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AN INTRODUCTION

TO THE STUDY OF

MATERIA MEDICA

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AN INTRODUCTION

TO THE STUDY OF

MATERIA MEDICA

BEING A SHORT ACCOUNT OF THE MORE IMPORTANT CRUDE DRUGS OF VEGETABLE AND ANIMAL ORIGIN

DESIGNED for STUDENTS of PHARMACY and MEDICINE

BY

HENRY G. GREENISH, F.I.C., F.L.S.

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WITH TWO HUNDRED AND THIRTEEN ILLUSTRATIONS

LONDON

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PREFACE

During the time that it has been my duty to deliver the courses of lectures on Materia Medica to the students of the School of Pharmacy of the Pharmaceutical Society of Great Britain, I have keenly felt the want of a suitable work that I could place in their hands to relieve them of the necessity of taking and copying out copious lecture-notes. Although it is true that this practice serves to impress facts on the student's mind, yet it is undeniably accompanied by grave disadvantages. In the first place, the attention of the student is constantly diverted from the lecturer, the thread of the lecture is broken, and useful explanations may escape him; in the second place, the copying out of notes entails a loss of valuable time that might be more profitably devoted to consulting works of reference, and thus acquiring a knowledge of the literature of the subject. To this must be added the liability to introduce errors into his note-book and to perpetuate them by committing them to memory. These considerations have induced me to collect, arrange systematically, and in some respects amplify the details that have served me as a basis for my lectures.

The term 'materia medica,' literally interpreted, signifies all remedial agents of whatever kind, but it is more commonly used to designate that department of medicine devoted to the consideration of simple medicinal substances, known as 'drugs.' In medicine the term is usually employed in this sense, but in pharmacy it is generally understood to include only those drugs that are derived from the animal and vegetable kingdoms, and have not undergone any process of elaboration whereby their characters have been materially altered; such drugs are termed 'crude drugs.' Thus the poppy capsule is a crude drug, and opium, which consists simply of the dried latex of the unripe capsule, is also classed as a crude drug; but the alkaloid morphine, which is the chief constituent of opium, and can be extracted from it only by a comparatively elaborate process, is not regarded as such. Similarly the resins, oleo-resins, gum-resins, various dried juices, &c. are included amongst the crude drugs. The term is also extended to certain vegetable extracts imported from distant countries in which alone they are prepared, even if they have been partially purified, as, for instance, cutch and gambier, although similar extracts, prepared in this country, would no longer be considered as crude drugs.

Disregarding for the moment the few drugs derived from the animal kingdom, it is evident that the student will have to deal with organised and unorganised drugs. The former will consist of plants, or of organs that form parts of plants; the latter of products of plants. To enable him to study the former intelligently it is obvious that he must be acquainted with the morphology and anatomy of the organs they represent; for the examination of unorganised drugs some knowledge of inorganic and organic chemistry is, in addition, equally requisite. The study of these two sciences should therefore precede that of Materia Medica, and in the following pages that is assumed to have been the course adopted.

The drugs have been divided first into those that are organised and those that are unorganised.

The organised drugs have been subdivided into sections according to the organs they represent, and the members of each of the sections thus formed have been grouped in their natural orders. This arrangement, although in some respects convenient, is by no means an ideal one. I should have preferred a subdivision based upon the anatomical characters of the members, but such a classification would have premised a familiarity on the part of the student with the use of the microscope that I did not feel justified in assuming.

The unorganised drugs have been divided into groups depending principally upon differences in their composition or mode of preparation.

I have made no attempt to deal fully with the minute anatomy of the organised drugs. The introduction of a mass of detail that the student could neither appreciate nor verify appeared to me undesirable; moreover, the inclusion of complete descriptions of the microscopical structure accompanied by the necessary illustrations would have made the volume inconveniently bulky and have contributed to defeat rather than to accomplish its object. I do not, however, wish to convey the impression that I consider a knowledge of the minute structure of drugs unnecessary; on the contrary, so firmly am I convinced of its ever-increasing importance that I propose to devote a subsequent volume exclusively to this portion of the work. For the present the student will do well to study the anatomy of the drugs as far as it can be ascertained by the aid of a good hand-lens.

I have persistently endeavoured to impress upon my students the necessity for minute and accurate observation. This is as essential in Materia Medica as in any science, and is undoubtedly the very foundation-stone of the study. The most difficult and at the same time the most important task of the teacher is that of educating his students to observe and to draw correct conclusions from the observations made. For this purpose the value of making sketches of the drugs examined cannot be over-estimated, for by so doing the student will be led to see much that would otherwise escape his observation. Having been once trained to use his powers of observation and reason, he should have little difficulty in detecting substitution. The enumeration of all the known substitutes, together with the characters that serve to identify each, appears to me to be undesirable. Such a course not only burdens the student with a number of disconnected details, but fails to educate him in the systematic, careful, and minute examination of every drug, by which means alone he can render himself capable of detecting and rejecting all substitutes and adulterants whether they have been previously observed or not. With the exception, therefore, of a few drugs (e.g. jaborandi, ipecacuanha), I have refrained from enumerating all the substitutes, intentional or accidental, that may, at some time or other, have appeared on the market. I would, however, insist upon the careful study of the drug itself, and, to assist the student, I have arranged the most important characters categorically, so that such as are not readily seen may not escape his notice; in order that he may learn to make use of these, I have suggested other drugs with which the one under examination might with advantage be compared.

I have referred very briefly to the history of many of the drugs, although I am well aware that this may be condemned as a waste of valuable space. It is, however, in my opinion very desirable that the student should possess an intelligent knowledge of the drug as a whole. This should embrace its history, botanical and geographical source, mode by which it is prepared or obtained, morphology, structure, constituents, &c. To restrict his knowledge to such details as may be considered necessary for examination purposes or directly convertible into pounds, shillings, and pence during his subsequent business career is a grave error, and a strong protest must be recorded against the treatment of the subject in so utilitarian and commercial a spirit. Irreparable mischief may be wrought by placing so low an ideal before the student, who should rather be encouraged to regard a complete knowledge of each drug as the object to be aimed at, and to be attained only by patient and far-reaching study.

In the compilation of this volume I have not hesitated to lay the leading authorities under contribution. The historical notes are taken chiefly from Flückiger's 'Pharmacognosie,' those on the uses of the drugs from Mitchell Bruce's 'Materia Medica and Therapeutics.' I have endeavoured to increase its utility by numerous illustrations, for most of which I am indebted to the works of Bentley, Bentley and Trimen, Berg, Luerssen, Maisch, Moeller, Pereira, Planchon and Collin, Tschirch, and Vogl, to the publishers of which my thanks are due. The Editor of the 'Pharmaceutical Journal' also has permitted the use of several blocks that have illustrated publications in the Journal; these have, by request, been referred to Holmes. In each case the source has been duly acknowledged. Many of the illustrations have been prepared from photographs taken specially for that purpose.

It has obviously been impossible to verify all the statements made; in most cases the name of the authority, with or without the date, has been inserted in brackets. I regret that the latter course has not been more uniformly adopted, as it appears to me to render reference easy and at the same time to indicate the time that has elapsed since the statement was first made.

My thanks are also due to many friends who have assisted me with information and advice, especially to Mr. J. Slinger Ward, who has put himself to much trouble to obtain and furnish particulars that I was in want of; and to Mr. F. A. Upsher Smith, Demonstrator of Materia Medica and Pharmacy, who has assisted me in the tedious work of proof-reading.

It has been my endeavour to place before the student of Materia Medica a work that shall be of real assistance to him, and although I am painfully conscious of many shortcomings, I trust that I may to some extent have succeeded.

ADVICE TO THE STUDENT

In making use of the accompanying volume as an aid in the study of crude drugs the following points cannot be too strongly impressed on the student.

1. The study must be essentially a practical one. Each drug should be carefully compared with the description given. Differences should be noted, and, if possible, an explanation should be sought from the teacher.

2. Before commencing any one of the first ten sections, the student should study the morphology and anatomy of the respective organs in his textbook of botany.

3. Whenever practicable a careful sketch should be made of the drug. In the case of seeds, fruits, roots, rhizomes, and barks, the prominent features of the transverse section should also be delineated, if necessary, on an enlarged scale. Flowers and leaves may be expanded by soaking them in warm water.

4. The meaning of botanical technical terms, if not precisely known, should be ascertained at the time from a suitable glossary.

5. A geographical atlas should be kept at hand, and referred to for each drug. On a blank atlas the names of the drugs may be entered at the places from which they are obtained.

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Erratum

Page 269, line 11, for *Ranunculaceæ* read *Berberideæ*.

MATERIA MEDICA

SECTION I

LEAVES

TEA

(Folia Theæ)

Source &c.—The tea shrub, *Camellia Thea*, Link (N.O. Camelliaceæ *Ternstrœmiaceæ*), from the leaf-buds and young leaves of which the black and green teas of commerce are prepared, has been cultivated from time immemorial in *China* and *Japan*, and more recently in *Assam*, *Ceylon*, *Java*, and other countries in which the climate is suitable.

In the manufacture of black tea the leaves are subjected to certain processes that vary somewhat in the different countries. In Assam, where much of the tea consumed in England is produced, the leaf-buds together with two or three of the youngest leaves are collected and spread upon trays until they have lost their turgidity, during which they retain their green colour. The 'withered' leaves are then rolled between two flat surfaces worked by machinery, by which they acquire the twist characteristic of ordinary tea. They are next 'fermented' by exposing them on mats to the air; during this process the colour changes from green to yellow and finally to coppery red, and the tea acquires its well-known odour. The fermented leaves are dried in special drying machines by a current of hot air, and are finally sifted through sieves of varying size. These separate the leaf-buds, the small and the larger leaves, and in this way the various qualities are produced.

Green tea is prepared in a different manner. The leaves, which at most are only slightly withered, are subjected to a process of roasting in pans heated by direct fire, in which they are kept continually moving; they are then cooled, rolled into balls, and allowed to ferment. After fermentation, during which the leaf retains its green colour, the leaves are rolled (by hand singly into small balls for the variety known as gunpowder tea), dried, and thrown into rotating drums, in which by the friction of leaf against leaf the final characteristic colour of green tea is produced.

The change of colour that occurs during the fermentation of black tea is probably due to a change in the tannin present in the leaf, and it appears that the preliminary roasting in the manufacture of green tea prevents this change from taking place; hence the difference in colour.

Description.—The full-grown tea leaf is from 2 to 4 inches long, dark green in colour, lanceolate or elliptical in outline, blunt at the apex, and tapering at the base into a short stalk; the margin is distantly and shortly serrate. When quite young the leaves are covered with silky hairs, but as they mature these are lost, and the surface becomes glabrous.

Constituents. — The principal constituents of tea are *caffeine* and *tannin*. It contains in addition traces of *theobromine* and *theophylline*, as well as of a *volatile oil*, to which its agreeable odour is due.

Caffeine, an alkaloid obtainable in colourless silky crystals, was first discovered in coffee by Runge in 1820. In 1827 Oudry extracted a crystalline substance from tea, which was considered to be distinct from caffeine and termed theine, but the identity of these two alkaloids has, however, now been satisfactorily demonstrated. Caffeine occurs also in maté (the leaves of *Ilex paraguayensis*, Lamb., which are largely used in the Argentine Republic as we use tea), in cola seeds, and in guarana; it is present in tea in proportions varying from 1 to 5 per cent., Ceylon and Assam tea showing little variation from an average of about 4 per cent. (Paul and Cownley, 1887). The tannin varies from 10 to 24 per cent. in the same two varieties of tea (Hooper, 1889). But the commercial value of tea is not determined by the percentage of caffeine or of tannin contained in it, but by a combined consideration of several factors, such as appearance, which counts to a considerable degree, the size of the leaves as indicating their age, the presence of 'tip' (unexpanded leaf-bud), and the taste of the infusion (Paul and Cownley).

Adulterations.—Tea has been largely adulterated with foreign leaves, as well as with exhausted tea leaves that have been rolled and dried. For details concerning the detection of adulterations in tea, the student should refer to Allen's 'Commercial Organic Analysis.'

COCA LEAVES

(Folia Cocæ)

Source &c.—In *Peru* and *Bolivia* the coca shrub has been cultivated for so many centuries that the plant is no longer known in the wild state. It certainly occurs in several distinct forms, which, according to the British Pharmacopœia, are to be considered as varieties of one species, viz. *Erythroxylum Coca*, Lam. (N.O. *Lineæ*). The dried leaves of the plant are in common daily use by the Indians, to whom they have become an almost indispensable nerve-stimulant; mixed with lime or with the ashes of a species of *Chenopodium* and chewed they impart unusual powers of endurance, allaying the cravings of hunger and the feeling of fatigue. On the steep sides of the valleys in the spurs of the Andes the coca is cultivated in large quantities. The leaves are picked twice in the year, or sometimes oftener, and dried. Only a very small proportion of the coca produced is exported; by far the greater part is consumed by the natives, whilst a considerable quantity is used in Callao for the manufacture of cocaine, the crude alkaloid being exported instead of the leaves.

There are two well-marked varieties of coca leaves, commercially known as *Huanuco* or *Bolivian*, and *Truxillo* or *Peruvian*, these names indicating their geographical sources.

Description.—*Huanuco* coca leaves usually reach the English market in a fairly good state of preservation. They have a characteristic brownish-green colour, and are oval in outline, varying usually in length from 1½ to 3 inches and in breadth from 1 to 1½ inch, although it is possible to find leaves that are much smaller. Both surfaces of the leaf are glabrous, and the lateral veins and veinlets are distinctly prominent. The margin is entire, and the lamina tapers towards both base and apex; the latter is acute, the midrib projecting in the form of a minute horny point (apiculus), which, however, is frequently broken off. When the upper surface of the leaf is examined with a lens the midrib is usually seen to lie in a slight depression; above it, and following its course, a distinct raised ridge may be observed. On the under surface near to the midrib, and on either side of it, a distinct curved line runs from the base to the apex of the leaf. Although the leaf is not thick it is by no means fragile, the lateral veins being comparatively strong. When a transverse section is examined under the microscope most of the epidermal cells of the under surface will be seen to project in the form of small papillæ; this peculiarity, although exhibited by other species of *Erythroxylum*, is so unusual as to render it of considerable diagnostic importance; hence its introduction into the British Pharmacopœia.

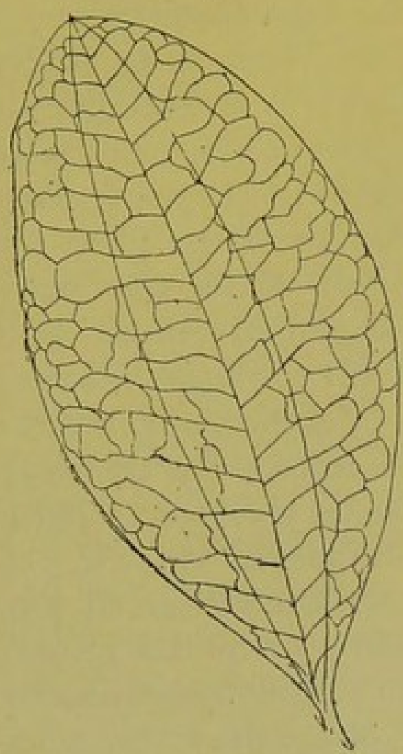


FIG. 1.—Leaf of *Erythroxylum Coca*, Lam., var. *Bolivianum*, Burck. (Burck.) Under surface, showing lines on each side of the midrib.

Coca leaves have a faint but characteristic odour. The taste is slightly bitter, the leaves producing, when chewed, a feeling of numbness in the mouth and throat.

The characters of this variety are so well marked that the plant yielding it has been considered entitled to rank as a distinct species.

Truxillo or *Peruvian* coca leaves are rather smaller than the Huanuco; they are pale green in colour and are more fragile, hence they are usually more or less broken. On the under surface the two curved lines are much less distinct; on the upper surface the ridge above the midrib is less marked and the network of veinlets less close and less prominent. These leaves frequently contain an admixture of the carefully picked and dried flowers of a species of *Inga*. This is an intentional addition, made apparently with the view of improving the coca, and is not to be regarded as an adulteration. The *Inga* flowers are about an inch long, and are easily recognised by their yellowish-brown, tubular, hairy calyx and numerous deep red filaments forming a plume.

Truxillo coca has been referred to *E. coca*, Lam., var. *Novo-Granatense*, Dyer, a variety cultivated in India, but the leaves much more closely resemble those of the var. *Spruceanum*, Burck, which is cultivated in Java.

Coca has been cultivated in British India, Ceylon, and Java, but commercially these sources are at present unimportant. Small quantities occasionally reach the market from Ceylon; they correspond in physical characters to the Huanuco variety.

FIG. 2.—Leaf of *Erythroxylum Coca*, Lam., var. *Spruceanum*, Burck. (Burck.) Cultivated in Java. Under surface.

The student should observe in both varieties of coca leaves

(*a*) The *curved lines on the under surface of the leaf*,
(*b*) The *minute horny apiculus*,
(*c*) The *characteristic odour and taste*;

in the Huanuco leaves:

(*d*) The *brownish-green colour*, *prominent veinlets*, and *less broken appearance*,
(*e*) The *ridge above the midrib*;

in the Truxillo leaves:

(*f*) The *pale green colour* and *fragile, broken appearance*,
(*g*) *Absence of a distinct ridge over the midrib.*

Constituents.—Coca leaves contain several alkaloids, the most important of which is *cocaine*, a definite crystalline substance with a bitter benumbing taste. Bolivian leaves contain more of this alkaloid than the Peruvian, but the quantity is usually less than 1 per cent. Other alkaloids of less importance are *cinnamyl-cocaine* and *truxilline*; these are frequently present in Peruvian leaves in larger quantity than the cocaine. All of these alkaloids are easily hydrolysed, and they all yield, together with other products, a crystalline alkaloid, ecgonine, from which by suitable treatment cocaine can be regenerated. Thus cocaine, when hydrolysed by heating to 100° C. with hydrochloric acid, yields methyl alcohol, benzoic acid, and ecgonine; cinnamyl-cocaine yields methyl alcohol, cinnamic acid, and ecgonine; and truxilline yields methyl alcohol, truxillic acid, and ecgonine. Ecgonine is very closely allied to tropine. (See under 'Belladonna Leaves.')

In leaves imported from Java *benzoyl pseudo-tropeine* has been found; this alkaloid yields, when hydrolysed, benzoic acid and pseudo-tropine; the latter is isomeric with tropine. Coca leaves contain, in addition, *cocatannic* acid.

Uses.—Coca is a stimulant tonic and restorative, and has been used to prevent muscular exhaustion. The alkaloid cocaine, when administered hypodermically, or applied to an exposed mucous surface, rapidly paralyses the sensory nerves and thus produces local anæsthesia. It is therefore of great value, and much used in minor surgical operations of the eye, nose, ear, &c.

Varieties.—Small quantities of coca leaves are imported from Ceylon and Java, but the bulk of the commercial drug is derived from South America. Cultivated coca leaves are, as a rule, less rich in cocaine than South American, and of the latter Huanuco (Bolivian) leaves are to be preferred. There is, however, no definite criterion of the relative value of coca leaves but the determination of the proportion of cocaine they contain.

BUCHU LEAVES

(Folia Buchu)

Source &c.—The official buchu leaves are obtained from *Barosma betulina*, Bart. & Wendl. (N.O. *Rutaceæ*), a small shrubby plant indigenous to *Cape Colony*. The drug, the use of which appears to have been learnt from the Hottentots, was introduced in 1821, but this was probably not derived from the species now official. The leaves are collected while the plant is flowering and fruiting, dried, and exported from Cape Town.

Description.—The leaves of *Barosma betulina*, commercially known as 'short' buchu, average from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, and are of a pale green or yellowish-green colour. They have a very characteristic shape, being rhomboid-obovate in outline, with a blunt, strongly recurved apex. They are rigid and brittle when quite dry, but become cartilaginous when moist. The surface is glabrous, the upper presenting small wart-like prominences due to the elevation of the epidermis by subjacent oil-glands; the lower surface is finely wrinkled. The margin is provided with numerous minute sharp teeth. When examined with a lens by transmitted light the lamina exhibits numerous oil-glands distributed throughout it,

FIG. 3.—Buchu leaves (*B. betulina*), showing the shape, margin, and recurved apex. Natural size.

but especially near the margin, one being situated at the base of each indentation.

The leaves have a characteristic odour, especially perceptible when they are crushed, and a strong aromatic taste.

The student should carefully observe

(*a*) The *rhomboidal outline* and *recurved apex*,
(*b*) The *oil-glands* and their distribution,
(*c*) The *characteristic odour and taste*;

and should compare the official variety with the other commercial buchu leaves mentioned below, as well as with

Bearberry leaves, which are rounded at the apex, spathulate in outline, and destitute of oil-glands.

Constituents.—The principal constituents of buchu leaves are *volatile oil* and *mucilage*, the former being contained in the oil-glands, whilst the latter is deposited on the inner walls of the epidermal cells. They contain in addition a yellow crystalline substance, *hesperidin*, which is found in several other rutaceous plants, but does not markedly contribute to the physiological action of the drug; this substance forms sphero-crystals in the epidermal cells. The volatile oil, of which short buchu yields about 1·45 per cent., deposits about 30 per cent. of a crystalline substance, *diosphenol*, when it is cooled. Diosphenol is considered to be an important constituent of buchu, and its absence from the variety of buchu known as long buchu has led to the exclusion of the latter leaves from the British Pharmacopœia.

Baros
camp

Buchu also contains traces of a crystalline substance, *diosmin*, which is probably a glucoside; it does not appear to be therapeutically important.

