticulate.

438. GELSEMIUM

Powder.—Dark yellow; tracheæ, spiral and with bordered pits associated with long narrow fiber-tracheids; bast fibers, long and narrow; starch grains, spherical (4 to 8 μ in diam.); calcium oxalate in monoclinic prisms (15 to 30 μ long); few very thick-walled groups of stone cells.

441. GENTIANA

Powder.—Light brown or yellowish-brown, consisting mostly of parenchyma cells varying much in size and form; tracheæ spiral, scalariform or reticulate; yellowish-brown cork.

230. GLYCYRRHIZA

Powder.—Brownish-yellow to pale yellow; starch grains oval or elliptical (3 to 25 μ in diam.); tracheæ with bordered pits associated with wood fibers, numerous; bast fibers, numerous, very long and usually in groups accompanied by crystal fibers, containing prisms of calcium oxalate (2 to 25 μ in diam.); fragments of reddish-brown cork occur in Spanish Licorice.

366. GRANATUM

Powder.—Yellowish-brown to dark brown; crystals of calcium oxalate in aggregate prisms or crystal fibers (10 to 20 μ in diam.); starch grains, spherical to polygonal, simple or compound (2 to 10 μ in diam.); cork fragments, whitish; stone cells, usually occur singly and are strongly lamellated (40 to 200 μ long).

576. GRINDELIA

Powder.—Yellowish-brown; tracheae, annular spiral reticulate, or with bordered pits, associated with narrow wood fibers; leaf epidermis characteristic, showing large colorless multicellular glandular hairs; pollen grains, spherical spinose (about 35 μ in diam.).

329. GUARANA

Powder.—Pinkish-brown; irregular masses of parenchyma and altered starch grains; starch grains, spherical to polygonal (10 to 25 μ in diam.); few elongated, yellowish, thick-walled sclerenchyma cells, which are usually not lignified.

134. HYDRASTIS

Powder.—Yellowish-brown; starch numerous, usually simple, nearly spherical (2 to 15 μ in diam.); vascular tissues usually associated with starch-bearing parenchyma; tracheae spiral, reticulate or with bordered pits; few thin-walled wood fibers; and occasional fragments reddish-brown cork.

509. HYOSCYAMUS

Powder.—Grayish-green; calcium oxalate crystals in 4- to 6-sided prisms (15 to 25 μ long), in spherical or rosette aggregates (about 20 μ in diam.) or in wedged-shaped micro-crystals; non-glandular hairs 2 to 10 cells long; glandular hairs with stalk 1 to 4 cells long and 1 to many celled head; stomata broadly elliptical about 30 μ long, with 3 to 4 neighboring cells; tracheæ spiral reticulate or with bordered pits and associated with few fibers; pollen grains about 40 μ in diam., nearly smooth. (See Fig. 280.)

530. IPECACUANHA

Powder.—Light brown; starch grains, numerous, simple 2 to 6 or more compound, spherical or polygonal (2 to 18 μ in diam.); calcium oxalate raphides (15 to 40 μ long)

few; tracheids numerous; occasional stone cells from stem bases (30 to 40 μ long). (See Fig, 277.)

460. JALAPA

Powder.—Light brown; starch grains, numerous, simple or 2 to 4 compound ellipsoidal to ovoid (4 to 35 μ in diam.); often swollen and somewhat altered; calcium oxalate in rosettes (10 to 40 μ in diam.); tracheæ with simple or bordered pits; laticiferous vessels containing yellowish-brown masses. (See Fig. 299.)

264. LINUM

Powder.—Lemon yellow to light brown; the seed coat has tabular pigment cells, filled with reddish-brown insoluble substance; stone cells elongated and yellowish; oil globules numerous; aleurone grains, numerous (2 to 20 μ in diam.).

552. LOBELIA

Powder.—Dark green; cells of seed coat more or less polygonal, walls thick and yellowish; few non-glandular hairs (30 to 60 μ long); tracheæ annular, spiral or reticulate, accompanied by narrow thin-walled wood fibers; leaf epidermis with elliptical stomata about 25 μ long and with 3 to 4 neighboring cells; pollen grains, nearly spherical about 25 μ in diam.

18. LYCOPODIUM

The spores are spherical tetrahedrons (25 to 40 μ in diam.) with the outer walls extended into irregular projections.

599. MATRICARIA

Powder.—Yellowish to yellowish-green; pollen grains numerous, spinose, varying from nearly spherical to triangular (about 20 μ in diam.); glandular hairs from the corolla, and cells of the anthers are characteristic; few sclerenchyma fibers.

473. MENTHA PIPERITA

Powder.—Dark green; non-glandular hairs 1 to 8-celled; glandular hairs with stalks 1 or 3-celled and 1 to 8-celled heads; pollen grains nearly spherical, smooth (about 30 μ in diam.); tracheæ, spiral or with simple or bordered pits; thin-walled sclerenchyma fibers, few.