Varieties.—*Barosma serratifolia*, Willd.—The leaves of this plant, which, like *B. betulina*, is also a native of South Africa, are imported in considerable quantity, and known

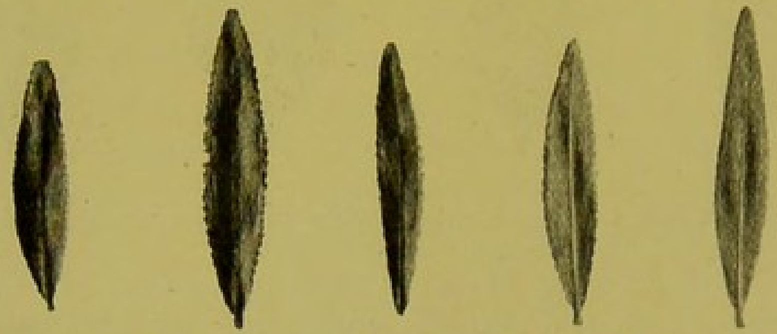


Fig. 4.—Buchu leaves (*B. serratifolia*). Natural size.

commercially as 'long buchu.' They are long narrow leaves, about 1 to 1½ inch long and linear-lanceolate in outline. The margin is serrate, and the apex distinctly truncate. The leaves contain oil-glands similar to those of *B. betulina*, one being distinctly visible in the truncate apex when examined with a lens. In odour and taste they resemble short buchu; they contain mucilage and about 1 per cent. of volatile oil, which, however, as previously mentioned, does not yield diosphenol when cooled.

The leaves of *Empleurum serrulatum*, Ait. (N.O. *Rutaceæ*), are occasionally imported and offered as 'long buchu.' They

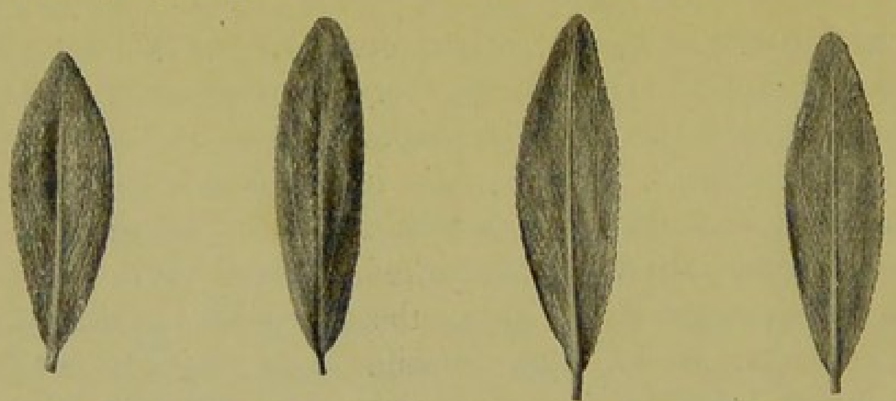


Fig. 5.—Buchu leaves (*B. crenulata*). Natural size.

closely resemble the leaves of *B. serratifolia* in appearance, and, like them, contain oil-glands; they may be distinguished by the following characters: the leaves taper gradually to an acute apex in which no oil-gland is visible, the odour is different, the taste bitterish, and the colour usually yellowish green.

Barosma crenulata, Hook.—The leaves of this plant are also imported from the Cape of Good Hope, but in smaller quantity than either of the preceding varieties of the drug. They are rather broader than the long buchu, varying in outline from lanceolate to oval-oblong. The margin is minutely serrate, and the apex is blunt but not recurved (as in *B. betulina*). In odour and taste they resemble the official leaves; they yield about 1·6 per cent. of volatile oil, which has not yet been examined for diosphenol.

Uses.—Buchu is regarded as possessing a tonic and diuretic action; it is used in inflammatory conditions of the urinary tract.

JABORANDI LEAVES

(Folia Jaborandi)

Source &c.—The name jaborandi is applied in South America, especially in *Brazil*, to a number of plants belonging chiefly to the natural orders Piperaceæ and Rutaceæ. The official description in the British Pharmacopœia limits the drug to the leaflets of a Brazilian shrub, *Pilocarpus Jaborandi*, Holmes (N.O. *Rutaceæ*).

Although the various jaborandis have long been used in South America, the sudorific and salivatory properties of the official drug were unknown in Europe till 1873, when the leaves were sent from Pernambuco to Paris. The demand that quickly arose for the drug was so large that the supply of the Pernambuco leaves was soon exhausted, and other varieties of jaborandi were exported in their place. To a certain extent these conditions still obtain. The supply of the official leaves is limited, and other varieties of jaborandi are from time to time exported, either in the place of, or mixed with, the official variety. This being the case, the attention of the student should be carefully directed to the diagnostic characters of the official drug.

The plant produces large, imparipinnate, compound leaves, with from two to four pairs of leaflets. These are collected, dried, and exported chiefly from Pernambuco and Ceara. The drug, as it arrives in this country, consists principally of the leaflets mixed with the petioles and occasional small fruits. The leaflets alone are official, and they are described as and commonly known as jaborandi leaves, although this designation is not strictly correct.

Description.—Jaborandi leaves are usually dull brownish-green in colour, coriaceous in texture, and oblong-lanceolate in shape, varying in length from 2½ to 4 inches. The margin is entire and revolute; the apex is blunt and emarginate. The leaf is usually rounded and unequal at the base, and attached to a short stalk. On the upper surface, which is quite glabrous, the lateral veinlets are distinctly prominent; the under surface is generally glabrous, but sometimes bears a few scattered hairs.

Examined by transmitted light, large oil-glands are easily visible in the mesophyll of the leaf. The crushed leaves exhale a characteristic but not powerful odour; they possess an aromatic pungent taste, and when chewed produce a copious flow of saliva.

The student should carefully observe

(*a*) The *presence of oil-glands*,
(*b*) The *entire margin*,
(*c*) The *emarginate apex*,
(*d*) The *inequality at the base*,
(*e*) The *prominence of the veinlets on the upper surface* which is *brownish green* in colour,
(*f*) The *glabrous or almost glabrous* under surface;

and should compare these leaves with

(i) *Cherry-laurel leaves*, which have a serrated margin, pointed apex, and no oil-glands,
(ii) *Bay leaves*, which are pointed at the apex, equal at the base, and have wavy margins,
(iii) Other varieties of *jaborandi leaves*, from all of which they are distinguished by their brownish-green colour, prominent veinlets, and glabrous surface.

Constituents.—Our knowledge of the constituents of jaborandi leaves is still in an unsatisfactory state. They contain about 0·5 per cent. of *volatile oil*, and in addition *one or more alkaloids* to which their activity is due. These alkaloids are present to the extent of between 0·5 and 1 per cent. (0·72, Paul and Cownley). The principal one, *pilocarpine*,

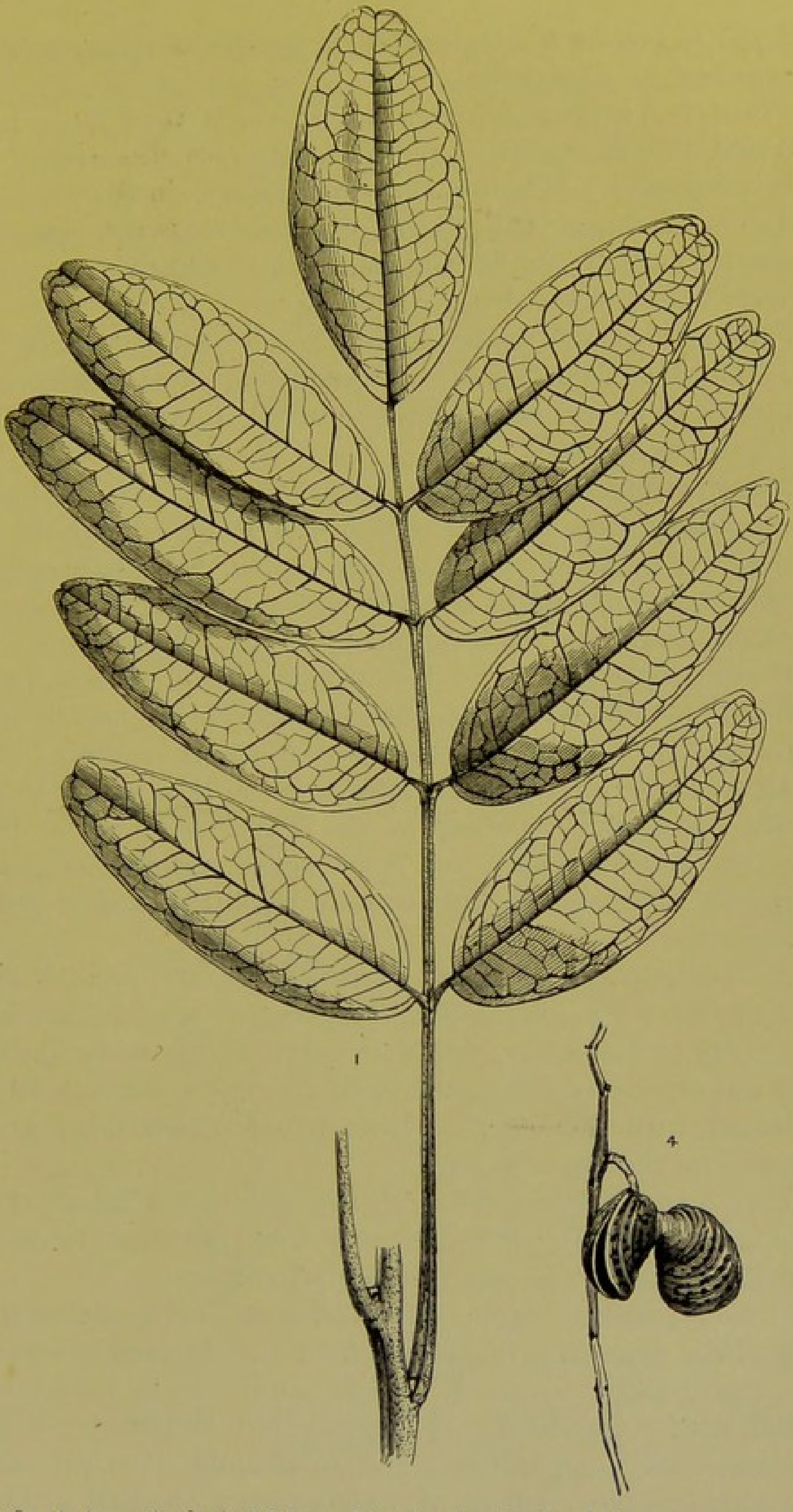


FIG. 6.—1, An entire leaf of Jaborandi, reduced ; 4, fruit of the same, natural size.
(Holmes.)

$C_{11}H_{16}N_2O_2$, has been obtained as a semi-solid mass, yielding with acids crystalline salts.

Pilocarpidine and *jaborine* are alkaloids that have been separated from the mother liquors after the crystallisation of the pilocarpine salts. Whether they exist as such in the leaves or are produced during the process of extraction is not definitely known, although recent investigations indicate the pre-existence of pilocarpidine in the drug.

Uses.—Jaborandi produces profuse salivation and perspiration, and is chiefly given as a powerful and rapid diaphoretic. It appears to be of most service in renal disease, eliminating both water and urea.

Substitutions &c.—Several substitutes for the official leaves have appeared from time to time in the English market. As the majority contain little or no pilocarpine, their absence from the official drug should be carefully ensured. The following are the chief substitutes and their distinguishing characters:

P. pennatifolius, Lem.—The leaflets of this species closely resemble the official leaves, but are paler, being usually of a greyish-green colour and less coriaceous in texture. The veinlets are not prominent on the upper surface, and they are usually equal and tapering at the base. They have been imported from Paraguay, and hence are sometimes designated 'Paraguay Jaborandi.' They contain but little alkaloid (0·2 to 0·3 per cent.).

P. trachylophus, Holmes.—The leaflets are smaller than those of either *P. Jaborandi* or *P. pennatifolius*, and are dark olive green on the upper, yellowish green on the under surface. They are especially distinguished by the under surface, which is clothed with short curved hairs, similar ones being found scattered on the upper surface.

They contain about 0·4 per cent. of total alkaloid (Paul and Cownley, 1896), of which only 0·02 per cent. formed a crystalline nitrate, and was possibly pilocarpine.

P. microphyllus, Stapf.—The leaflets are even smaller than those of the preceding, measuring from 1 to $1\frac{1}{2}$ inch in length; they are usually ovate in outline and deeply emarginate at the apex; the rachis is slightly but distinctly winged. The leaves are comparatively rich in alkaloid (0·84 per cent., Paul and Cownley, 1896), of which about one-half yields a crystalline nitrate (pilocarpine).

P. spicatus (?) ; *Aracati Jaborandi.*—The leaves resemble bay leaves in size and shape ; the upper surface is polished, the

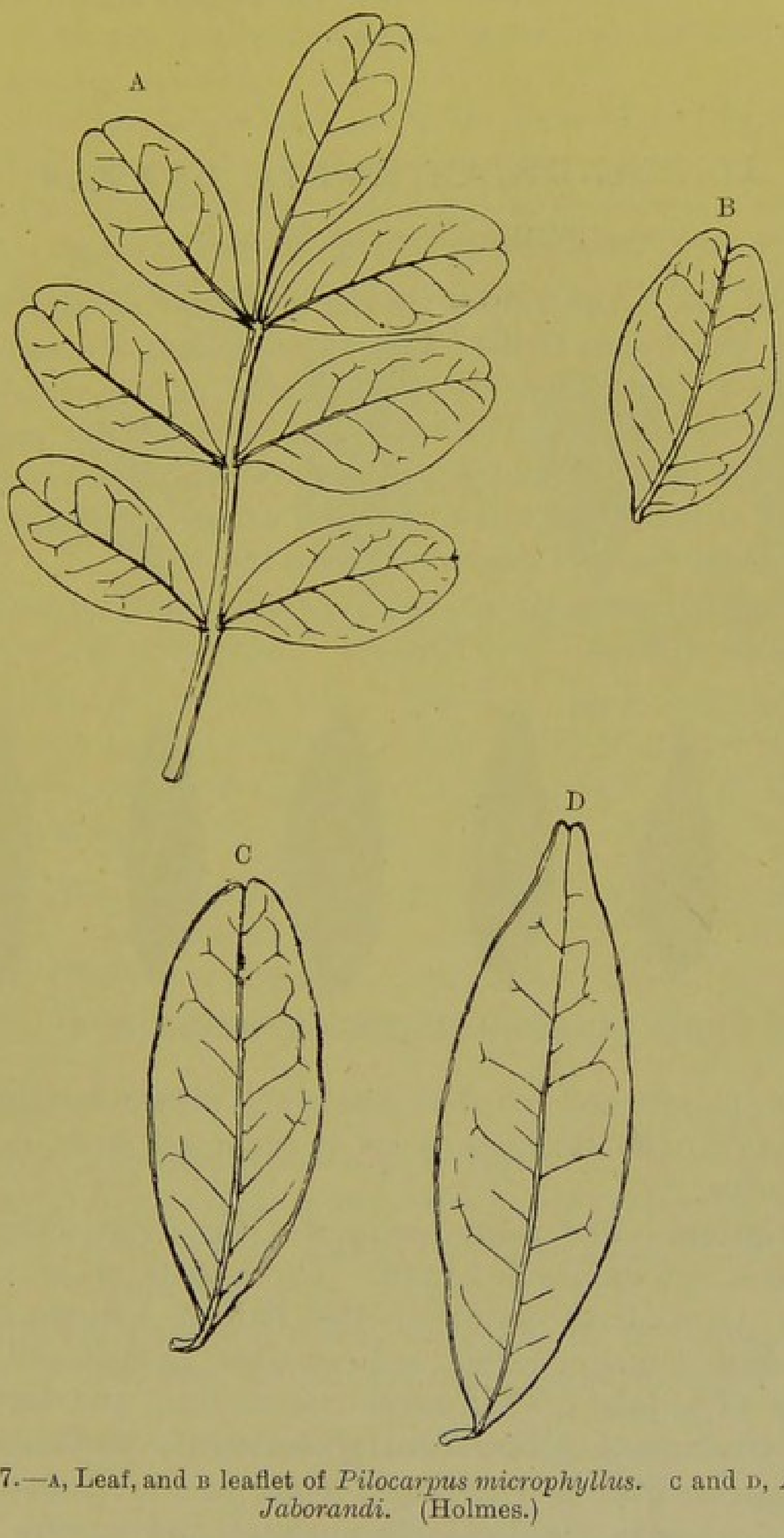


Fig. 7.—A, Leaf, and B leaflet of *Pilocarpus microphyllus.* C and D, *Aracati Jaborandi.* (Holmes.)

veins are scarcely visible, the outline is lanceolate and the petiole short and twisted.

Piper Jaborandi, Vell.—These leaves have been imported as jaborandi. They are large thin grey papery leaves tapering towards both base and apex. They are usually mixed with the stems, which are swollen at the nodes.

ALEXANDRIAN SENNA LEAVES

(Senna Alexandrina)

Source &c.—Alexandrian senna consists of the leaflets of *Cassia acutifolia*, Delile (N.O. *Leguminosæ*), a small shrub from 2 to 4 feet in height, growing wild in the *middle and upper Nile territories*. The medicinal value of the pods and leaves of the plant was known to the Arabian physicians of the tenth and eleventh centuries, through whom European physicians probably became acquainted with the drug.

Alexandrian senna is collected from wild plants by Bedouins, chiefly between Suakin and Kassala. The leaflets are separated

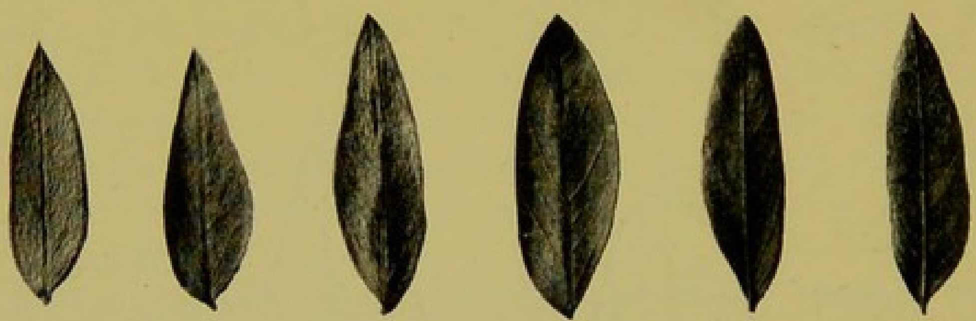


Fig. 8.—Alexandrian Senna leaves. Natural size.

from the petiole and dried. They are either brought for exportation to the Red Sea ports or conveyed down the Nile to Alexandria.

Description.—The plant produces a paripinnate compound leaf about 4 or 5 inches in length. The leaflets, which constitute the Alexandrian senna of the British Pharmacopœia, average about 1 inch in length, not exceeding $1\frac{1}{2}$ inch, and, when dried, are of a pale greyish-green colour, thin, and brittle in texture. In shape they vary from lanceolate to ovate-lanceolate. The margin is entire and the apex acute and mucronate. At the base the leaves are decidedly unequal, and on the under surface the veins are distinct. When examined with a lens both surfaces of the leaf are seen to be pubescent, small hairs being distinctly visible, especially near the veins. These hairs, when examined under the microscope, are found to be one-celled and thick-walled, and form a means by which senna leaves can be distinguished from argel leaves (see below), the hairs of which are three-celled.

Alexandrian senna has a faint but characteristic odour and a mucilaginous, sickly, unpleasant taste.

The leaves frequently appear in commerce in a more or less broken condition due to their brittle papery texture. They sometimes contain the flat curved fruits, fragments of the stalk,

Fig. 9.—Obovate Senna leaves (*C. obovata*). Natural size.

and occasionally the obovate, mucronate leaves of *C. obovata*, Collad., may be found here and there. Beyond these accidental impurities Alexandrian senna seldom contains any admixture.

The student should observe

(*a*) The *predominating asymmetrical, lanceolate* or *ovate-lanceolate shape*,
(*b*) The *veins distinct on the under surface*,
(*c*) *Both surfaces more or less distinctly pubescent* ;

and should compare the leaves with

(i) *C. obovata*, which are obovate,
(ii) *Indian senna leaves*, which are yellowish green in colour, less conspicuously asymmetrical, and less pubescent,
(iii) *Argel leaves*, which are equal at the base, thick in texture, and in which the veins are not distinct.

The leaves curl slightly as they dry, and, being loosely packed, retain this appearance in the drug ; Indian senna leaves, on the other hand, being pressed into bales, are commonly flat and bear other evidence of the pressure to which they have been subjected.

Constituents.—The purgative property of senna leaves is largely due to the presence of a substance possessing acid properties and known as *cathartic acid*. This substance, however, has not yet been obtained in a state of purity, and we have therefore no definite knowledge of its nature; it is said to be glucosidal, and to be an active purgative in doses of $1\frac{1}{2}$ to 2 grains.

Senna contains, further, *chrysophanic acid*, *mucilage*, and a yellow substance allied to and possibly identical with *emodin*; lastly, two bitter principles, *sennacrol* and *sennapicrin*, which are stated to be glucosides, but of which there is little definite information.

Uses.—Senna stimulates the muscular coat of the intestine and produces purgation, which is not followed, as commonly is the case, by constipation; it is therefore one of the most useful of purgatives, especially in cases of habitual constipation.

Substitutions &c.—Alexandrian senna, as already mentioned, seldom contains any admixture beyond the stalks and fruits of the plant, and occasionally the leaves of *C. obovata*. The latter plant, which grows in Upper Egypt, was formerly highly valued as a drug, and was even cultivated in Italy during the first half of the sixteenth century. Its leaves are easily recognised by their broadly obovate shape, abruptly tapering apex, and distinct pinnate venation.