474. MENTHA VIRIDIS

Powder.—Similar in structure to Mentha Piperita.

365. MEZEREUM

Powder.—Light grayish-brown; numerous long bast fibers (400 to 3000 μ long) somewhat uneven and bent, non-lignified; cork cells yellowish-brown; starch grains, few, simple or 2 to 4 compound (3 to 15 μ in diam.).

154. MYRISTICA

Powder.—Dark reddish-brown; perisperm of thin-walled parenchyma cells in which are large oil reservoirs; endosperm of parenchyma filled with starch and aleurone grains; starch, simple or compound, spherical to polygonal (3 to 20 μ in diam.); few small spiral tracheæ; oil globules numerous.

294. MYRRHA

Powder.—Yellowish-brown; mounted in fixed oil shows angular fragments; when cleared and stained in chloral hydrate iodine a few spherical or irregular starch grains (10 to 35 μ in diam.) may appear; when tested with phloroglucin may show fragments of sclerenchyma fibers or stone cells. (See Fig. 302.)

435. NUX VOMICA

Powder.—Light gray; endosperm cells thick-walled, containing oil globules and aleurone grains; numerous non-glandular, lignified hairs having pitted walls; cells of adhering fruit pulp may show few small spherical starch grains. (See Fig. 302.)

180. OPII PULVIS

Powder.—Light brown; consists of irregular granular fragments; epidermis of poppy capsuls 4 to 5-sided or elongated, thick-walled and lignified; fragments of poppy leaves and rumex fruits.

548. PEPO

Powder.—Whitish or yellowish; outer epidermis palisade-like, cells up to 1 mm. long; stone cells variable in size and thickness of walls up to 75 μ long; parenchyma cells with peculiar reticulate markings or rather thick-walled and somewhat

185. SANGUINARIA

Powder.—Brownish-red; starch grains, numerous, (3 to 20 μ diam.) spherical to ovoid; simple or 2 to 3 compound; latex tissue fragments with reddish-brown masses; tracheæ with slit-like pits few,

239. SANTALUM RUBRUM

Powder.—Brownish-red; wood fibers numerous, walls thick, yellowish, up to 800 μ long; tracheae, few with simple or bordered pits; crystal fibers with prisms of calcium oxalate (10 to 20 μ in diam.).

58. SARSAPARILLA

Powder.—Grayish-brown; starch grains, spherical to nearly tetrahedral, simple or 2 to 5 compound (3 to 25 μ in diam.); raphides of calcium oxalate (6 to 30 μ long); tracheae scalariform, reticulate or with simple or bordered pits, often associated with thin-walled sclerenchyma fibers; cells of hypoderm and endoderm yellowish, up to 500 μ long.

170. SASSAFRAS

Powder.—Light reddish-brown; starch grains, spherical to polygonal, simple or 2 to 4 compound (3 to 20 μ in diam.); bast fibers, spindle-shaped or irregular (150 to 400 μ long and 25 μ broad) with very thick walls; numerous parenchyma cells, many containing yellowish-red masses of tannin; few brownish-red fragments of cork.

462a. SCAMMONII RADIX

Powder.—Grayish-brown; starch grains, simple or 2 to 4 compound (3 to 18 μ in diam.); calcium oxalate in prisms (10 to 45 μ long); tracheae reticulate or with simple or bordered pits and usually associated with wood fibers; stone cells variable in form (40 to 125 μ long); few cork cells which are often lignified; fragments of phloem showing yellowish-brown resin cells.

67. SCILLA

Powder.—Light yellow; raphides of calcium oxalate (750 to 1000 μ long); parenchyma cells large, thin-walled, colorless; tracheae spiral or reticulate; occasionally a few nearly spherical starch grains occur.

302. SENEGA

Powder.—Yellowish-gray to brown; wood fibers non-lignified (175 to 250 μ long); fragments of thin-walled parenchyma containing oil globules; tracheae with simple or bordered pits; numerous medullary ray cells with large simple pits.

240. SENNA

Powder.—Light green (Alexandria Senna) or slightly darker green (India Senna); stomata broadly elliptical (about 20 μ in diam.) crystal fibers; calcium oxalate in rosettes (about 10 μ in diam.) or 4 to 6-sided prisms about 15 μ long; nonglandular hairs 1-celled, often curved, thick-walled and rough up to 350 μ long. In India Senna the hairs are relatively fewer. (See Fig. 295.)

118. SERPENTARIA

Powder.—Grayish-brown; starch grains spherical to plano-convex (3 to 14 μ in diam.), simple or 2 to 4 compound; tracheae annular, spiral or reticulate; short wood fibers; small amount of cork; numerous lignified parenchyma pith cells; few non-glandular

hairs from stem may be present.

188. SINAPIS ALBA

Powder.—Light yellow to brownish-yellow; parenchyma cells contain aleurone and oil; fragments of seed coats nearly colorless composed of small stone cells and large epidermal cells, the outer walls being mucilaginous; occasionally few small starch grains are present.