Argel leaves, the leaves of *Solenostemma Argel*, Hayne (N.O. *Asclepiadaceæ*), a small shrub growing in the same districts as senna, were formerly regularly mixed with Alexandrian

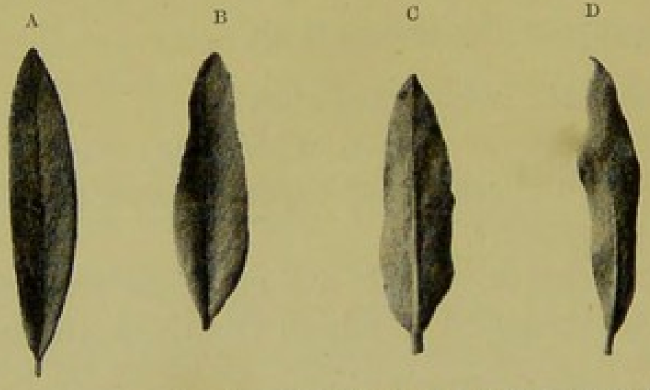


FIG. 10.—Argel leaves. A, showing the shape of the leaf; B, C, D, showing the curled appearance of the dried leaves. Natural size.

senna. They closely resemble senna leaves in their colour and outline, but may be distinguished by their thick, rigid texture, and by their peculiarly curled, curved, or twisted appearance;

the surface is finely wrinkled, the veins are not evident, and the leaf is equal at the base. They have a distinctly bitter taste. When examined by the microscope they exhibit three-celled hairs, whilst those of senna leaves are one-celled. The trade in senna was formerly a monopoly of the Egyptian Government, and during that time argel leaves were regularly mixed with the drug in the proportion of about 1 part of argel leaves to 4 parts of senna. Of late years this practice has been persistently discouraged, and the arrival of senna mixed with argel leaves is now a rarity in the English market.

Senna pods, the fruits of *Cassia acutifolia,* which are found mixed with the senna, and are also imported as a separate article of commerce, are very flat legumes. They are dark brown or greenish brown in colour, broadly oblong, slightly curved, and rounded at each extremity. They vary from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length, and from $\frac{3}{4}$ to 1 inch in breadth, and contain several flat obovate-cuneate seeds. They have been recommended for medicinal use as preferable to the leaves, and have been employed to a considerable extent.

INDIAN SENNA LEAVES

(Tinnevelly Senna, Senna Indica)

Source &c.—Indian or Tinnevelly senna consists of the leaflets of *Cassia angustifolia,* Vahl, which is indigenous to southern Arabia, but is cultivated largely for medicinal use in *southern India,* especially in the district of *Tinnevelly,* in the extreme south-east. Here the plant attains an unusual luxuriance, and produces larger leaves than the Arabian wild plant. They are carefully collected, dried, pressed into bales, and exported from Tuticorin.

Description.—Tinnevelly senna is usually free from admixture either of foreign leaves or even of stalks and fruits. The leaves resemble Alexandrian senna rather closely, but are generally of a yellowish-green rather than greyish-green colour, a difference more noticeable in bulk than in single leaves. They attain a larger size than the Alexandrian, varying usually from 1 to 2 inches in length. They differ also in being more uniformly lanceolate in shape, less conspicuously asymmetrical, and less pubescent. They are somewhat firmer in texture than the Alexandrian, and are consequently less broken when they arrive, and, being exported in compressed bales, are usually flatter. There is also a slight but perceptible difference in the odour of the two varieties. The student

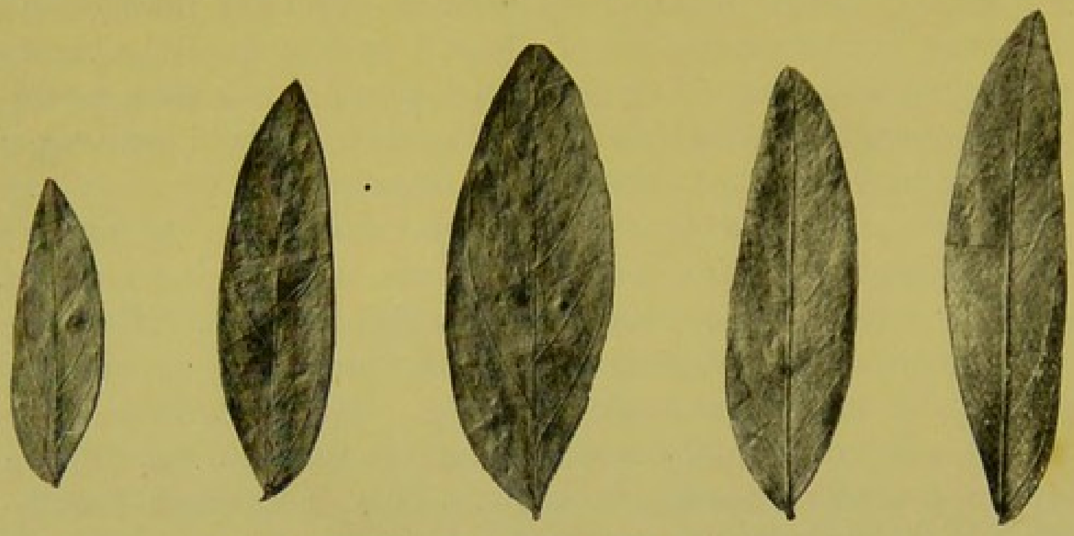


FIG. 11.—Tinnevelly Senna leaves. Natural size.

should carefully compare these two varieties of senna and note the *greater symmetry* in the Tinnevelly, the *lanceolate shape*, the *flatness* of the leaves, their *yellowish-green colour*, and *less pubescent* surface. It is, however, quite possible to select from the two varieties exceptional leaves that are indistinguishable from one another. The student must be guided by the characters of the majority.

Constituents.—The constituents of Tinnevelly senna are identical with those of Alexandrian senna. Either variety may be used in making the official preparations of senna.

Substitutions &c.—Beyond the two varieties of senna described, occasional packages only of other sennas reach the London market. Among these may be noticed here—

Arabian or Mecca senna, obtained from wild plants of *C. angustifolia*. These leaves are collected in southern Arabia and sometimes shipped *via* Bombay, or now more commonly by the Red Sea route, to London. They may be distinguished from Tinnevelly senna by the evident want of care in collecting and drying the leaves, which are usually discoloured and mixed with stalks. From Alexandrian senna, under which name they have also appeared, the elongated lanceolate shape of the leaf will distinguish them.

Senna pods.—The fruits of *C. angustifolia* closely resemble those of *C. acutifolia*; they are, however, rather narrower, and the remains of the base of the style are usually more distinct.

CHERRY-LAUREL LEAVES

(Folia Laurocerasi)

Source &c.—The cherry laurel, *Prunus Laurocerasus*, Linn. (N.O. *Rosaceæ*), is an evergreen shrub indigenous to Persia and Asia Minor, but *cultivated in most temperate regions*. It was introduced into this country towards the end of the sixteenth century, but the poisonous property of the water distilled from the leaves was not known till 1731; the poisonous principle contained in it was identified as hydrocyanic acid soon after the discovery of the latter by Scheele in 1782.

Description.—Cherry-laurel leaves, which are official in the fresh state only, are of considerable size, averaging about 6 inches in length by 2 inches in breadth. The upper surface is dark green in colour and glossy, the under surface paler. In outline they vary from oblong-lanceolate to nearly obovate, tapering towards both base and apex, the latter being shortly acute and recurved. The leaves are thick and coriaceous in texture, and are supported on short stout petioles. The margin is slightly recurved and is provided at intervals with short strong serrations, which are easily felt in the dried leaf when the finger is passed along the margin from apex to base. From the midrib, which is prominent on the under surface, lateral veins are given off at angles of 45° to 60°, and near the base of the leaf, also on the under surface, and on either side of the midrib are from one to four brown depressed spots. These spots are the remains of glands in which a sugary substance is produced whilst the leaf is young. Both surfaces of the leaf are quite glabrous.

When fresh and entire, cherry-laurel leaves are almost inodorous; but when crushed, or even scratched with a needle, they evolve an odour recalling that of oil of bitter almond and hydrocyanic acid. Dried leaves yield a much less perceptible odour when crushed and moistened with water than the fresh.

Constituents.—The principal constituent of cherry-laurel leaves is *laurocerasin*, a glucoside that has been obtained in hygroscopic crystals (Lehmann, 1885), and closely resembles, but appears not to be identical with, amygdalin, which is contained in the bitter almond. When brought into contact with *emulsin* (an enzyme ferment also contained in the leaves) and water, laurocerasin is decomposed, yielding *benzaldehyde* (oil of bitter almonds), *hydrocyanic acid*, and *dextrose*.

As long as the leaves remain intact no decomposition takes place, for the emulsin is stored in the endodermis of the veins, whilst the laurocerasin is distributed through the parenchyma of the leaf. The two bodies cannot therefore come into contact with one another until the cells containing them are broken; directly this is effected, as it would be by cutting or bruising the leaf, the reaction takes place.

Fresh leaves from healthy plants yield on an average about 0·1 per cent. of hydrocyanic acid. In the autumn the yield is less than in the spring or early summer, the young leaves, which are more numerous in the latter seasons, being especially rich in laurocerasin. In June new unfolded leaves have yielded as much as 2·49 per cent. of hydrocyanic acid (Ven, 1898).

Uses.—Cherry laurel water is employed as a flavouring agent, and is also administered as a sedative, its action being due to the hydrocyanic acid it contains.

WITCH-HAZEL LEAVES

(Folia Hamamelidis)

Source &c. — The witch-hazel, *Hamamelis virginiana*, Linn. (N.O. *Hamamelideæ*), is a common shrub in the *United States* and *Canada*. It attains a height of about 10 feet, and resembles the common hazel both in its leaves and in its fruit, which is edible. Both the fresh and dried leaves are official, the former being employed for the preparation of Liquor Hamamelidis. The bark is also used in medicine. (See 'Witch-hazel Bark.')

Description.—Commercial witch-hazel leaves are usually in a somewhat indifferent state of preservation, being frequently discoloured, broken, and pressed together into more or less compact masses. Well-preserved full-grown leaves are of a dark green or brownish-green colour on the upper surface, paler on the under surface, and attain 6 inches in length by 4 inches in breadth. In outline they are broadly oval or rounded-obovate, the lamina tapering somewhat towards the base, where it is decidedly oblique, usually cordate, and provided with a short petiole; at the apex they are obtuse. The margin is coarsely crenate or even sinuate. On the under surface the midrib is prominent, and the lateral veins, which are also very distinct, branch from it at an acute angle, and run straight to and terminate in the crenations of the margin. In the angles thus formed and on the veins, hairs, which will be seen under the lens to have a characteristic branching form, are usually to be found; they are more frequent on young leaves, very young leaves being brown in colour and densely hairy. The leaves have only a slight odour, but a decidedly astringent and somewhat bitter taste.

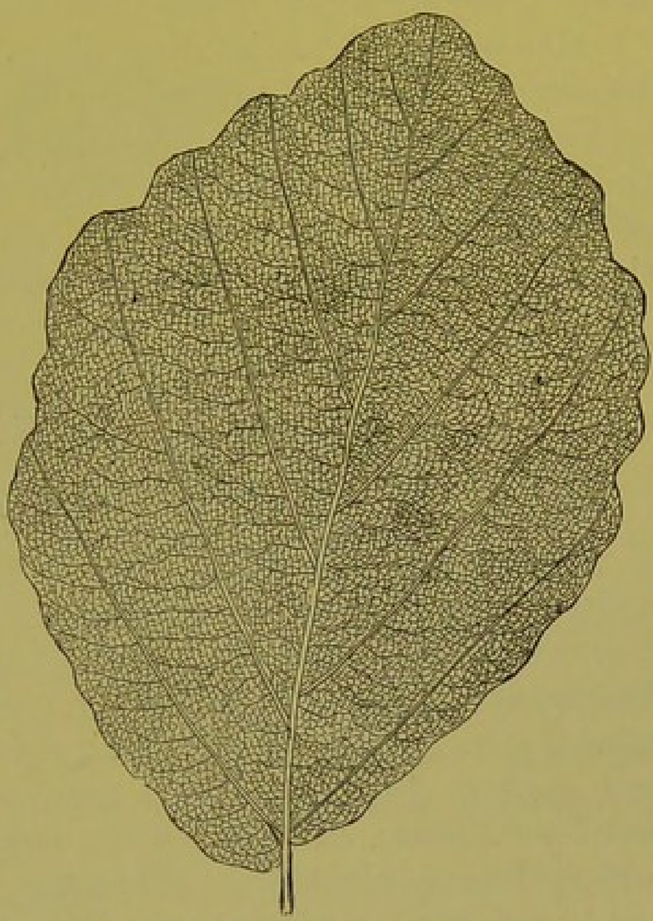


FIG. 12.—Witch-hazel leaf. One-half natural size. (Maisch.)

The student should observe

(*a*) The *sinuate margin*, Papery

(*b*) The *lateral veins running straight to the margin*,

(*c*) The *branching hairs*.

Constituents.—Witch-hazel leaves have not yet been subjected to careful analysis. They contain *gallic acid*, *tannin*, a *bitter principle*, and a *trace of volatile oil*. By distilling the fresh or dry leaves with water or dilute alcohol, a distillate is obtained possessing a distinct aroma, different from that of the leaves themselves, due probably to some product of decomposition. The official Liquor Hamamelidis, which is made by distilling the fresh leaves with dilute alcohol, contains, in addition to the aromatic body alluded to, a trace of protocatechuic acid.

Hamamelin is a mixture of substances obtained by extracting the leaves, or sometimes the bark, with strong alcohol and evaporating the tincture thus obtained; it is not one of the active constituents of the drug.

Uses.—Witch-hazel leaves are astringent and hæmostatic; they are useful in hæmorrhage from the nose, lungs, &c.

EUCALYPTUS LEAVES

(Folia Eucalypti)

Source &c.—The plant from which the official eucalyptus leaves are obtained is *Eucalyptus Globulus*, Labill. (N.O. *Myrtaceæ*), the ordinary 'blue gum' tree of Victoria and Tasmania. This tree, which is one of the largest known, attains a height of over 300 feet; it is indigenous to *Tasmania* and *eastern Australia*, but is now *cultivated in Italy*, *Spain*, *southern France*, and other warm countries. It grows rapidly, and is largely planted in unhealthy marshy districts, such as the Campagna near Rome, upon which it exercises a beneficial influence.

The tree is remarkable on account of the dimorphism of its leaves. On young plants these are opposite, ovate, cordate at the base, and sessile, and they grow with one surface directed upwards and one downwards. On older plants, and especially on the upper parts of the trees, longer scimitar-shaped stalked leaves are produced, which grow with one margin directed upwards and the other downwards, and are irregularly disposed on the stem. The latter alone are employed in making the preparations of eucalyptus leaves. They are collected in the south of France, and dried for medicinal use. Both forms of the leaf are used fresh for the distillation of the volatile oil.

Description.—Eucalyptus leaves are well characterised by their great length (up to 12 inches) and narrow ensiform outline. They taper gradually towards the apex, but narrow rather abruptly at the base into a short twisted petiole, the twist in the petiole enabling the leaf to hang with its margins instead of its surfaces directed upwards and downwards. The lamina is thick, coriaceous in texture, and, when quite dry, brittle. The margin is entire and somewhat thickened; the midrib is not prominent on either surface, and the lateral veins,

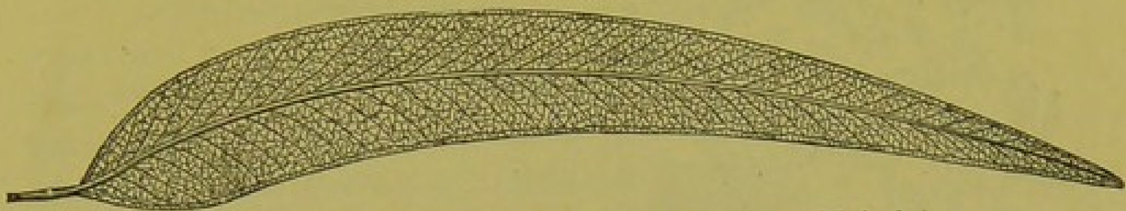


FIG. 13.—Eucalyptus leaf. Reduced in size. (Maisch.)

most of which leave the midrib at an acute angle, anastomose near the margin to a continuous line.

The leaves are quite glabrous, but distinctly punctate from the presence of numerous oil-glands situated in the mesophyll; these are best observed by examining the surface with a lens whilst the leaf is held against a strong light. The surfaces of the leaves are frequently marked with a number of minute warty brown spots (groups of cork cells).

The odour of fresh eucalyptus leaves is strong, camphoraceous, and characteristic; in the dry leaves it is less perceptible until they are crushed. The taste of the dry leaves is aromatic, pungent, and slightly bitter.

The student should observe

(*a*) The *ensiform outline*,
(*b*) The *coriaceous texture*,
(*c*) The *similarity between the two surfaces*.

Constituents.—Eucalyptus leaves contain, when fresh, from 3 to 5 per cent. of *volatile oil*. They also contain *tannin* and a *bitter principle* which has not yet been investigated.

BEARBERRY LEAVES

(Folia Uvæ Ursi)

Source &c.—The common bearberry, *Arctostaphylos Uva-ursi*, Sprengel (N.O. *Ericaceæ*), is a small procumbent evergreen shrub distributed throughout *central and northern Europe* and North America. It is indigenous to Great Britain, but is confined to Scotland, the north of England, and Ireland.

The plant sends out branching stems that take root, and so forms small clumps. The drug was probably in use long ago in this country, but was first introduced into the London Pharmacopœia in 1788.

Fig. 14.—Bearberry. Reduced to about one-fourth natural size. (Maisch.)

Description. — Bearberry leaves are small shining coriaceous leaves, seldom measuring as much as 1 inch in length by $\frac{1}{2}$ inch in breadth. The colour of the upper surface is dark green or yellowish green, that of the under surface paler. In outline they are spathulate or obovate, the lamina being rounded at the apex, but tapering gradually towards the base to a short petiole. They are more or less rigid, and, when quite dry, brittle. The margin is entire, slightly revolute, and in young leaves ciliate with short hairs, but these are not discernible in the drug, which is quite glabrous. The veins, and even the veinlets, are depressed on the upper surface, which thus assumes a chequered or wrinkled appearance; the greyish-green under surface is reticulately marked with somewhat darker veins, which are often slightly raised, but it does not show raised brown points when examined with a lens. The leaves have no marked odour, but a strongly astringent and somewhat bitter taste.

Fig. 15.—Bearberry leaves. Natural size.

The student should observe

(*a*) The *spathulate outline*, *entire margin*, and *rounded apex*,
(*b*) The *veinlets depressed on the upper surface*,
(*c*) The *absence of brown points on the under surface*;

and should compare the leaves with

(i) *Buchu* leaves, which have a toothed margin,
(ii) The substitutes mentioned below.

Constituents.—Bearberry leaves contain both *tannin* and *gallic acid*; an infusion of the leaves accordingly gives a bluish-black precipitate with ferric salts. They contain, further, two crystalline substances, *arbutin* and *ursone*. Methyl a[illegible]

Arbutin is glucosidal, and yields, when hydrolysed with dilute sulphuric acid (or with emulsin), dextrose and hydroquinone. A similar decomposition takes place when arbutin is administered by the mouth, hydroquinone being excreted by the urine; in fact, the activity of bearberry leaves is said to be partly due to the stimulant and antiseptic properties of the latter substance. Arbutin has also been isolated from several other ericaceous plants.

Ursone has been obtained in tasteless, colourless, and odourless crystals.

Lastly, bearberry leaves have been reported to contain *ericolin*, an ill-defined glucoside said to occur in other ericaceous plants, and Perkin has lately (1898) isolated *ellagic acid* and a *yellow colouring principle* crystallising in glistening needles.

Substitutes.—Bearberry leaves are seldom adulterated; the leaves of the box (*Buxus sempervirens*, Linn.) and of the cowberry (*Vaccinium Vitis-idæa*, Linn.) are reported to have been used for that purpose, but are easily distinguished, as the former are emarginate at the apex, and the latter have brown dots scattered over the under surface of the leaf.

Uses.—Bearberry leaves are used as a stimulant, diuretic, and disinfectant in diseases of the urino-genital tract; they resemble buchu in their action, but are more astringent.

BELLADONNA LEAVES

(Folia Belladonnæ)

Source &c.—The deadly nightshade, or belladonna, *Atropa Belladonna*, Linn. (N.O. *Solanaceæ*), is a tall branching herb attaining a height of 5 feet or more, with a perennial root. It is widely distributed over *central and southern Europe*; in *England* it is confined chiefly to the *southern counties*, but is cultivated in Bedfordshire, Hertfordshire, and elsewhere, and it is grown for medicinal use in Germany also.

The poisonous properties of belladonna were certainly known towards the end of the fifteenth century, probably

Fig. 16.—Belladonna, showing leaves in unequal pairs. Reduced.

much earlier. The leaves were introduced into the London Pharmacopœia of 1809, the root coming into use much later.

The fresh leaves and branches of the plant are used for preparing extract of belladonna. The dried leaves, which were formerly used in making the tincture, are now no longer official; they are frequently imported from Germany and France.

Description.—The stem of the belladonna plant divides usually a little above the ground into three large branches, each of which branches again freely. The lower leaves on the stem are solitary, but the upper are arranged in pairs, consisting of a large and a small leaf, the former being directed outwards, the latter inwards. The petiole of the large leaf is adnate to the stem, and the leaf really belongs to the next lower node, where there will be a small leaf with a leaf-bud in its axil and large leaf with flower-bud in its axil. The flowers are solitary and pendulous; they have a dull purplish campanulate corolla and superior, two-celled, many-seeded ovary, which develops into a purplish-black fleshy fruit. The leaves vary from 3 to 8 inches in length, the lower on the stem being larger than the upper. They are broadly ovate in outline, acute, entire, tapering towards the base, and glabrous or nearly so, except when quite young, when, in common with the young stems, they exhibit a soft pubescence. The lateral veins are prominent on the under surface and leave the midrib at an angle of about 45° to 60°, the latter figure being frequent in the smaller, upper leaves of the plant.

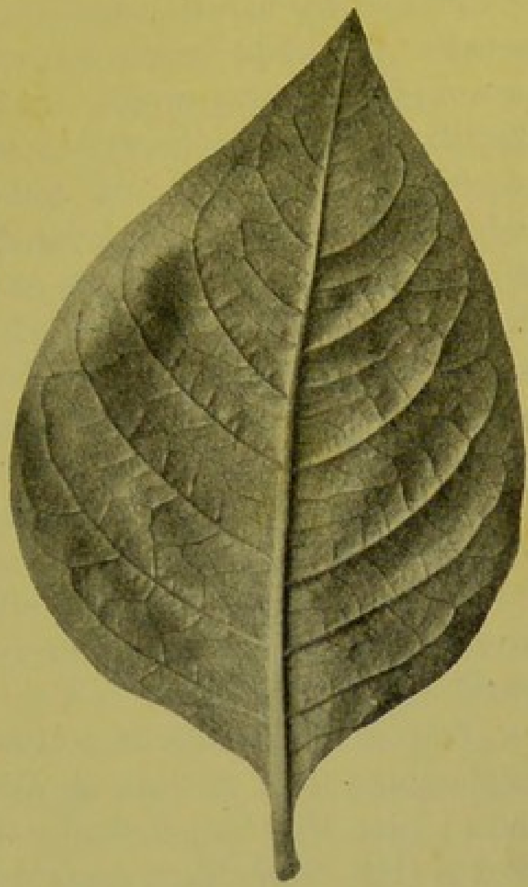


FIG. 17.—Belladonna leaf. Under surface, showing the venation. Natural size.

The transverse section of the midrib exhibits, when examined under the microscope, strands of bast both above and below the wood (bi-collateral bundles)—a feature common in the natural order *Solanaceæ* and in some few other orders—but by no means of frequent occurrence, and hence of use in identifying the leaves. Some of the cells of the mesophyll are filled with numerous minute crystals of calcium oxalate, best seen when the leaves, after suitable treatment, are examined under the microscope. This is an important character, as it enables us to distinguish these leaves from stramonium, henbane, foxglove, and many others.

The dried leaves are thin, papery, and brittle; they are usually of a dull green colour, paler below. The midrib is prominent on the under surface, and the lateral veins are distinct. Hairs are rarely to be found except on young leaves, especially of wild plants, but the surface exhibits under the lens numerous whitish elevated points; these are produced by the cells filled with calcium oxalate contained in the mesophyll of the leaf, which produce, when the tissue of the leaf dries and shrinks, the appearance described. Neither all specimens of the drug nor both surfaces exhibit this character equally well.

The fresh plant exhales, when crushed, a disagreeable odour, but the dry leaves are almost inodorous. Both fresh and dried leaves have a bitterish taste, and the juice of the former or an infusion of the latter, when dropped into the eye, dilates the pupil.

The leaves should be collected when the plant is in flower, as they are then richest in alkaloid. For the preparation of the extract the larger stalks should be rejected, as it has been shown that the extract prepared from the stalks contains less alkaloid than that prepared from the leaves (Ranwez, 1897). For the same reason the dry drug should be as free as possible from stalk.

The student should observe

(*a*) The *upper leaves in unequal pairs*,
(*b*) The *glabrous surface*,
(*c*) The *presence of whitish raised points* (on the dried leaves);

and should compare the dried leaves with

(i) *Stramonium leaves*, which curl and twist as they dry, have a characteristic odour and lateral veins making a more acute angle with the midrib,
(ii) *Foxglove leaves*, which are hairy,
(iii) *Henbane leaves*, which are hairy.

Constituents.—The chief constituents of belladonna leaves are the alkaloids *hyoscyamine* and *atropine*. Hyoscyamine can be obtained in colourless crystals, and is easily transformed by heating for six hours to 110° C. into atropine, with which it is isomeric. The proportion of total alkaloid present in the dry leaves varies from 0·3 to 0·7, according to the assays of various chemists; probably about 0·4 to 0·5 per cent. would represent the average of leaves of good quality. Of this total alkaloid the greater proportion is hyoscyamine, not, as was formerly supposed, atropine; in fact, the pre-existence of the latter alkaloid in the drug has been doubted. These alkaloids are found in all parts of the plant associated probably with other alkaloids of less importance (*belladonnine* &c.), and with a fluorescent principle, *β methyl-æsculetin* (chrysatropic acid), which has been obtained from the root in yellow crystals and has also been found in gelsemium root.

In the manufacture of the alkaloids hyoscyamine and atropine the root is used, and not the leaf, because the alkaloids can be separated from the substances that accompany them in the root more easily than from those present in the leaf.

Uses.—Belladonna acts as a local anæsthetic and anodyne, and is used externally to relieve pain. Internally, it is given to check the sweating in phthisis, as a sedative to the respiratory nerves, to relieve spasmodic cough, and in numerous other cases.

STRAMONIUM LEAVES

(Folia Stramonii)

Source &c.—The thornapple, *Datura Stramonium*, Linn. (N.O. *Solanaceæ*), is a large bushy annual attaining about 3 feet in height, a native probably of the shores of the Caspian, but found commonly on waste ground throughout the temperate and warmer regions, and met with occasionally in England, escaped from cultivation. It is *cultivated in this country* in Bedfordshire &c., but our supply of the drug is derived largely from *Germany*, *France*, and *Hungary*. The introduction of stramonium into medicine is due chiefly to the exertions of Störck in the latter half of the eighteenth century. For medicinal use, the leaves and young shoots are collected when the plant is in flower and dried.

Description.—The stem of the thornapple is stout and erect, branching repeatedly, and producing in the forks of the branches a leaf and a single flower with a tubular calyx and large white funnel-shaped corolla. This flower is succeeded by an erect spiny capsule about the size of a walnut. In addition to mature and young leaves the drug therefore frequently contains the remains of the flower with a tubular calyx and now yellowish corolla, or of the young shrivelled bristly fruit.

The dried leaves are usually much shrivelled and wrinkled; they are of a dark greyish-green colour, especially on the upper surface, ovate in outline, unequal at the base, and petiolate. They attain 6 inches or more in length, and are characterised by the very coarse pointed teeth which impart to the margin a sinuate-dentate outline; the apex of the leaves is shortly acuminate. On the under surface the midrib is distinct though not very prominent; the lateral veins leave it at an angle of about 45° and divide when near the margin, one branch passing into the pointed lobe of the leaf, whilst the other anastomoses with other, tertiary veins.

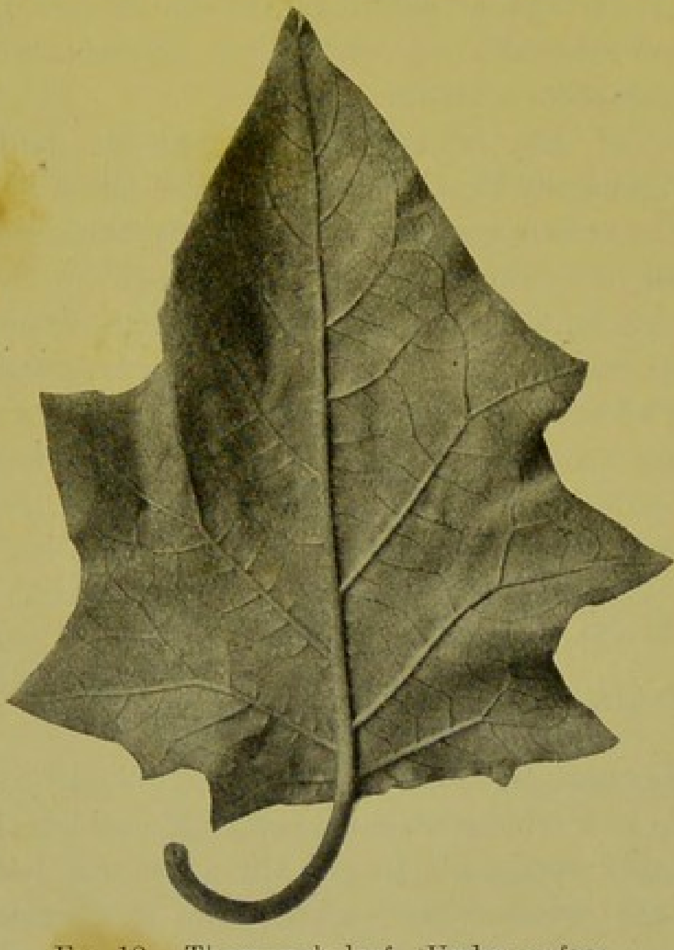


Fig. 18.—Thornapple leaf. Under surface, showing the venation. Natural size.

When quite young the leaves are covered with stout curved hairs, but as they reach maturity these fall off, and full-grown leaves are glabrous or nearly so. In the cells of the mesophyll calcium oxalate in cluster-crystals can be observed when the leaves are examined under the microscope after suitable treatment. This character is useful, as it enables one to distinguish this drug from belladonna, henbane, and foxglove. The odour of the drug, though not strong, is disagreeable and characteristic; the taste is unpleasantly bitter.

The student should carefully observe

(*a*) The *curled and twisted appearance of the dried leaves*,
(*b*) The *angle made by the lateral veins with the midrib*,
(*c*) The occasional presence of the remains of the *flower and fruit*,
(*d*) The *characteristic odour*, and,
(*e*) After soaking in water, the *sinuate-dentate outline* (unless the leaves are too much broken);

and should compare them with

(i) *Belladonna leaves* (see before),
(ii) *Henbane leaves*, which are hairy,
(iii) *Foxglove leaves*, which are hairy.

Constituents.—Stramonium leaves contain the same principal alkaloids as belladonna leaves, viz. *hyoscyamine* and *atropine*, but in somewhat smaller proportion. Probably about 0·3 per cent. would be the average of total alkaloid, but upon this point, as well as upon the relative proportion of alkaloid in the stem and leaf, further information is wanted. Hyoscyamine appears to be present in larger proportion than atropine; indeed there is some doubt as to the pre-existence of the latter in the drug, since it may be easily produced from hyoscyamine during the process of extraction.

Uses.—Stramonium leaves resemble belladonna in their action; they are, however, almost exclusively used in the treatment of spasmodic affections of the respiratory organs.

HENBANE LEAVES

(Folia Hyoscyami)

Source &c.—The common henbane, *Hyoscyamus niger*, Linn. (N.O. *Solanaceæ*), is an erect herb attaining a height of about 2 or 3 feet, distributed over the *whole of Europe* and extending to Persia and India. In *England* it is found chiefly on waste places near buildings; it is cultivated in this country for medicinal use, but much is imported from Germany, and large quantities are produced also in Russia (Gehe). The medicinal use of the plant dates from very remote ages. It was well known to the Anglo-Saxons in the tenth and eleventh centuries, but subsequently fell into disuse. It was omitted from the London Pharmacopœia in 1746, but restored in 1809 chiefly by the influence of Störck, who also introduced stramonium.

Two varieties of the plant are known, an annual and a biennial, the distinction between them being by no means well marked. Both varieties are used medicinally, but the second year's leaves and flowering tops of the biennial plant are alone official, these having been generally considered to be superior in activity to those of the annual plant, or to the first year's leaves of the biennial plant.

Biennial henbane produces in the first year of its growth simply a rosette of large stalked leaves attaining 12 inches

Fig. 19.—Henbane (*H. niger*). First year's growth of the biennial plant. Reduced.

in length, some of which are frequently collected and form the drug known commercially as 'first biennial henbane;' these are not official. In the second year the plant sends up a large branching stem attaining a height of 4 feet or more, which flowers, ripens its seeds, and dies. The smaller branches of this plant with the leaves and flowers constitute the drug from which the green extract of henbane and juice of henbane are directed to be prepared, whilst the leaves and flowering tops, separated from the branches and dried, are employed for making the tincture.

Annual henbane is a much smaller plant than the biennial. The stem does not branch as that of the biennial does, nor are the leaves so large or so deeply incised ; the corolla is paler in colour and less deeply veined with purple. This variety flowers in the first year of its growth, ripens its seeds, and dies. Although not official it occurs regularly in commerce.

Three commercial varieties of henbane must therefore be distinguished, viz. :

'*First biennial*,' consisting of the leaves of the first year's growth of the biennial variety.

'*Second biennial*,' or '*biennial*,' consisting of the leaves and flowering tops of the second year's growth of the biennial variety. This is the drug official under the name of 'Henbane Leaves' (Folia Hyoscyami).

'*Annual*,' consisting of the stem with leaves and flowers of the annual variety.

Description.—As previously mentioned, in the second year of its growth the biennial variety of the plant produces a tall, stout, branching stem with leaves and flowers.

The leaves vary considerably in size. The lower are the larger, attaining as much as 10 inches in length, and are stalked ; towards the upper part of the plant they become smaller and sessile. They are pale green in colour, and, especially when fresh, soft and unpleasantly clammy or sticky to the touch. This peculiarity is due to soft hairs which occur on both surfaces of the leaves, but particularly near the veins on the under surface. These hairs possess glandular heads by which a resinous substance is secreted.

In outline the leaves vary from nearly ovate to elongated triangular ; the margin is more or less deeply incised so as to render it coarsely dentate or even pinnatifid, and the midrib is broad. The stems are rounded, and also bear glandular hairs like those of the leaf.

The flowers, which are usually crowded together, arise from the axils of large, hairy, leafy bracts ; they possess a hairy urceolate calyx and a yellowish gamopetalous corolla deeply veined with purple. The fruit is a pyxis ; it is two-celled and contains numerous seeds.

The dried drug consists principally of the flowering tops, for these are separated from the fresh plant for drying, whilst the lower leaves and branches are used for the preparation of extract of henbane. In commerce it is commonly found in irregularly rounded or flattened masses about 1 to 2 inches in diameter, in which the coarsely dentate hairy bracts, the yellowish corolla with deep purple veins, and two-celled ovary with numerous ovules can easily be identified.

The fresh plant has a strong heavy odour, which is less perceptible in the dry drug; but the taste of the latter is more distinctly bitter than that of the former.

FIG. 20.—Henbane (*H. niger*). Flowering top of a large second year's plant of biennial Henbane. Reduced.

The leaf of henbane is characterised by the presence in the mesophyll of small prismatic crystals of calcium oxalate. The particular form which the calcium oxalate assumes serves to distinguish this drug from belladonna, stramonium, foxglove, and others, even when in small fragments, but it will not distinguish the official henbane from the other commercial varieties.

The student should observe

(*a*) The *hairy leaves with sinuate-dentate outline and broad midrib*,
(*b*) The *purple veins of the corolla*;
(*c*) The *characteristic fruit* (or ovary).

Constituents.—The principal alkaloid in henbane leaves is *hyoscyamine*, but it appears to be accompanied by small proportions of *atropine* and *scopolamine*. The drug contains much less total alkaloid than either belladonna or stramonium, viz. from 0·045 to 0·09 per cent. (of the dry drug). The cultivated plant contains about the same proportion as the wild, but the leaves contain more than the stalk, and the extract of the leaves more than that from the stalk; hence the practice that sometimes obtains of using the stalks and lower unsightly leaves, that are unsuitable for drying, for the preparation of the extract, is reprehensible.

Uses.—The action and uses of henbane closely resemble those of belladonna and stramonium, but the drug is much weaker. The extract has a decided laxative and carminative effect, whilst the tincture has a more marked action on the urinary organs.

Varieties.—*The first year's leaves* of biennial henbane are easily recognised by their being longer and relatively narrower, stalked, and free from stem and flower.

Annual henbane is distinguished by its slender simple stem, smaller leaves, and paler corolla, with less distinct purple venation. As in this case the entire plant is cut and dried, portions of the stem as well as leaf and flower are found in the drug.

FIG. 21.—Annual Henbane. Small specimen. Reduced.

The assay of these two varieties has shown that they are by no means so inferior in activity as has been supposed. In fact the first biennial leaves have been shown to contain practically the same proportion of alkaloid as the official drug, viz. about 0·04 to 0·07 per cent., whilst the leaves and tops of the annual variety yielded 0·06 to 0·07 per cent. of total alkaloid. But the foreign annual henbane yielded less alkaloid, viz. 0·03 per cent., due probably to the large proportion of stalk it contains.

TOBACCO LEAVES
(Folia Tabaci)

Source &c.—The common tobacco plant, *Nicotiana Tabacum*, Linn. (N.O. *Solanaceæ*), is a large annual herb indigenous to *America*, and cultivated both in North and South America from time immemorial. It was introduced into Europe by the Spaniards from Cuba at the end of the fifteenth century, and its use rapidly spread over Europe. It is now, with other species, *cultivated largely in temperate and subtropical countries*.

Description.—The plant produces an unbranched stem, attaining a height of 5 or 6 feet, with large leaves and a terminal panicle of pink flowers. Both leaf and stem are clothed with long glandular hairs, which, like those of henbane, secrete a resinous substance, rendering the entire plant clammy and unpleasant to the touch. The leaves, which sometimes exceed 2 feet in length, vary in shape from lanceolate to broadly ovate. They have a heavy odour, which is changed to the characteristic odour of smoking tobacco by the process of 'curing' to which the leaves are subjected.

Constituents.—Tobacco contains a liquid volatile alkaloid, *nicotine*, in proportions varying usually from 1 to 5 per cent., although in some instances still more has been found. Nicotine is extremely poisonous; when pure it is a colourless oily liquid, but it soon becomes yellowish brown. It is probably in great part destroyed when tobacco is smoked, the poisonous properties of tobacco smoke being due to the products of the destructive distillation of this and other bodies.

Uses.—Tobacco has been employed as an enema to produce relaxation of the muscles, but is now seldom used.

FOXGLOVE LEAVES

(Folia Digitalis)

Source &c.—The purple foxglove, *Digitalis purpurea*, Linn. (N.O. *Scrophularineæ*), is a handsome biennial herb, widely distributed throughout Europe and *common in England*, where it occurs wild and is also cultivated as a garden plant, as well as for medicinal use. It appears to have been long used as a domestic medicine; it was introduced into the London Pharmacopœia as long ago as 1650, although it did not come into frequent use until about a century later.

The foxglove produces, like henbane, in the first year a rosette of leaves, but no aerial stem; in the second year a tall, erect, usually simple stem that may attain a height of 6 feet or more, and bears numerous flowers. The latter are well characterised by their crimson bell-shaped corolla, with darker spots on the inner part of the mouth; the ovary is conical and contains two cells with numerous ovules; the stamens are didynamous.

The plant flowers during the summer months, and the leaves for official use are directed to be gathered from plants commencing to flower. They are generally considered to be then most active, whilst the presence of the flowers precludes any possibility of the leaves of other plants being collected by mistake. They should be dried immediately after collection.

Description.—Foxglove leaves vary usually from 4 to 12 inches in length, and may attain as much as 5 or 6 inches in breadth; in shape they vary from broadly ovate to lanceolate, those on the upper part of the stem being the narrower. Towards the base of the leaf the lamina is contracted and passes into a winged petiole of varying length, down which the lower lateral veins are usually decurrent, the petioles of the lower leaves being longer than those of the upper. The upper surface is dull green in colour and bears numerous short hairs, the under surface paler and more or less densely pubescent, the hairs being seen under the lens to be simple and unbranched. The midrib is prominent on the under surface; the majority of the lateral veins leave the midrib at a rather acute angle (especially in the narrower leaves) and gradually curve round towards the apex, passing into smaller ramifications near the margin. The latter is crenate or irregularly crenate-dentate, the apex blunt or subacute. The odour of the fresh leaves is unpleasant, and the taste of both fresh and dried leaves disagreeably bitter.

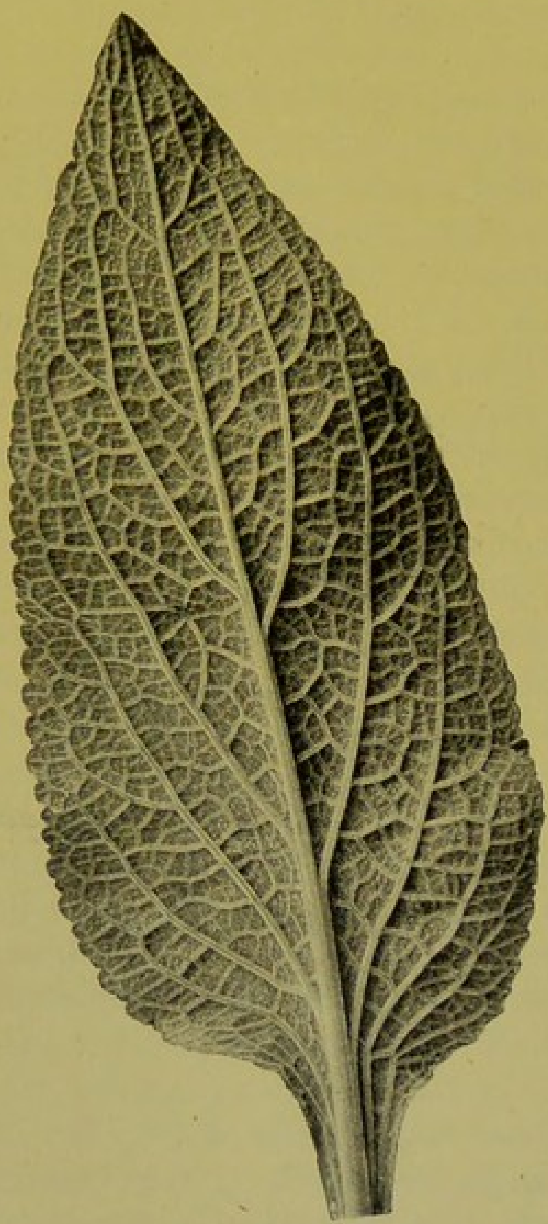


FIG. 22.—Foxglove leaf. Under surface, showing the lower veins decurrent in the petiole. About two-thirds natural size.