189. SINAPIS NIGRA

Powder.—Light brown to greenish-brown; thin-walled parenchyma of embryo contains aleurone grains and oil; fragments of seed coats composed of small yellowish stone cells with dark lumen; and large mucilaginous cells of epidermis often associated with the very large sub-epidermal cells.

439. SPIGELIA

Powder.—Grayish-brown; starch grains nearly spherical (2 to 6 μ in diam.); tracheae and tracheids conspicuous; few long slender bast fibers; fragments of reddish-brown epidermis and brownish cork.

304. STILLINGIA

Powder.—Pinkish or reddish-brown; starch grains variable in form, mostly simple (5 to 35 μ in diam.); tracheae with simple pits, usually associated with wood fibers; bast fibers long, narrow, thick-walled; reddish-brown cork; rosettes of calcium oxalate up to 35 μ in diam; somewhat tabular reddish-brown secretion cells.

507. STRAMONIUM

Powder.—Brownish-green; stomata elliptical about 25 μ long, usually with 3 neighboring cells; calcium oxalate in numerous rosettes (10 to 20 μ in diam.) in prisms or wedge-shape micro-crystals; non-glandular hairs with 1 to 2-celled stalks and 2 to 4-celled heads; spiral or annular tracheae; stems have large tracheae with annular and spiral thickening or with bordered pits usually associated with wood parenchyma and occasional wood fibers; long collenchymatous cells are often present, (See Fig. 293.)

451. STROPHANTHUS

Powder.—Grayish to dark-brown; mostly composed of thin-walled parenchyma cells; many of which are colored greenish upon addition of H_2SO_4 ; numerous fragments of long thin-walled hairs (relatively fewer in *S. hispidus*); numerous oil globules.

400, SUMBUL

Powder.—Grayish-brown; numerous large tracheae which are mostly reticulate; long

narrow collapsed fragments of phloem; few fragments of parenchyma containing starch grains (3 to 12 μ in diam.); numerous nearly colorless or yellowish to reddish-brown irregular fragments.

553. TARAXACUM

Powder.—Light brown; parenchyma cells large; thin-walled containing masses of inulin; fragments of yellowish latex vessels; reticulate trachea; and sclerenchymatous fibers.

256. TRAGACANTHA

Powder.—Whitish; irregular fragments showing lamellated mucilaginous walls and few starch grains nearly spherical, simple or 2 to 3 compound (3 to 17 μ in diam.).

37. TRITICUM

Powder.—Yellowish; tracheæ annular, spiral or with simple pits and associated with long narrow sclerenchymatous fibers; epidermal cells rectangular strongly lignified with numerous transverse pits; numerous fragments of rectangular thinwalled parenchyma.

109. ULMUS

Powder.—Light brown; bast fibers numerous very long and slightly lignified, often associated with crystal fibers; calcium oxalate in prisms (10 to 25 μ in diam.); starch grains, mostly simple, nearly spherical (about 3 or μ in diam. or up to 25 μ) fragments of large mucilage cells.

41L UVA URSI

Powder.—Olive green; epidermal cells polygonal; stomata, broadly elliptical about 25 μ long with 5 to 8 adjacent cells; tracheae mostly spiral, often associated with sclerenchyma and crystal fibers; prisms of calcium oxalate (6 to 15 μ in diam.).

543. VALERIANA

Powder.—Light brown or grayish-brown; starch grains spherical to polygonal, simple or 2 to 4 compound, (3 to 20 μ in diam.); tracheae reticulate or with simple or bordered pits often accompanied by sclerenchyma fibers; fragments of epidermis with root hairs and brownish cork.

60. VERATRUM VIRIDE

Powder.—Grayish-brown to dark brown; starch grains, spherical or ellipsoidal simple or 2 to 3 compound (3 to 20 μ in diam.); calcium oxalate raphides (15 to 150 μ long); tracheæ scalariform or reticulate and usually associated with narrow sclerenchyma fibers; fragments of reddish-brown cork.

541. VIBURNUM PRUNIFOLIUM

Powder.—Dark brown; stone cells, numerous, large and thick-walled; bast fibers few, with occasional crystal fibers; calcium oxalate in prisms or rosettes (15 to 35 μ in diam.).

270. XANTHOXYLUM

Powder.—Grayish-brown; cork cells nearly colorless and lignified; parenchyma containing small starch grains, oil globules or calcium oxalate; stone cells in small groups; few bast fibers,

78. ZINGIBER

Powder.—Light yellow to brown; parenchyma cell large and thin-walled filled with starch; starch grains ovate to elliptical (15 to 60 μ long); sclerenchyma fibers long and thin-walled; tracheae reticulate or scalariform; yellowish or brown oil and resin cells; brownish flattened cork cells, which are absent in Jamaica Ginger. (See Fig. 298.)