Although the leaves are directed to be collected from flowering plants, it is not possible to distinguish these accurately from those of the first year; generally speaking, the latter are narrower and have longer petioles, whilst the biennial leaves are usually broader and have shorter petioles, but no sharp line can be drawn, as the flowering plant produces a number of lanceolate leaves which cannot be distinguished from first-year's leaves of similar shape, and *vice versa*.

Microscopically, foxglove leaves are characterised by the hairs, the majority of which are simple and three-celled, some being short and glandular, and by the absence of crystals of calcium oxalate from the mesophyll. The latter is a valuable negative character, as most leaves contain calcium oxalate deposited in a crystalline form in the cells of the mesophyll.

The student should direct his attention particularly to

(*a*) The *crenate margin*,

(*b*) The *winged petiole with decurrent veins*,

(*c*) The *simple unbranched hairs*,

(*d*) The *course taken by the lateral veins* ;

and should compare these leaves with

(i) *Matico leaves*, in which the veinlets are depressed on the upper surface, dividing it into small squares,

(ii) The possible substitutions mentioned below.

Constituents.—Foxglove leaves contain, as far as is at present definitely known, two principles, *digitoxin* and *digitalin*, to which the physiological activity is to be ascribed, whilst a third constituent, *digitonin*, is practically inert; all of these are crystalline glucosides.

Digitoxin is contained in dry leaves to the extent of about 0·2 to 0·3 per cent. It is extremely poisonous, and despite its very slight solubility in water, it passes into solution when foxglove leaves are infused in that menstruum.

The percentage of digitoxin in the first year's leaves appears to be quite equal to that in the second year's leaves, and to be higher in wild plants than in cultivated ones (Cæsar and Loretz, 1897-98). But it must be remembered that digitoxin is not the only active constituent of foxglove leaves, and that the process of assay is not quite so satisfactory as might be wished. It would be premature, therefore, to make the assertion that the first year's leaves are therapeutically equal to the second year's until comparative physiological experiments have confirmed the assay.

Digitalin is less toxic than digitoxin; whilst digitonin does not take part in producing the characteristic action on the heart.

The foregoing digitalin (the digitalin of Schmiedeberg and Kiliani) must be carefully distinguished from Nativelle's digitalin, which, according to Schmiedeberg, consists principally of digitoxin.

Uses.—Foxglove is one of the most valuable medicines in certain diseases of the heart and in dropsy.

Adulterations.—Foxglove leaves are not often adulterated, but the attention of the student may be directed to the following possible admixtures as serving to accentuate the characters of the genuine drug.

Mullein leaves (*Verbascum Thapsus*, Linn.) are woolly; the hairs examined under the lens are seen to be branched.

Comfrey leaves (*Symphytum officinale*, Linn.) are lanceolate, and present on their surface isolated stiff hairs.

Primrose leaves (*Primula vulgaris*, Huds.) are nearly spathulate; the lateral veins are straight; near the margin they divide.

Ploughman's spikenard (*Inula Conyza*, DC.).—The margin is either entire or dentate, with horny points to the teeth.

LAUREL LEAVES

(Folia Lauri)

Source &c.—The true laurel, bay or bay laurel, *Laurus nobilis*, Linn. (N.O. *Laurineæ*), is a small evergreen tree, common in the western Caucasus and Syria, spread by cultivation over all the temperate and warmer regions of Europe, and a *frequent garden plant in this country*. The tree was held in high esteem by both the Greeks and the Romans; the leaves were formerly employed as a medicine in Germany, but now they are seldom used except as a domestic flavouring agent. The fruits contain a quantity of fat, which can be separated by crushing them and pressing between hot plates.

Description.—Laurel leaves are of a shining green colour on the upper surface, paler below, coriaceous in texture, lanceolate and acuminate in outline and shortly stalked, with an entire, wavy margin, the apex being often acute but sometimes blunt. They are quite glabrous, with the exception of a few hairs often present on the under surface in the angles made by the lateral veins with the midrib. The upper surface appears finely shagreened, the lower is reticulated, both being due to the prominence of the network of minute veinlets. When crushed they emit an aromatic odour, due to the volatile oil contained in oil-cells situated in the mesophyll of the leaves. These oil-cells are with difficulty visible, even when the leaf is held against a strong light and examined with a lens. The taste is aromatic and bitter.

The student should note

(*a*) The *coriaceous texture*,

(*b*) The *entire, wavy margin* and *acute apex*,

(*c*) The *characteristic odour*;

and should be careful not to confuse these leaves with *cherry-laurel leaves*.

Constituents.—The leaves contain about 0·3 per cent. of *volatile oil*. This oil should not be confounded with that of *Pimenta acris*, Wight, also known as oil of bay, and from which bay rum is made. The latter oil is distilled in the West Indies.

Uses.—Laurel leaves are aromatic and stimulant, but are now seldom employed medicinally.

MATICO LEAVES

(Folia Maticæ)

Source &c.—Matico leaves were official in the British Pharmacopœia of 1885, and were directed to be obtained from *Piper angustifolium*, Ruiz and Pav. (N.O. *Piperaceæ*), a climbing plant distributed over the *north of South America*, extending into Bolivia. The name matico appears to be also applied to a number of other similar plants, and not to be confined to the species of *Piper* under notice. It has been much used in Peru as a styptic, and also for venereal disease; it was introduced into the British Pharmacopœia in 1864, but is now no longer official, although its use in France for the treatment of gonorrhœa is said to be increasing.

The leaves, together with occasional stalks and fruits, are dried and packed into bales for exportation.

Description.—Matico leaves reach this country usually in brittle compressed masses of a dull dark greyish-green or yellowish-green colour. The leaves, which are very brittle, can easily be separated if the masses are previously soaked in water; they can then be spread out and examined. They are lanceolate in outline, about 4 to 6 inches long and 1 to $1\frac{1}{2}$ inch broad, and taper gradually to an acute apex; they have short stalks, and are cordate and very unequal at the base, the lamina of one side extending over the petiole so as to conceal it. The margin is entire and revolute. On the upper surface the midrib and the network of lateral veins are so deeply depressed as to divide the surface into small raised squares about $\frac{1}{25}$ inch in diameter. On the under surface the midrib, lateral veins and veinlets are nearly equally prominent, and both the veins and veinlets, as well as the interneural depressions, are covered with short grey shaggy hairs. The latter are less prominent on the upper surface, but the leaves are not all equally hairy.

Both stalks and fruits are frequently found mixed with the leaves; the former are characterised by the swollen nodes which distinguish piperaceous plants; the latter are long slender cylindrical spikes.

The leaves have a slight, aromatic odour and an aromatic, camphoraceous, somewhat bitter taste. Although the mesophyll contains oil-glands, they cannot easily be seen even with a strong lens.

Matico leaves frequently appear in commerce of larger size than those described, being ovate-lanceolate or ovate in outline, and attaining 9 inches in length by 3 inches in breadth. They are derived from a stouter variety of *Piper angustifolium* (var. *a cordulatum*) that is found in Brazil. Whether they differ materially in activity from the usual variety is doubtful. It has been shown that the volatile oil distilled from the drug sometimes contains asarone in the place of matico camphor.

The student should observe

(*a*) The *veinlets depressed on the upper surface, prominent on the under surface,*
(*b*) The *shaggy hairs,*
(*c*) The *characteristic taste*;

and should compare the leaves with

Foxglove leaves, in which the veinlets are not depressed and the taste not aromatic.

Constituents.—Matico leaves contain between 2 and 3 per cent. of *volatile oil, tannin,* and a *bitter principle* which has not yet been satisfactorily examined. The volatile oil deposits crystals of *matico camphor* when cooled.

Uses.—Matico has been used as a hæmostatic, but is now seldom employed; it is doubtful whether this effect is due to the hairy nature of the leaf or to its chemical constituents.

SECTION II

FLOWERS

RED POPPY PETALS

(Petala Rhœados, Flores Rhœados)

Source &c.—The red or field poppy, *Papaver Rhœas*, Linn. (N.O. *Papaveraceæ*), is a common herb which, though doubtfully indigenous to England, grows in abundance in cornfields and waste places throughout Europe and has long been used as a medicine. It is the commonest British poppy, and is distinguished by its rich scarlet petals and glabrous, nearly globular fruit.

Description.—The two hairy sepals that are present in the bud fall off as the four delicate crumpled petals expand. The latter are of a bright scarlet colour, with a short dark violet claw; they are smooth and shining in appearance and broadly elliptical in outline. The margin is entire. They have, when fresh, an unpleasant heavy odour and slightly bitter taste. By drying, the bright scarlet colour changes to a dingy violet, and the petals, which are used on account of the colouring matter they contain, are therefore official in the fresh state only.

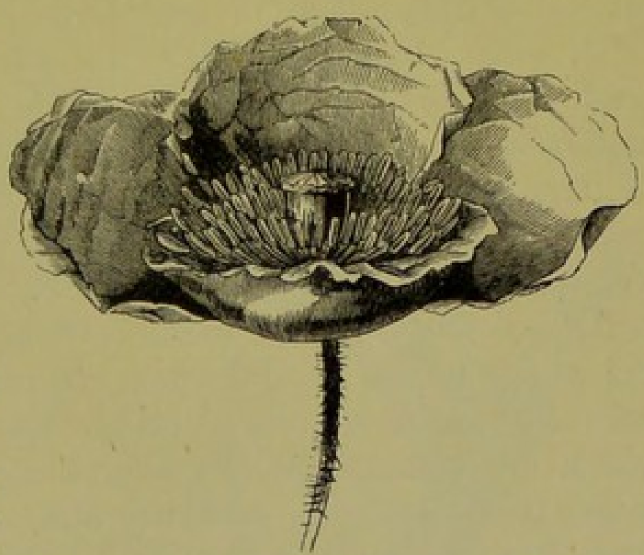


Fig. 23.—Red Poppy. (Planchon and Collin.)

Constituents.—Red poppy petals have been proved to contain a small proportion of *morphine*. Dieterich found in the petals cultivated and dried by himself 0·7 per cent., whilst commercial petals yielded only 0·1 per cent.

The colour is said to be due to two acids, *rhœadic* and *papaveric* (Meier, 1846), but of the nature of these acids little is known. The presence of meconic acid, an important constituent of opium, has not yet been definitely ascertained. In the juice of the capsules and herb Hesse found the alkaloid *rhœadine*, which is also contained in opium; and it is worth noting that this alkaloid, when decomposed with hydrochloric acid, yields a red colouring matter of intense colorific power.

Uses.—Red poppy petals are employed solely as a colouring agent, chiefly in the form of syrup.

CUSSO

(Kousso, Cousso)

Source &c.—The tree yielding this drug, *Brayera anthelmintica*, Kunth (N.O. *Rosaceæ*), is a native of north-eastern Africa. It is cultivated in *Abyssinia*, being commonly planted by the natives near their villages, and is in general use as a remedy for intestinal worms, from which they suffer severely. Bruce became acquainted with it in the course of his travels through Africa (about 1770). It was brought to London about 1851, and introduced into the British Pharmacopœia in 1864. At present it is not much used, and but little is imported.

The long panicles of pistillate flowers, which are said to resemble lambs' tails as they hang on the tree (Schweinfurth, Bruce), are collected after fertilisation and dried. They are usually packed into cylindrical rolls about 1 or 2 feet in length and 2 or 3 inches in diameter, bound round with the flexible stem of a monocotyledonous plant. The staminate inflorescences, which are sometimes borne on the same, sometimes on different trees, are also collected and the flowers stripped from them, but they are not official.

Description.—The panicles, of which a roll or, as it is technically termed, 'hank' of cusso consists, are of large size, attaining as much as 18 inches in length, and of a decided, though dull, reddish colour, whence this variety of the drug derives the name of 'red' cusso. The main axis, which is

Fig. 24.—*Brayera anthelmintica.* *A*, flowering branch, three-fourths natural size (after Berg and Schmidt). *B* and *C*, staminate flower closed and open, magnified. *D*, pistillate flower, magnified. *E*, the same, cut longitudinally, magnified: *b*, outer, *k*, inner whorl of sepals; *c*, corolla. (Luerssen.)

stout and covered with shaggy brown hairs, branches repeatedly, forming a sympodial branch system. The branches spring from the axils of large bracts, and are more or less thickly covered with shaggy brownish or greyish hairs and with minute glands, the latter appearing under the lens as a brownish powder adhering to the surface. The flowers, which are very numerous, are shortly stalked. Each bears on its pedicel two rounded bracts, and consists originally of two whorls of greenish sepals, a caducous white corolla, abortive stamens, and two monocarpellary ovaries enclosed in the tube of the calyx. After fertilisation the inner sepals bend over the young fruit and shrivel; the outer grow larger and become deeply veined with purple. Only one of the two ovaries arrives at maturity. In the drug the most conspicuous part of the flower is the outer whorl of reddish veined sepals; in its centre may be found the inner sepals bending over the immature fruit; of corolla and abortive stamens no trace is to be found.

Cusso has no marked odour, but a bitter and acrid taste.

The student should soak a little cusso in water and, when thoroughly softened, examine it with the help of lens and dissecting needles. The two whorls of sepals and the young fruit can then be distinguished without difficulty.

The drug is easily identified, but the student should particularly observe

(*a*) The *inner whorl of sepals bending over the young fruit*,
(*b*) The *enlarged, veiny outer whorl of sepals*,
(*c*) The *reddish colour of the drug*,

as these characters serve to distinguish the pistillate flowers, which alone are official, from the staminate.

Constituents.—The principal constituent of cusso is a highly active amorphous substance, *kosotoxin* (Leichsenring, 1894); an inactive crystalline body, *protokosin*, has also been isolated from it. Bedale's kosin (1858) was probably impure. Whether the crystalline kosin examined by Buri (1874) is contained pre-formed in the drug, and whether it possesses anthelmintic properties, appears, from later experiments and investigations, more than doubtful.

Cusso contains in addition *tannin* and *resin*.

Substitutions &c.—Under the name of 'loose cusso' the flowers stripped from the panicles and dried are sometimes imported. They arrive usually in more or less fragmentary condition, and frequently contain a considerable admixture of staminate flowers. These may be easily distinguished by their greenish colour, small outer sepals densely covered with short hairs, and fertile stamens; they are often unexpanded. They are said to be much less active than the pistillate flowers, and the Pharmacopœia, by describing the drug in panicles, properly excludes the use of loose cusso.

Uses.—In large doses cusso produces nausea, vomiting, and colic; its principal action is anthelmintic, tapeworms being readily killed by it. It is used for the latter purpose alone, and at the present time, in this country at least, only rarely.

RED-ROSE PETALS

(Petala Rosæ Gallicæ)

Source &c.—The red or Provins rose, *Rosa gallica*, Linn. (N.O. *Rosaceæ*), is probably indigenous to southern Europe, but has been cultivated as a garden plant in numerous varieties everywhere. For medicinal use the red rose is grown in England (Oxfordshire, Derbyshire, &c.), in the south of France, near Hamburg, &c.

The drug is collected by plucking the whole of the unexpanded petals from the calyx and cutting off the lighter-coloured lower portion from the deep purplish-red upper part. The little masses of petals are then either used fresh for the preparation of the confection, or dried, in which state they are officially employed for making the infusion; in the latter case they are often gently sifted to remove the stamens. The petals of the red rose are obovate in outline, velvety, and of a deep purplish-red colour, with a paler claw.

Description.—When collected as described they remain united in small conical masses of a deep purplish-red colour, paler towards the base. They possess a delicate rose-like aroma and slightly astringent taste.

Constituents.—Our knowledge of the constituents of red-rose petals is in an unsatisfactory state. They owe their aroma to a trace of *volatile oil*, and they contain a *red* *colouring matter* of an acid nature, which has not yet been subjected to careful examination. *Quercitrin*, a glucoside that has been found in a number of other plants, and *quercetin*, one of the products yielded when quercitrin is boiled with a dilute mineral acid—both yellow crystalline substances, striking a deep green colour with ferric salts—have been isolated from them, and they also contain *gallic acid* ; but whether quercitannic acid (the tannin of oak bark) is present or not has not yet been definitely decided.

Substitution &c.—Red-rose petals should have attached a portion of the paler base of the petal. Artificially coloured petals, which have been met with in commerce, may be recognised by their uniform dark reddish colour.

Uses.—The petals are slightly astringent ; they are chiefly used medicinally, in the form of acid infusion, as an agreeable astringent vehicle.

CLOVES

(Caryophylla)

Source &c.—The clove tree, *Eugenia caryophyllata*, Thunb. (N.O. *Myrtaceæ*), is a handsome evergreen tree and a native of the Molucca Islands, where, as well as on the neighbouring islands, it was formerly extensively cultivated.

Although the spice was known in Europe in the fourth century, the Clove Islands were not discovered till 1504. They passed into the hands of the Portuguese and then into those of the Dutch, who unsuccessfully attempted to monopolise the trade in cloves and confine the tree to the Moluccas. The French, however, succeeded in introducing the plant into Mauritius and Réunion, whence it was brought to Cayenne and to Zanzibar. On the latter island and its neighbour, Pemba, the clove tree is now extensively cultivated, and these two islands furnish the bulk of the world's supply. In the Moluccas the industry is in a deplorable condition, the harvests varying so much that the natives are unwilling to continue the cultivation.

The inflorescence of the plant is a compound raceme, on the ultimate ramifications of which the flowers are borne. When quite young the buds are white ; as they develop they assume a green and finally a crimson colour. They are then collected, before the white corolla expands, and dried in the sun, during which the crimson colour changes to a dark reddish brown. Sometimes the whole inflorescence is collected, or sometimes the buds are knocked off with bamboos, but usually each bud, as it reaches the proper stage, is picked off singly from the tree by hand. The buds are finally separated from peduncles, which are exported separately under the name of 'clove stalks.' The ripe fruits are also occasionally collected; they are known in commerce as 'mother cloves.'

Description.—The cloves of commerce are therefore the dried flower-buds of the tree. Each of them consists of a nearly cylindrical dark reddish-brown portion, which is sometimes regarded as a gynophore, sometimes as a fleshy calyx-tube, but is perhaps most correctly interpreted as the solid lower portion of the ovary (Tschirch), crowned by four thick divergent calyx-teeth of a similar colour, from the centre of which arise four paler, brown unexpanded imbricated petals forming a small rounded bud. After soaking in water for twenty-four hours these petals can be removed, and they will be found to enclose a large number of stamens bending over a stiff erect style arising from a depression in the centre of a small disc. Just below the disc is the two-celled ovary with its numerous ovules; it can be found by cutting the clove either longitudinally or transversely.

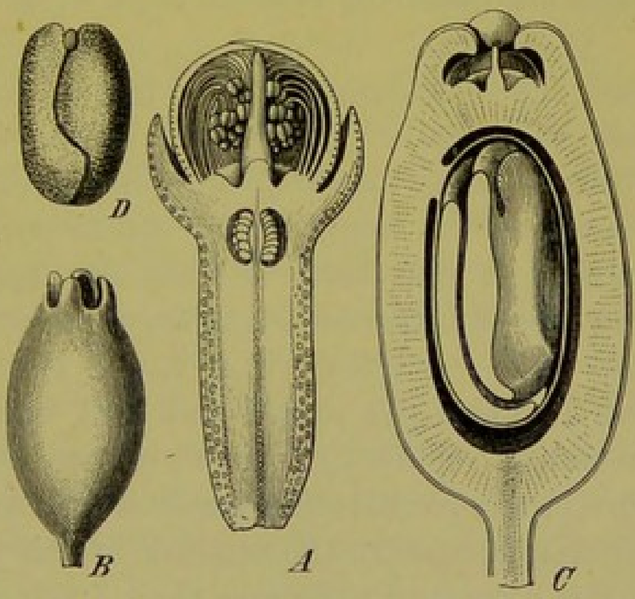


FIG. 25.—Clove (*Eugenia caryophyllata*). *A*, clove cut vertically, showing calyx, corolla, stamens, pistil, and ovules; near the margin oil-glands; magnified. *B*, fruit (mother clove), natural size. *C*, the same, cut vertically and magnified. *D*, embryo, natural size. (Luerssen.)

The lower part of the ovary is solid and fleshy, spongy near the centre. It contains, especially near the periphery, a large number of oil-glands, visible, when the transverse section is examined under the lens, as dark shining points or small cavities. Similar glands can be seen both in the calyx-teeth and petals; in the latter they appear as translucent dots by transmitted light.

Cloves are strongly aromatic and have a pungent aromatic taste. If of good quality they should be plump and heavy, sink in water, and exude oil when indented with the finger-nail.

Constituents.—Cloves contain a large quantity of *volatile oil*, a considerable proportion (13 per cent.—Peabody, 1895) of tannin, which has been identified as *gallotannic acid*, and a colourless, odourless, crystalline substance, *caryophyllin*.

The most important of these constituents is the volatile oil, and the value of the drug is determined chiefly by the amount of oil that it contains. Good cloves should yield from 15 to 20 per cent.

Uses.—Cloves are used as an agreeable aromatic stimulant, antispasmodic, and carminative, properties that are due to the volatile oil they contain.

Varieties &c.—Although Zanzibar supplies the bulk of the cloves imported, those from Penang and Amboyna are considered the best and realise the highest prices. Smaller quantities are imported from Java, the Seychelles, Ceylon, &c.

Clove stalks do not often exceed 1½ inch in length or ⅛ inch in thickness; they branch usually twice or thrice trichotomously, the ultimate branchlets which support the flowers being about ⅛ inch long. They are dry, woody, and brownish in colour; they break with a short fracture, and exhibit in transverse section but few oil-glands. They have, however, when crushed, an aromatic odour and a pungent clove-like taste. They yield much less volatile oil than cloves (about 5 to 7 per cent.), and that which they do yield is less aromatic. They are said to be used for adulterating powdered cloves, a sophistication easily determined by microscopical examination and by the amount of ash yielded by the drug, good cloves affording not more than 7 per cent.

Mother cloves.—Of the numerous ovules contained in the ovary of the clove, only one arrives at maturity. After fertilisation it rapidly increases in size, pushes the other ovules and surrounding tissue aside, and forces its way into the lower part of the ovary (compare fig. 25, *C*). The ripe fruits, which are seldom imported, are ovoid brown berries and about 1 inch long. They contain much less oil than cloves, and are said to be used for adulterating powdered cloves; their presence can easily be detected, as they contain starch, from which cloves are free.

ELDER FLOWERS

(Flores Sambuci)

Source &c.—The common elder, *Sambucus nigra*, Linn. (N.O. *Caprifoliaceæ*), is indigenous and common in England, and is distributed throughout the whole of *central and southern Europe*. It flowers in the early summer, producing large polychasial cymes, 5 or 6 inches in diameter, of small white flowers. The entire inflorescences are collected and allowed to remain in heaps for a few hours, during which they become slightly heated and the corollas drop off from the stalks. The latter are removed by sifting, and the corollas are either dried or preserved by mixing them with common salt. By this 'pickling,' as it is termed, the rather disagreeable odour of the fresh flowers is gradually changed to a pleasant fragrance. Either the fresh or pickled flowers may be used officially for the preparation of elder-flower water, but that made from the fresh flowers has a distinct and unpleasant odour, which it is said to lose after it has been kept for some weeks and then redistilled.

Description.—Each flower of the cyme consists of a three-celled, three-seeded, inferior ovary bearing five small green calyx-teeth and a white, rotate, monopetalous corolla ; the latter possesses five ovate or rounded lobes, and a very short tube in which five stamens with short filaments and yellow anthers are inserted. When the corollas are separated by heating and sifting they bring with them the five stamens, and the drug consists therefore not of the entire flowers, but only of the corollas and stamens, with which a few pedicels are usually mixed. They have a slight taste, and when fresh a not altogether agreeable odour ; dried flowers have a yellowish colour and faint odour.

The student should soak a few dried or pickled flowers in water, and examine them with a lens after they have expanded.

He should observe

(*a*) The *five-lobed monopetalous corolla*,
(*b*) The *yellow anthers* of the stamens.

Constituents.—Elder flowers contain a minute quantity of *volatile oil*, which has not yet been investigated.

Substitutes &c.—The flowers of various small composite plants (*Achillea Millefolium*, Linn. &c.) are said to have been used for adulterating elder flowers. The latter can be easily distinguished by the characters detailed above.

The flowers of the dwarf elder (*Sambucus Ebulus*, Linn.), which, however, is a comparatively rare plant, are distinguished by their dark red anthers.

Uses.—Elder flowers are chiefly used as an agreeable vehicle in the form of the distilled water.

CHAMOMILE FLOWERS

(Flores Anthemidis)

Source &c.—The common or Roman chamomile, *Anthemis nobilis*, Linn. (N.O. *Compositæ*), is a small creeping perennial plant with shortly ascending, leafy, flowering branches bearing terminal white-rayed flowerheads. It is common on waste grounds in this country, and is cultivated for medicinal use both in England (Hampshire &c.) and in Belgium, France, and Saxony. Formerly large quantities were produced near Mitcham, but at present there is but little grown in Surrey, and that is chiefly used for distillation. The flowers have long enjoyed a wide reputation as a domestic medicine.

The inflorescence of the wild plant is a capitulum surrounded by two or three rows of overlapping bracts; the disc-florets are yellow, tubular, closely packed on an elongated conical receptacle, and surrounded by a single row of ray-florets with white ligulate corollas. Such chamomile flowers, which are properly designated 'single,' are collected to some extent in Scotland, but they are not official.

Under cultivation the flower usually becomes more or less double. The yellow tubular corollas of the disc-florets become more or less completely white and ligulate, and the flowerhead is converted into a hemispherical mass of white ligulate florets. These are 'double' chamomiles, and form the bulk of the imported cultivated flowers; intermediate forms, or semi-double flowers, in which the conversion of tubular into ligulate corollas has been only partially effected, may, however, frequently be found.

The entire flowerhead is collected for medicinal use, and dried in a warm room.

Description.—The official chamomiles are limited to the 'double' or semi-double flowerheads obtained from cultivated plants, those imported from Belgium, France, and Saxony being preferred by the drug trade on account of their handsome appearance, whilst English flowers yield more volatile oil when distilled.

The flowerheads are hemispherical in shape and white or nearly white in colour, becoming yellow or buff-coloured when kept; they vary from ½ to ¾ inch in diameter. The involucre surrounding each flowerhead consists of two or three rows of overlapping bracts with membranous margins, and is almost entirely concealed in the drug by the reflexed outer ligulate florets. The latter are pistillate, the yellow tubular central florets (if present) being hermaphrodite. The corolla of the ligulate florets is white, rather narrow, and terminated by three teeth; towards the base it is contracted to a short tube, immediately below which is the small, nearly smooth ovary. The calyx is completely adherent to the ovary, and, as there is no pappus developed, is not distinguishable. If the florets are all carefully plucked from the flowerhead, a number of blunt, narrow, concave, scaly bracts (paleæ) will be found standing on a conical receptacle; on cutting a flowerhead longitudinally through the centre each floret will be seen to spring from the axil of a bract, and the conical receptacle will be found to be solid. When closely examined with a powerful lens, the lower part of the corolla may be seen to be sprinkled with minute, yellowish, shining oil-glands.

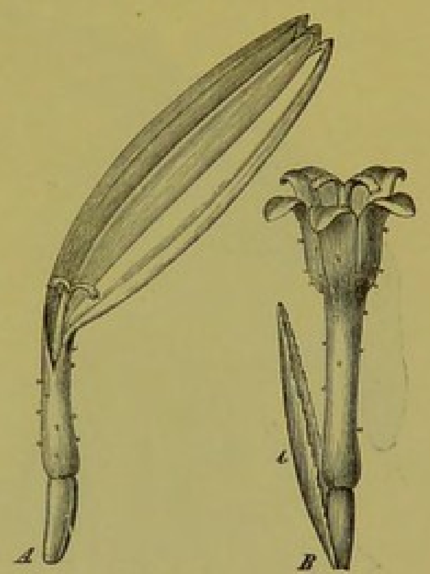


FIG. 26.—Chamomile (*Anthemis nobilis*). *A*, ray-floret, magnified 4 diam. *B*, disc-floret with bract (*b*), showing external glands; more highly magnified. (Luerssen.)

Chamomiles have an aromatic odour and an aromatic intensely bitter taste.

The student should carefully strip the florets from a flowerhead, and observe

(*a*) The *presence and shape of the paleæ*;

and should also cut a flowerhead longitudinally through the centre, and note

(*b*) The *solid elongated-conical receptacle.*

He should further compare these with the flowers of the wild chamomile (German chamomile, *Matricaria Chamomilla*, Linn.) and of the feverfew (*Chrysanthemum Parthenium*, Bernh.), which are alluded to below.

Constituents.—Chamomile flowers contain a small quantity of *volatile oil*, which is blue when freshly distilled, but becomes yellow by keeping. Of the bitter principle, which has been termed *anthemic acid*, little definite is known.

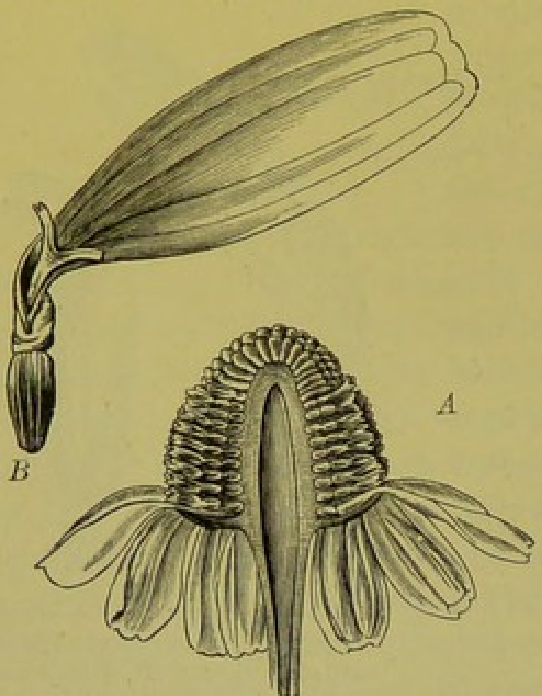


FIG. 27.—German Chamomile (*Matricaria Chamomilla*). *A*, flowerhead cut vertically. *B*, ray-floret, magnified. (Moeller.)

Uses.—Chamomile flowers possess aromatic, bitter stomachic properties; the oil is frequently administered in pills as a carminative.

Substitutions &c. — The characters given above will easily distinguish the true or Roman chamomile from the following, which somewhat resemble it:

Matricaria Chamomilla, Linn., German Chamomile.—The flowerheads are single, and have a hollow conical receptacle, devoid of paleæ.

Chrysanthemum Parthenium, Bernh., the Feverfew.—The cultivated plant has double flowerheads, resembling those of the chamomile. The receptacle is flat; paleæ may be present or absent, according to the variety; if present they are acute.

ARNICA FLOWERS

(Flores Arnicæ)

Source &c.—Arnica flowers are the flowerheads of *Arnica montana*, Linn. (N.O. *Compositæ*), a small plant with creeping perennial rhizome, indigenous to central Europe. In the warmer districts it is common in the meadows on the lower mountain spurs; in the more northern districts it grows in the valleys. It produces on the summits of the flowering stems large, solitary, orange-yellow flowerheads, not unlike yellow marguerites, measuring about 2 inches in diameter.

The flowerheads are usually collected entire and dried; the receptacle being especially liable to be attacked by insects, this, together with the involucre, is sometimes separated, and the drug then consists of the ligulate and tubular florets.

Description.—The drug as met with in English commerce commonly consists of the entire flowerheads, the most conspicuous parts of which are the green involucre and whitish bristly pappus; the dark yellow ligulate corolla, so prominent in the fresh flower, shrivels so much as to become quite inconspicuous.

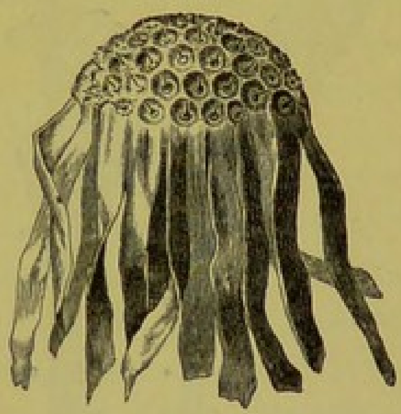


Fig. 28.—Arnica flowers. Receptacle magnified 4 diam. (Vogl.)

The involucre consists of two rows of dark green, acutely pointed, linear-lanceolate, hairy bracts. The florets of the ray are pistillate and arranged in a single row; they possess long, narrow, dark yellow ligulate corollas. When the corollas, which are much shrivelled in the dry drug, are expanded by soaking in water and examined with a lens, it will be seen that each contains from seven to nine veins and is terminated by three teeth; these characters should be carefully noted.

The disc-florets are numerous, and have a long, dark yellow tubular corolla, which bears on its outer surface minute glands, visible under a strong lens; similar glands are found also on the ligulate ray-florets. The fruit, which is more or less shrivelled, is elongated, straight, covered with appressed hairs, and surmounted by a single ring of stiff whitish barbed bristles (pappus).

After the florets have been removed, the receptacle, which is about $\frac{1}{4}$ inch in diameter and arched, exhibits a corresponding number of depressions, each of which bears in its centre a stiff dark bristle, and is surrounded by short bristly hairs, the latter being, however, sometimes absent.

Arnica flowers have a slight pleasant odour, and bitter, rather acrid taste.

The student should particularly note

(*a*) The *narrow ligulate corollas, with from seven to nine veins and three teeth,*

(*b*) The *straight bristly fruit* and *abundant, whitish, bristly pappus,*

(*c*) The *linear-lanceolate, hairy, involucral bracts.*

Constituents.—Arnica flowers contain traces of *volatile oil* and a bitter principle, *arnicin*, which has been obtained in minute yellow deliquescent crystals. The flowers are said to contain more arnicin than the root.

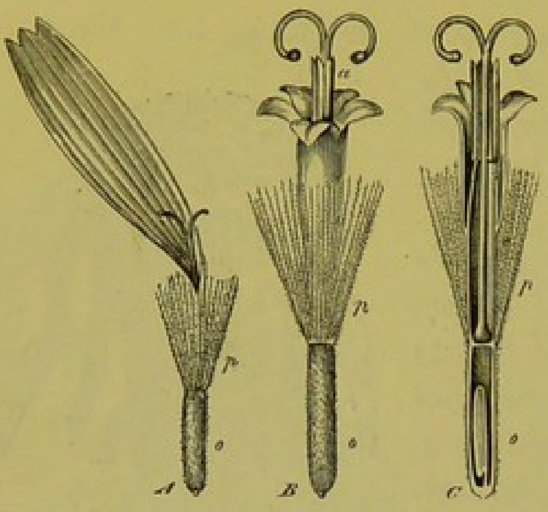


Fig. 29.—Arnica flowers. *A*, ray-floret. *B*, disc-floret. *C*, the same, cut vertically: *o*, ovary; *p*, pappus; *a*, anthers. All magnified. (Luerssen.)

Uses. — Preparations of arnica flowers applied to the skin appear to increase the activity of the circulation, and the tincture, diluted with water, is a popular application to the skin; internally they are stimulant and irritant, but are now seldom administered.

Substitutions &c.—Numerous other composite flowers are reported to have been mixed with or sold for arnica, as, for instance, those of *Calendula officinalis*, Linn., *Inula britannica*, Linn., *Tragopogon pratensis*, Linn., *Scorzonera humilis*, Linn., &c. The straight (not curved) hairy fruit, the single row of bristles surmounting it, and the number of veins and teeth in the ligulate corolla as above described, are sufficient to distinguish arnica from all of them. To these characters the student should therefore pay particular attention.

WORMSEED

(Santonica, Semen Cinæ, Semen Contra)

Source &c.—The drug that is known by the name of wormseed consists of the small unexpanded flowerheads of

Artemisia maritima, var. *a Stechmanniana*, Besser (N.O. *Compositæ*). The species has, in numerous varieties, an extremely wide distribution, from the Bay of Biscay to Chinese Mongolia. The variety from which part at least of the drug is obtained grows in enormous quantities in the deserts of the Kirghiz in Turkestan, especially near the town of Chimkent, which lies to the north of Taschkent and some seventy miles east of the Sir Daria river; in Chimkent a factory has been erected, in which large quantities of santonin are produced from the wormseed collected in the vicinity. Comparatively little of the crude drug is now exported. The plant is small and woody, throwing up a number of erect branches about a foot long, on which the little flowerheads are borne. These are stripped from the stems before they expand, and dried. They are collected in July and August by Kirghiz and other tribes and brought to Chimkent.

Wormseed has long been used as an anthelmintic; it was employed in Italy under the name of semenzina (diminutive of semenza = seed), under the belief that it consisted of small seeds. From this word semenzina is derived the name 'semen cinæ,' by which the drug is often known; semen contra is an abbreviation of 'semen contra vermes.' The drug appears at first sight to consist of a number of small brownish ridged seeds, and it is not till they are closely examined and dissected that their true nature becomes apparent.

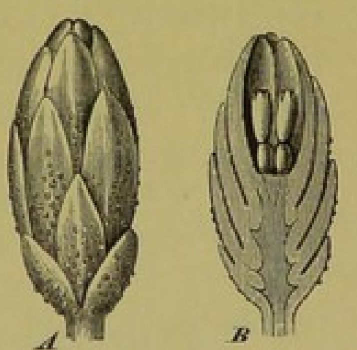


FIG. 30.—Flowerhead of *Artemisia*. *A*, entire, showing imbricated bracts with external glands; *B*, cut longitudinally, showing florets. Magnified. (Luerssen.)

Description. — When collected the flowerheads are of a greenish-yellow colour, but they turn brown by drying and keeping. They are very small, being only about $\frac{1}{10}$ inch long, elongated ovoid in shape, and somewhat angular; their surface is shining and glabrous, or at most only slightly hairy.

The involucre consists of imbricated bracts of ovate or lanceolate shape, furnished with a distinct keel, on each side of which are shining oil-glands; the latter, however, are not easily seen even under a powerful lens. After the drug has been well soaked in water the bracts can be removed with dissecting needles, and in the centre from three to six very minute unexpanded tubular florets will be found; they are completely enclosed by the upper bracts of the involucre.

The drug exhales, when crushed, an agreeable aromatic odour, and possesses a bitter, aromatic, camphoraceous taste. It frequently contains a considerable admixture of fragments of the leaves and very slender flower stalks.

The student should soak the wormseed in water for twenty-four hours, and then dissect a flowerhead with the aid of the dissecting needles and a lens. He should note

(*a*) The *imbricated keeled glabrous bracts*,
(*b*) The *minute florets enclosed within them*,
(*c*) The *characteristic odour and taste*.

Constituents.—Wormseed contains a *volatile oil* and a crystalline principle, *santonin*, to which the anthelmintic property of the drug is due. The santonin attains its maximum (2·3 to 3·6 per cent.—Ehlinger, 1885) in July and August. After flowering it rapidly disappears.

Santonin ($C_{15}H_{18}O_3$) forms colourless bitter crystals that are very slightly soluble in water but unite with alkalies, forming soluble salts of monobasic santonic acid ($C_{15}H_{20}O_4$). Exposed to light, santonin assumes a yellow colour.

Wormseed contains also a crystalline substance, *artemisin*.

Uses.—Wormseed is now seldom administered, but its active constituent, santonin, is often employed as an anthelmintic; it rapidly kills the round worm, but has less effect upon thread-worms. It produces remarkable disturbances of vision, objects appearing first blue and then yellow.

CALENDULA

(Flores Calendulæ, Marigold Florets)

Source &c.—The marigold, *Calendula officinalis*, Linn. (N.O. *Compositæ*), is a native of southern Europe and the Levant, but is commonly cultivated in numerous varieties as a garden plant. It produces an orange-yellow flower about 2 inches in diameter, with numerous barren disc-florets and one or more rows of fertile ligulate ray-florets. The latter are collected when the flower is fully expanded and dried.

Description.—The drug consists almost entirely of the yellow ligulate corollas of the ray-florets, about 1 inch in length, enclosing in a short tube the remains of the style and two stigmas. The limb of the corolla, the tube of which is hairy externally, is terminated by three teeth, and exhibits, when examined with a lens, four principal veins. (Compare fig. 32, *B*.)

The drug has a somewhat aromatic odour and a distinctly bitter taste.

Constituents.—Calendula contains traces of *volatile oil*, a *bitter principle*, and *calendulin*, the latter being a tasteless substance swelling in water (Geiger, 1818).

The student should soften some calendula in water, spread the florets out, and examine them with a lens, noting

(*a*) The *three teeth of the corolla*,
(*b*) The *four principal veins* ;

and should compare them with the ligulate florets of arnica (which have from seven to nine veins) and of dandelion (which have five teeth). (Compare figs. 29, *A*, and 32, *B*.)

Uses.—Calendula is used chiefly in the form of a diluted tincture as an application to bruises.

INSECT FLOWERS (Dalmatian)

Source &c.—Dalmatian insect flowers are the unexpanded flowerheads of *Chrysanthemum cinerariæfolium*, Vis. (N.O. *Compositæ*), a native of Dalmatia, Herzegovina, and Montenegro, and cultivated both in Dalmatia and California. The attempt has also been made to cultivate the plant in Australia, southern Africa, and elsewhere, but the supply of insect flowers is at present derived chiefly from Dalmatia.

The flowers of several composite plants have long been known to possess the remarkable property of stupefying flies and other small insects when kept near them for a short time. None, however, appear to act so energetically as those of the plant under consideration, and they, it has been observed, are most active if collected when they are fully developed, but before they expand. They are then known commercially as 'closed' flowers ; 'half-closed' and 'open' being flowers collected, as the terms indicate, at more advanced stages of development. They retain their insecticidal properties indefinitely, even in the state of dry powder.

The flowers alone appear to be active; the leaves have been shown to be destitute of insecticidal properties.

Description.—The closed flowerheads of commerce are of a dull brownish-yellow or greyish-brown colour and nearly globular shape, measuring almost $\frac{1}{2}$ inch in diameter. The bracts of the involucre, which are arranged in two or three rows, are yellowish or greyish in colour, lanceolate, hairy, and membranous at the margin. In the closed flowers they are erect, but as the flowers expand they bend outwards, the capitulum assuming a flattened hemispherical shape. There is only one row of ray-florets, with brownish or whitish ligulate corollas. The disc-florets, which are numerous, have a comparatively short yellow corolla. The fruit is longer than the corolla, club-shaped, and provided with five ribs that project so strongly as to make it appear almost winged. Both the corolla and the fruit are sprinkled with yellow shining oil-glands. After the corolla has been removed, the calyx may be seen in the form of a raised membranous ring crowning the fruit. The receptacle is naked and nearly flat.

The expanded capitula are frequently destitute of both ligulate and tubular corollas, and the drug then presents, when viewed from above, a reticulated appearance due to the membranous calices of the closely packed fruits.

They possess a bitter, acrid taste; the odour is aromatic, but not strong.

The student should observe

(*a*) The *sub-globular shape of the 'closed' flowers,*
(*b*) The *yellowish colour of the bracts,*
(*c*) The *short corolla and membranous calyx of the tubular florets,*
(*d*) The *five prominent ribs of the fruit.*

Constituents.—Dalmatian insect flowers contain up to $1\frac{1}{4}$ per cent. of *volatile oil,* which, however, certainly does not contribute to the insecticidal properties of the flowers. The toxic principle is a yellow butyraceous substance, to which the name of *pyrethrotoxic acid* has been given. It is not volatile, and therefore the flowers do not lose their activity when exposed to the air.

Substances of alkaloidal and glucosidal nature have also been isolated, but our knowledge of them is very imperfect.

Good insect powder should stupefy common house-flies kept near it within a minute. Less active powders may take as much as twenty minutes to effect this.

Substitutes &c.—*Chrysanthemum coccineum*, Willd., a native of the Caucasus and northern Persia, yields the Persian (or Armenian) insect flowers, which were formerly more commonly used than the Dalmatian. The importation has now, however, practically ceased.

The flowerheads are distinguished from the Dalmatian by the dark, nearly black, colour of the involucral bracts, by the rose colour of the ray-florets, and by the ten-ribbed fruit. They are said to be less active than the Dalmatian.

Dalmatian insect powder is largely adulterated, not only with the powder of other composite flowers, but also with turmeric, lead chromate, &c. It should not yield more than 8 per cent. of ash or 10 per cent. of moisture. But the best test is the practical one of keeping a few house-flies under a tumbler with a little of the powder; they should be stupefied within a minute.

LAVENDER FLOWERS

(Flores Lavandulæ)

Source &c.—The common lavender, *Lavandula vera*, DC. (N.O. *Labiatæ*), is a small under-shrub indigenous to southern France, Italy, and Spain, but cultivated in this country as a garden plant, as well as on a large scale for its aromatic flowers. It is also extensively cultivated in southern France.

The best lavender is said to be that grown in Surrey. Formerly large quantities were produced near Mitcham, but Wallington is said to be now the centre of the Surrey lavender district. Lavender is also grown in Kent, Hertfordshire, Bedfordshire, &c.

The bulk of the flowers produced are used for the distillation of the volatile oil. They are cut with a small hook about 6 or 12 inches below the flowers. They are then thrown into large stills situated near the fields, water is added, and distillation conducted over a naked fire, the distillate being received in a separating can, in which the oil that is carried over is retained.[1]

[1] These particulars were kindly furnished by Miss Sprules, of Wallington.

Description.—The inflorescence of the lavender is a terminal spike, on which the flowers are arranged in small verticillasters, each of which arises from the axil of a rhomboidal bract. The calyx is tubular and ribbed, bluish-violet in colour, five-toothed, and hairy, shining oil-glands being visible with a lens amongst the hairs. The majority of the oil yielded by the flowers is contained in these glands on the calyx.

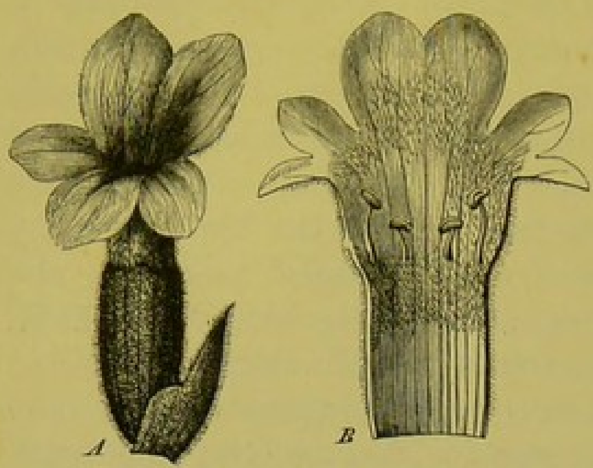


FIG. 31.—*Lavandula vera.* *A*, entire flower, showing bract and hairy calyx, magnified. *B*, the corolla opened vertically, magnified. (Luerssen.)

The corolla is bilabiate and of a beautiful bluish-violet colour.

Lavender flowers have an agreeable fragrant odour, which is especially perceptible when they are warmed or rubbed; their taste is bitter and aromatic.

The student should observe

(*a*) The *hairy, ribbed, tubular calyx,*

(*b*) The *rhomboidal bracts supporting the flowers.*

Constituents.—The principal constituent of lavender flowers is the *volatile oil,* of which they contain from 1½ to 3 per cent.

Substitutes &c.—*Lavandula spica,* DC., from which oil of spike is distilled, is distinguished from the common or true lavender by the inflorescence which is more compressed, by the bracts which are linear instead of rhomboidal, and by the leaves of the plant, which are spathulate. The oil distilled from the flowers is less fragrant than that of the true lavender.

SAFFRON

(Crocus)

Source &c.—The saffron crocus, *Crocus sativus,* Linn. (N.O. *Irideæ*), has been cultivated for so many centuries that we no longer know in what country it is really indigenous. It was well known to the Greeks and Romans, who used it as a medicine, as a dye, and as a flavouring agent. It was cultivated in Spain in the tenth century, and was subsequently introduced into France and England; it is, however, no longer grown in this country.

At the present time Spain produces the bulk of European saffron. On the plains towards the east and south-east the saffron crocus is grown extensively, the saffron being exported from Valencia and Alicante. France produces much less near Pithiviers, about fifty miles south of Paris, whilst a little is grown in Austria and Italy.

The plant produces in the autumn usually one or two flowers of a pale purplish-violet colour, not unlike the ordinary garden crocus. The long pale yellow style terminates in three deep red elongated stigmas (fig. 32, *A*), which protrude from the flower and are pendulous. The whole flower is collected, and from it the three stigmas, with the upper part of the style, are separated and dried. This forms the hay saffron of commerce, which must necessarily be a valuable drug, since it takes about fifty fully developed stigmas to make a grain weight of saffron.

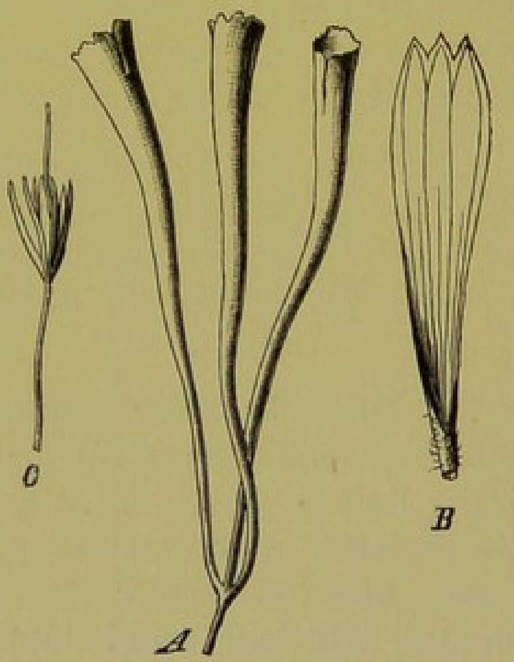


Fig. 32.—*A*, three stigmas of Saffron with a portion of the style, magnified 2 diam. *B*, Calendula floret, magnified 1½ diam. *C*, Safflower floret, magnified 1½ diam. (Vogl.)

Description. — Hay saffron thus produced forms a loosely matted mass of dark reddish-brown stigmas with a strong characteristic odour and bitterish taste. When fresh it is unctuous in appearance and to the touch, but after keeping, when quite dry, it becomes dull and brittle.

Thrown on the surface of water the dry stigmas rapidly expand, and their form can be easily studied. At the same time the water surrounding them assumes a deep yellow colour. Each stigma is about an inch in length, and has the shape of a long tube, narrow at the base, where it joins the style, but broadening towards the upper extremity, where it is slit on the inner side. The mouth of the tube is irregularly notched. The stigmas are either single or attached in threes to a short portion of the pale yellow style.

The characteristic shape of the saffron stigmas is of the greatest service in the detection of adulteration; the student should therefore soak a little saffron in water, examine it carefully with a lens, and observe the shape.

Constituents.—Saffron contains about 1 per cent. of *volatile oil*, an amorphous red colouring matter, *crocin*, and a colourless bitter principle, *picrocrocin*. Crocin is a glucoside, and yields by hydrolysis, with dilute mineral acids, a sugar (crocose) and crocetin; concentrated sulphuric acid colours it deep blue, nitric acid green, whence it has also been called polychroite.

Uses.—Although chiefly employed as a colouring agent, saffron has been regarded as stimulant, antispasmodic, and emmenagogue.

Substitutes &c.—The high price of the drug has naturally been, even during the time of Dioscorides and Pliny, a great inducement to adulteration. This has been effected in one (or more) of the following three ways:

(i) By substituting some substance for the saffron stigmas,

(ii) By recolouring exhausted saffron,

(iii) By artificially increasing the weight of genuine saffron.

(i) Under the first heading may be mentioned the florets of safflower (*Carthamus tinctorius*, Linn.), an Indian composite plant, largely employed as a dye, the stamens or portions of the perianth of the saffron crocus or of other plants, calendula florets, and the slender stems and roots of monocotyledonous plants. All these, and indeed almost every such substitution, can be detected with facility by expanding the saffron in water and examining it.

(ii) Artificial coloration has been effected with aniline dyes, logwood, Brazil wood, the salts of dinitrocresylic acid (Victoria yellow, Victoria orange), &c. Genuine saffron, when thrown on to the surface of water, should surround itself with a circle of yellow (not red or pink) liquid; it should yield but little colour to ether or petroleum spirit, in which many artificial colours are readily soluble. Useful information may also be obtained by comparing the colour of an infusion of 1 grain of the suspected sample in 1,000 grains of water with the colour of a similar infusion of genuine saffron, both depth and tint being scrutinised.

(iii) Saffron may be artificially weighted in a variety of ways. Vegetable or mineral oil, which, in addition to increasing the weight, improves the appearance, may be detected by pressing the saffron between thin sheets of paper ; a greasy stain indicates the presence of oil. Saffron should not contain more than 12·5 per cent. of moisture or yield more than 7 per cent. of ash (absence of an undue proportion of water, or presence of fraudulently added inorganic matter). The presence of glycerine, and of other substances soluble in water, but leaving no ash when incinerated, may be detected by ascertaining the amount of water-soluble substances yielded by the saffron ; they should not exceed 15 per cent.

Cape saffron consists of the flowers of a scrophulariaceous shrub, *Lyperia atropurpurea*, Benth., a native of South Africa ; it contains a yellow colouring matter, but could scarcely be mistaken for saffron.

Cake saffron ('croci placentæ,' 'crocus in placenta') consists of safflower florets made into cakes with an adhesive sugary substance. The structure of the florets is easily seen when a little of the drug is soaked in water.

LILY OF THE VALLEY FLOWERS

(Flores Convallariæ)

Source &c.—The common lily of the valley, *Convallaria majalis*, Linn. (N.O. *Liliaceæ*), is a small herbaceous plant, with perennial creeping rhizome. It is widely distributed over Europe and indigenous in England, where it occurs in woods or thickets, being much more abundant in some counties than in others.

The plant produces two broadly elliptical leaves and a flowering scape, bearing in the axils of small bracts pedicellate campanulate flowers, forming a graceful, unilateral raceme of fragrant, white, drooping flowers. The root, leaves, and flowers have all been used in medicine as a substitute for foxglove leaves, but the only part now employed is the flowers, on account of their greater activity. The entire inflorescence is collected and dried, during which process the white flowers assume a brownish-yellow tinge and the fragrant odour almost entirely disappears.

Description.—The drug consists of the slender scape, bearing from three to eight brownish-yellow campanulate flowers. The perianth has six recurved teeth, and bears on its inner surface six large anthers ; the ovary is superior and three-celled. It possesses but a slight agreeable odour and a bitter taste.

Constituents.—Two glucosides have been isolated from the lily of the valley, *convallamarin* and *convallarin* ; the former is amorphous, has a bitter taste, and acts upon the heart ; the latter is crystalline and purgative.

SECTION III

FRUITS

STAR ANISE FRUIT

(Fructus Anisi Stellati)

Source &c.—Star anise fruit is the ripe fruit of *Illicium verum*, Hook. f. (N.O. *Magnoliaceæ*), a small tree indigenous to the southern and south-western provinces of China. The drug has long been known in China, but effected its introduction into Europe very slowly. The bulk of star anise is used in the former country for the distillation of the volatile oil, only a small proportion of the dried fruits finding their way into the European market, chiefly from the southern Chinese port, Pakhoi.

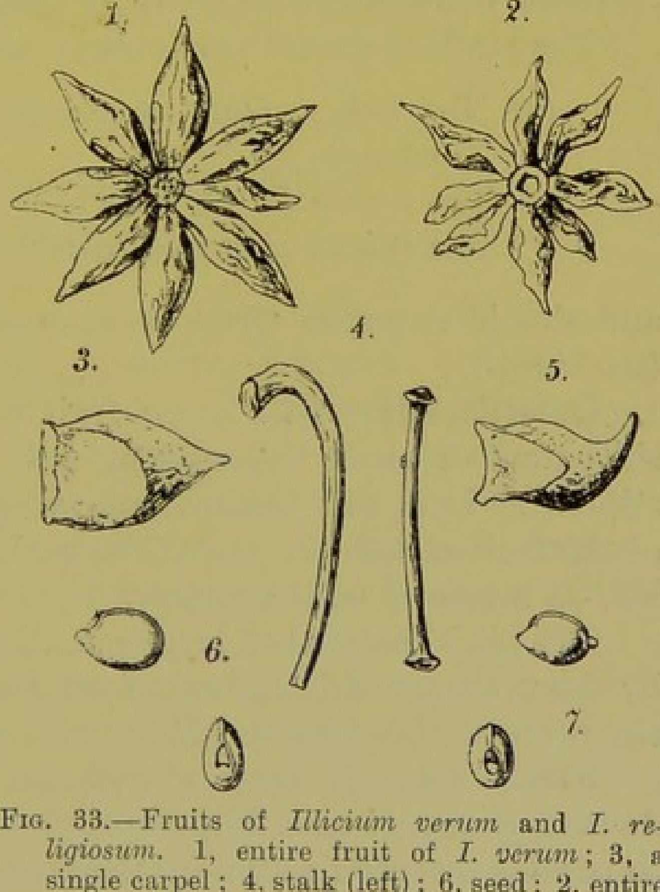


FIG. 33.—Fruits of *Illicium verum* and *I. religiosum*. 1, entire fruit of *I. verum*; 3, a single carpel; 4, stalk (left); 6, seed; 2, entire fruit of *I. religiosum*; 4, stalk (right); 5, single carpel; 7, seed. (Vogl.)

Description. — Star anise fruit is apocarpous, and consists normally of eight one-seeded ovaries. In the flower these are erect, but as the fruit ripens they bend outwards, and finally radiate from a central axis; simultaneously the pericarp becomes dark brown and woody, and dehisces by the now fully exposed ventral suture, disclosing a single, shining, brown seed. This is the appearance usually presented by the drug.

The carpels measure about ½ inch or rather more in length; they are boat-shaped, and usually bluntly beaked at the apex, but nearly flat at the base, where they are attached to a short central column proceeding from a curved peduncle. They are of a reddish-brown colour and woody; externally irregularly wrinkled, internally paler, smoother, and glossy. The seed, exposed by the ventral suture, which, however, is not usually widely open, is reddish brown in colour, smooth, shining, and hard; it is ovoid in shape, and slightly compressed. The hilum is conspicuous as an oval depression at one extremity. The seed-coats, though hard, are brittle, and enclose a large, soft, oily kernel.

Both the pericarp and the kernel have an agreeable aromatic odour and a sweet spicy taste.

The student should particularly observe

(*a*) The *size, regular appearance, and blunt beaks of the carpels,*
(*b*) The *peduncle, which is curved near the fruit,*
(*c*) The *spicy odour and taste*;

and should compare these fruits with the Japanese star anise (see below).

Constituents.—Star anise fruit contains a *volatile oil* to the extent of about 5 per cent., and this is the principal constituent. It is secreted in large oil-cells in both the pericarp of the fruit and the kernel of the seed, the latter yielding about half as much oil as the former.

The oil is distilled in large quantities in crude native stills by the peasants of Langson, in southern China, and brought to the ports of Hai-fong and Hong Kong for exportation.

Uses.—The oil is employed as a carminative and as a flavouring agent, especially in cough mixtures, as it is supposed to possess a special action on the bronchial mucous surfaces.

Substitutions &c.—True star anise fruits have been largely replaced in India by the fruits of the Japanese star anise (*Illicium religiosum*, Siebold); and a similar substitution has frequently taken place elsewhere. Large quantities of the Japanese fruit are exported from Japan, and some find their way to the London market. As they are poisonous and have produced unpleasant effects when eaten, they must be carefully distinguished from the genuine.

Japanese star anise fruit (fig. 33), or sikimi or shikimi fruits as they are termed, resemble the genuine in general appearance, but may be distinguished by the following characters: The fruits are less regularly developed, the carpels usually more wrinkled and provided with a more acute beak, which is commonly directed upwards; the ventral suture is usually more open, and the peduncle, to which the carpels seldom remain attached, is straight. Moreover, the taste and odour are quite distinct, for the Japanese fruits have a balsamic but not anise-like odour and a disagreeable bitterish taste; the taste and odour are, indeed, the best characters by which to distinguish the genuine from the false, as they can be applied to fragments only of the fruit.

The poisonous constituent is the crystalline principle sikimin.

COCCULUS INDICUS

(Levant Berries, Fructus Cocculi)

Source &c.—The fruits commonly known as Cocculus indicus are produced by *Anamirta paniculata*, Colebrooke (N.O. *Menispermaceæ*), a tall woody climbing shrub indigenous to *eastern India* and the Malayan Archipelago. They derive the name of Levant berries, by which they are sometimes known, from the fact of their having been formerly brought from India by way of Alexandria and the ports of the Levant.

The plant produces a pendulous panicle of flowers; the ovaries of the pistillate flowers are apocarpous, each carpel being gibbous and developing into a drupaceous fruit containing a single seed. The fruits are collected when ripe, and dried; they are exported chiefly from Bombay and Madras.

Description.—Cocculus indicus of commerce consists of small dark brown or nearly black fruits, not quite half an inch in length. When examined carefully they will be seen to be more or less distinctly reniform in shape, one side being flattened or even slightly concave, whilst the other is boldly arched. On the former the small scar left by the stalk can usually be distinguished, and near it is a minute prominence, the apex of the fruit. The gibbous dorsal surface of the carpel from which the fruit is formed develops much more rapidly than the ventral, and the apex of the fruit thus remains near

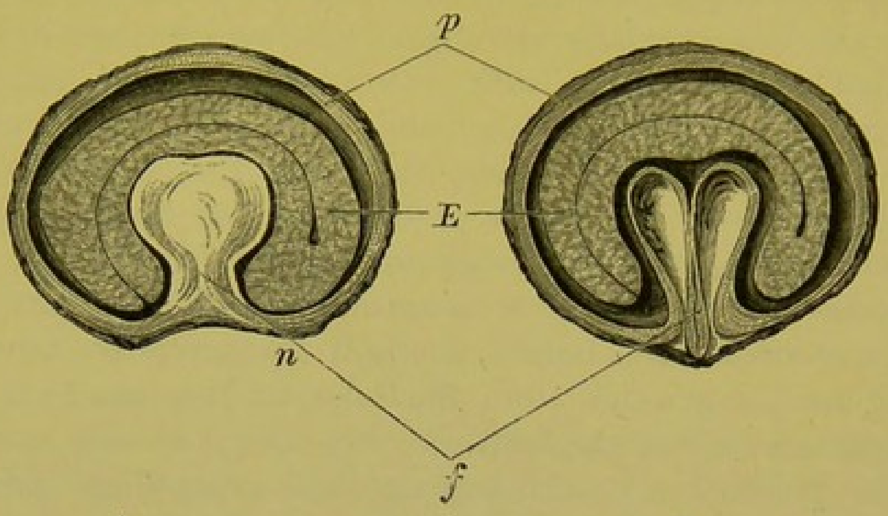


Fig. 34.—*Cocculus indicus.* *A*, vertical; *B*, transverse section: *p*, pericarp; *n*, base of fruit; *E*, embryo; *f*, fold of pericarp. Magnified. (Moeller.)

to the base, the dorsal surface becoming conspicuously arched; the latter is traversed from base to apex by an indistinct ridge. The pericarp is rough and finely wrinkled, and although thin is hard and woody. It encloses a single oily seed, which is so deeply hollowed out as to be cup-shaped. This cup-shaped hollow is completely filled by two parallel lenticular ingrowths of the endocarp and mesocarp, which can easily be seen by cutting a fruit longitudinally through the median line of the carpel and removing the two halves of the seed, or less clearly by cutting the fruit transversely. The seed exhibits a crescent-shaped section when cut either longitudinally or transversely. Cocculus indicus has no odour; the pericarp is tasteless, but the seed is very bitter.

The student should observe

(*a*) The *sub-reniform shape of the fruit,*

and should cut it longitudinally and transversely, noting

(*b*) The *shape of the seed,*

(*c*) The characteristic *ingrowths from the pericarp.*

He should further notice that the seed is bitter, but the pericarp is almost tasteless.

Constituents.—The seed contains from 1 to 1·5 per cent. of an intensely bitter crystalline principle, *picrotoxin*, accompanied by a crystalline but tasteless body, *cocculin*, and a large proportion of *fat*. Picrotoxin contains no nitrogen and is therefore not alkaloidal, nor does it possess glucosidal properties; its constitution is as yet unknown.

From the pericarp, which is tasteless, two alkaloids, menispermine and paramenispermine (Pelletier and Couerbe, 1833), have been isolated, but they require re-investigation.

Uses.—Cocculus indicus is now used almost exclusively for the preparation of picrotoxin, which has been given internally to check the night-sweating of phthisis and has also been employed to destroy pediculi. The power possessed by the fruits, when thrown into water, of stupefying fish has long been known, and is due to the picrotoxin contained in the seed. So susceptible are fish to the influence of picrotoxin, that they have been used as a means of detecting its presence. A number of other plants, however, share this property with Cocculus indicus.

POPPY CAPSULES

(Poppy Heads, Fructus Papaveris)

Source &c.—The opium poppy, *Papaver somniferum*, Linn. (N.O. *Papaveraceæ*), is probably a native of Asia Minor, but is now cultivated in many *warm or temperate countries* both as a garden plant and for the sake of its fruits and seeds. The plant is an erect herbaceous annual; it varies very much in the colour of the petals, as well as in the shape of the fruit and colour of the seeds.

In England a variety with pale flowers and whitish seeds is cultivated for medicinal use. The fruits are of a pale glaucous green when young, and exude when wounded a bitter white milky juice (latex); as they mature and ripen they change to yellowish brown, and are then cut from the stems. In Germany the unripe fruits are considered to be more active than the ripe.

Description.—Poppy heads vary very much both in shape and size. Some varieties are ovoid, others are nearly globular, others again depressed both at the summit and base, the latter variety attaining 3 inches or more in diameter. The fruit is of a pale yellowish-brown colour, often marked with darker spots, glabrous, and crowned with the persistent remains of the stellate sessile stigmas, usually twelve or fifteen in number; below,

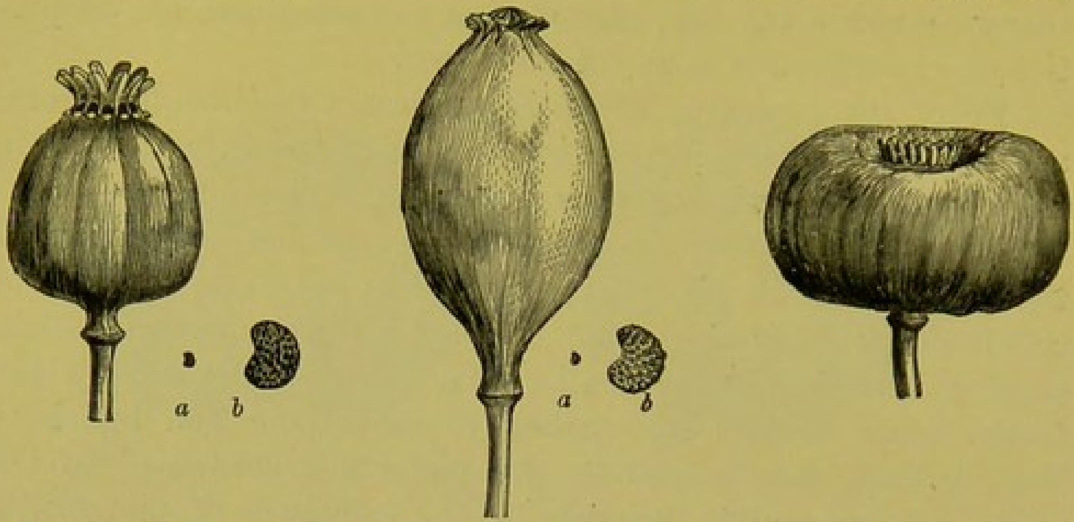


FIG. 35.—Poppy capsules and seeds. *a*, natural size; *b*, magnified. (Maisch.)

it is contracted into a neck which is swollen just above the point of attachment to the peduncle and marked there with the scars of the petals and sepals. Cut transversely the fruit is seen to be

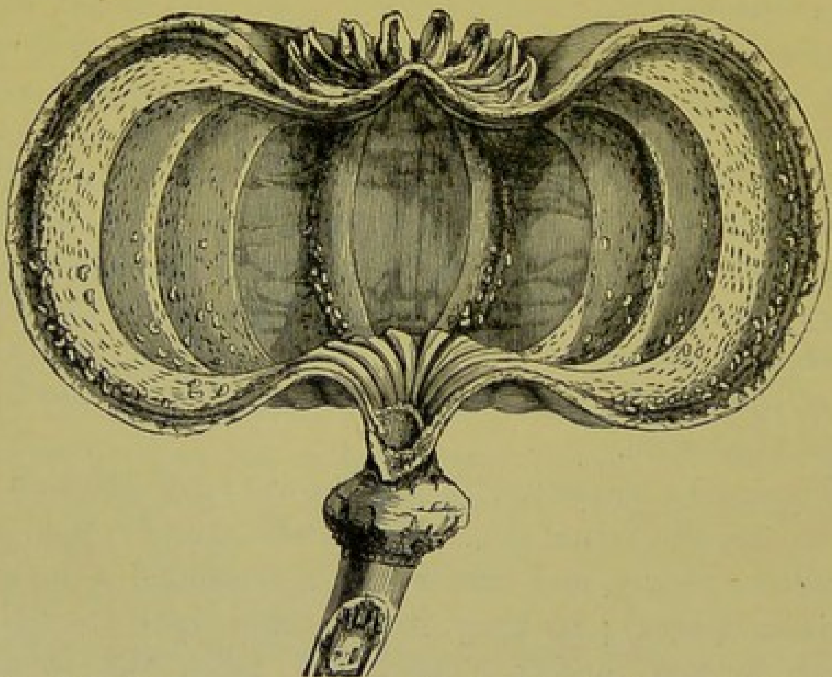


FIG. 36.—Poppy capsule, cut vertically. (Planchon and Collin.)

unilocular, but formed by the union of as many carpels as there are stigmas. From the inner surface of the pericarp, which is thin and brittle, the yellowish membranous placentas corresponding in number to the carpels project into the cavity of the fruit.

The seeds, which for the most part lie loose in the fruit, are minute and very numerous. Under a lens they may be seen to be reniform in shape and covered with distinct delicate reticulations. They vary in colour from whitish to slate (the latter being known as maw seed), and contain an oily endosperm.

Poppy capsules have no odour ; the seeds have an oily taste, but the pericarp is distinctly bitter.

The student should observe

(*a*) The *sessile stellate stigmas*,
(*b*) The *membranous placentas*,
(*c*) The *reniform shape of the seed* and the *reticulations on its surface*.

Constituents.—Poppy capsules contain the principal constituents of opium, the most important of which is the crystalline alkaloid *morphine*. The assay of ripe capsules has shown them to contain 0·16 (Dieterich) and 0·28 (Paul and Cownley) per cent. of morphine, whilst unripe capsules contained only 0·086 (Dieterich) ; but there is much difference of opinion as to the relative medicinal value of ripe and unripe fruits.

Poppy capsules also contain *meconic acid*, an organic acid found only in the latex of the opium poppy. Although this acid is not an active constituent from a therapeutic point of view, the detection of its presence is often important as indicating a preparation of poppy capsules or opium.

The seeds are free from morphine ; the principal constituent in them is the fixed oil, which has been applied to various technical uses.

Uses.—The action of poppy capsules is the same as that of opium, but much weaker. The warm decoction is a favourite anodyne fomentation. The extract and syrup are uncertain remedies, and preparations of opium are in every respect preferable.

BAEL FRUIT

(Indian Bael, Fructus Belæ)

Source &c.—Indian bael is the fruit of *Ægle Marmelos*, Correa (N.O. *Rutaceæ*), a tree attaining a height of 40 feet, and growing both wild and cultivated throughout the entire *Indian* *peninsula.* Being a sacred tree the Hindoos plant it near their temples. It became known to the Portuguese as a remedy for dysentery when they occupied the eastern shores of India, but was not introduced into European medicine until about the middle of the present century. The half-ripe fruit is collected from cultivated trees, and the pulp eaten whilst fresh; uncultivated trees yield a less aromatic fruit. In the last edition of the British Pharmacopœia the dried fruit was used in the preparation of the liquid extract, but it appears to be much less efficacious than the fresh, and the drug is no longer official.

Description.—The fruit is ovoid or rounded, and about the size of an orange, although sometimes rather larger. Externally it is yellowish brown, smooth, or slightly granular and hard, and bears a circular scar at the point of attachment of the peduncle. The whole fruit is too hard to cut with a knife, but may be sawn in two transversely, and will then be found to consist of a reddish woody rind about $\frac{1}{10}$ inch thick, enclosing from ten to fifteen carpels, each containing several hairy seeds embedded in a transparent yellowish or red mucilage. The dry pulp, which is mucilaginous and aromatic when fresh, is hard, and varies in colour from pale to dark red; it frequently breaks away from the rind during the drying, leaving only a thin layer attached to it. Even the dried fruit has an agreeable odour and mucilaginous, sometimes also aromatic, taste.

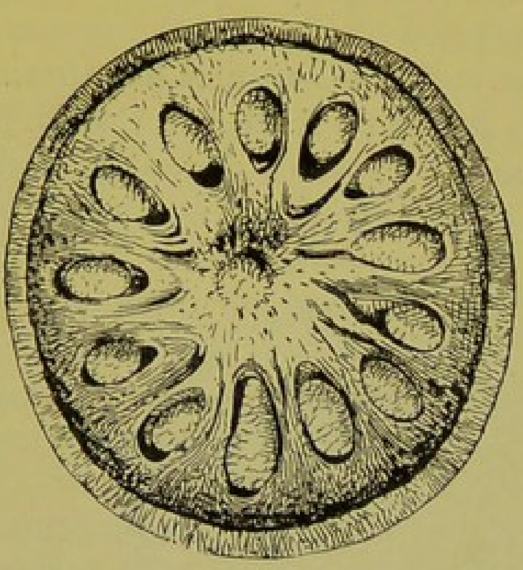


Fig. 37.—Bael fruit. Transverse section of a small specimen. Natural size. (Holmes.)

The fruit is frequently imported in dried transverse slices. These have an appearance similar to that of the transverse section of the whole fruit, but the pulp usually adheres firmly to the rind and has a darker colour externally, being paler within. Preference should be given to unripe fruits, or the slices cut from them, and these may be recognised by the small undeveloped seeds they contain; they are also less aromatic than the ripe fruits. In this respect the whole fruits are often inferior to the slices.

The student should observe

(*a*) The comparatively *smooth hard rind* to which (in the sliced fruit) the *reddish pulp firmly adheres*,

(*b*) The *numerous carpels*,

(*c*) The *hairy seeds embedded in mucilage*.

Constituents.—As far as has been ascertained the principal constituent of bael fruit is the *mucilage* that it contains. Tannin is not present in the unripe fruit, but the infusion of the ripe fruit yields the reaction for that body when tested with a ferric salt.

Uses.—In the fresh state Indian bael is a pleasant refreshing fruit with astringent refrigerant properties which render it valuable in the treatment of diarrhœa and dysentery. As imported it is probably useless, but a liquid extract from the *fresh* fruit appears to possess its specific effects.

Substitutes.—Several substitutes for bael have been met with, viz. *Mangosteen fruits* (*Garcinia Mangostana*, Linn., N.O. *Guttiferæ*) ; these may be distinguished by the darker rind to which the pulp does not firmly adhere, and by the wedge-shaped radiate stigmas.

Wood apple (*Feronia elephantum*, Correa, N.O. *Rutaceæ*).—The fruit is five-lobed but one-celled, and has a rough exterior.

Pomegranate rind may be distinguished by its astringent taste and the triangular impressions of the seeds.

BITTER ORANGE

(Seville Orange, Fructus Aurantii)

Source &c.—The bitter or Seville orange, the fruit of *Citrus Aurantium*, var. *Bigaradia*, Hook. f. (N.O. *Rutaceæ*), is a small tree, probably originally a native of north-eastern India, but spread by cultivation to most warm countries. In Europe it is grown especially in the countries bordering on the *Mediterranean*, whither it was probably brought by the Arabs, as it was unknown to the Greeks and Romans. The fruit is collected before it is quite ripe, packed in boxes and exported, the ripening being completed during the voyage. Bitter oranges are shipped chiefly from southern Spain (Seville) and Sicily (Palermo); the former are considered to be the best variety of orange for medicinal use.

In addition to the fresh fruit the dried peel is also largely imported from Malta and Spain.

Description.—The ovary of the orange tree is superior and polycarpellary; it is composed of eight (or sometimes more) carpels, each containing two rows of seeds with axile placentation.

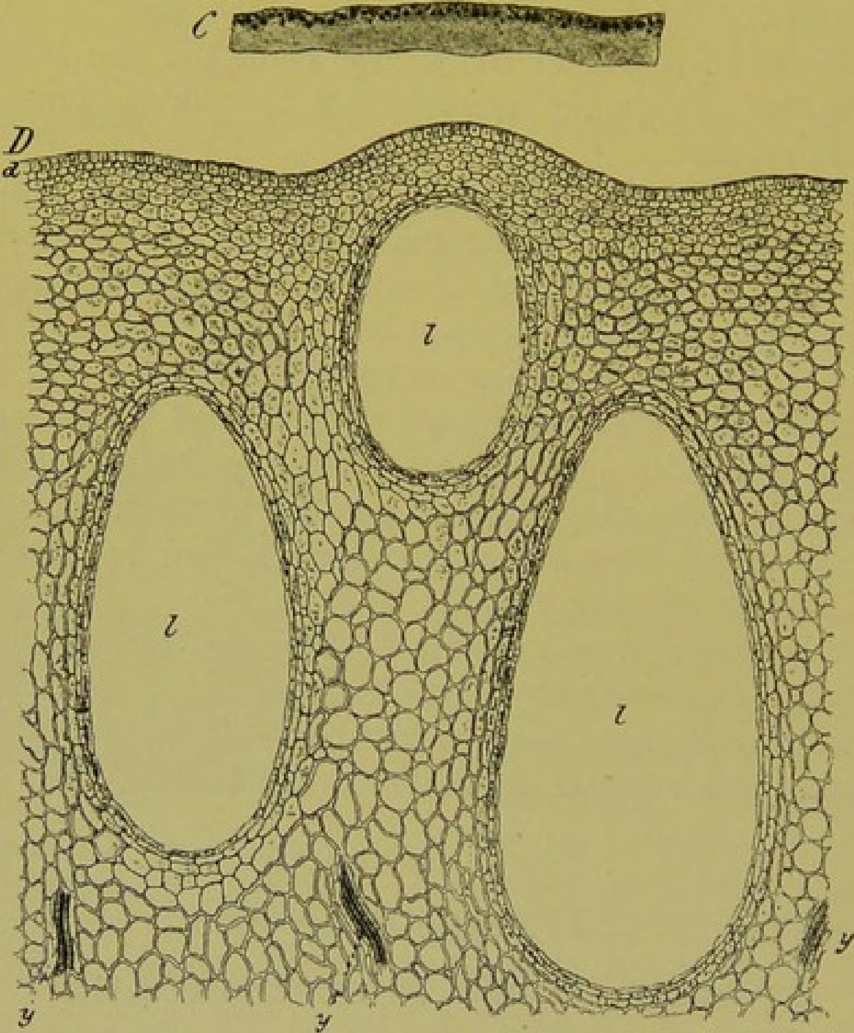


Fig. 38.—Orange peel. *C*, transverse section, natural size; *D*, transverse section, enlarged 100 diam.: *l*, oil-glands. (Berg.)

During the growth of the ovary the loculi increase in size, and the outer wall (pericarp) in thickness. Into the loculi there grow from the inner epidermis of the pericarp numerous hair-like processes which fill with juice and completely occupy the loculi; they form the pulp contained in the 'quarters' of the orange, the thin membrane enclosing each being the endocarp. The fruit is termed a hesperidium.

The bitter orange resembles in size and shape the sweet orange, but may be distinguished by its rougher, darker rind and sour, bitter pulp. The rind, which is agreeably aromatic and has also a bitter taste, shows, when cut transversely, a narrow yellow outer part corresponding to the epicarp, in which large oil-glands are discernible with the naked eye, and an inner white portion corresponding to the mesocarp.

The peel is used both fresh and dried. The former is cut from the fresh fruit in this country, care being taken that the oil-glands are not ruptured more than is necessary, for it is to the volatile oil they contain that the pleasant aroma of the peel is due; at the same time too much of the white 'zest' should not be removed, as that is lacking in bitterness. The dried peel may be obtained by drying the fresh peel in a warm room, but it is also imported in large quantities, especially from Malta; in the latter case it is generally in the form of very narrow strips, evidently cut by machinery, or in wider spiral strips or in four 'quarters.'

Constituents.—The principal constituents of bitter orange peel are the *volatile oil* and an amorphous bitter principle, *aurantiamarin*. *Hesperidin*—a colourless, tasteless, crystalline glucoside that occurs in several other plants belonging to the natural order *Rutaceæ*—*isohesperidin*, and *aurantiamaric* acid, the latter a bitter principle, have also been isolated from bitter orange peel, but appear to be of secondary importance.

Uses.—Bitter orange peel possesses both aromatic and bitter properties, and is used as a tonic and as an agreeable flavouring agent.

Substitutes.—The peel of the sweet orange is said to be frequently mixed with that of the bitter orange; it may be distinguished by being thinner, paler, and more yellow in colour and much less bitter in taste.

Other products from *Citrus Aurantium*, var. *Bigaradia*.—The delightfully fragrant flowers of the bitter orange yield by distillation a small percentage of volatile oil, *oil of neroli*; a saturated solution of this oil in water, obtained by the distillation of the fresh flowers with water, is official under the name of Aqua Aurantii Floris (orange-flower water).

The volatile oil of the bitter orange peel is known in commerce as oil of bigarade; that from sweet orange as oil of Portugal.

LEMON

(Fructus Limonis)

Source &c.—The lemon is the fruit of *Citrus medica*, Linn., var. β *Limonum*, Hook. f. (N.O. *Rutaceæ*), a small tree which, like the orange, is probably a native of northern India. It is cultivated in all the countries bordering on the *Mediterranean*, especially in Sicily and southern Italy, in Spain and Portugal, and in the Riviera.

The fruits are gathered whilst they are still green, and the finest are wrapped in paper and exported in cases of 300 to 400; less sightly fruits are packed in barrels and preserved with salt water.

Description.—The lemon resembles the orange in development and in structure, but it is easily distinguished by its more elongated, ovoid shape and pale yellow colour; at the apex it is crowned by a distinct nipple.

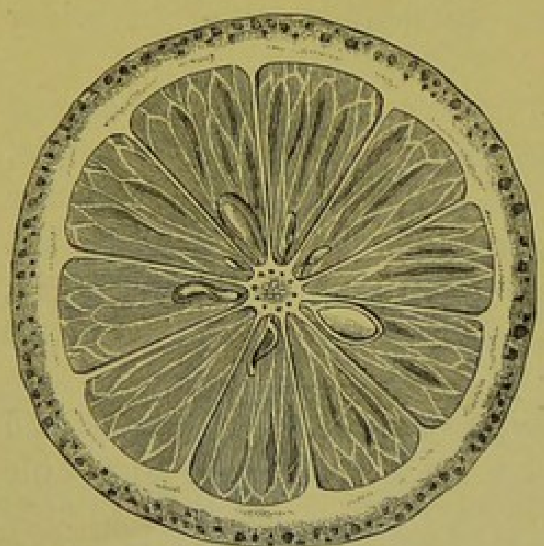


FIG. 39.—Lemon. Transverse section. (Planchon and Collin.)

The pulp has a strongly but agreeably acid taste; the peel is aromatic and bitter.

The following parts of the fruit are official: the peel, the juice, and the volatile oil obtained from the peel (essence of lemon).

1. *Lemon peel*, which is official in the fresh state only, is pale yellow in colour and more or less rough on the outer surface, and whitish on the inner. The transverse section shows numerous large oil-glands embedded in the tissue. The peel has a strong fragrant odour and aromatic, bitter taste. It contains *volatile oil* and *hesperidin*, and is used chiefly as an agreeable flavouring agent.

2. *Lemon juice.*—Fresh lemons yield about 30 per cent. of juice, which, for pharmaceutical use, should be pressed from the fresh fruit. It is a turbid yellowish liquid with a characteristic odour and acid taste. The principal constituent is citric acid, of which it contains from 6·7 to 8·6 per cent. (30 to 40 grains

in each fluid ounce). The amount of citric acid in the juice is largest in lemons imported in December and January, and smallest in August, both the fruit and the juice itself gradually diminishing in acidity when kept.

Large quantities of lemon juice are pressed in Sicily from the pulp that is left in the production of the volatile oil. This juice is concentrated to a specific gravity of 1·233 to 1·235 and exported, chiefly to England, for the manufacture of citric acid.

3. *Essence of Lemon.*—Various methods are used for the production of essence of lemon, but the following appears to be largely adopted in Sicily, whence most of the essence of lemon is exported.

The workman cuts the lemon into four quarters, removes the acid pulp, and presses each piece of peel against a sponge held in the right hand in such a way as to break the oil-glands and discharge their contents on the sponge. When sufficient has accumulated the sponge is pressed; the liquid thus obtained separates on standing into a lower watery stratum and an upper clear oily layer which can be poured off. The pieces of pulp from which the peel has been stripped are pressed to obtain from them the lemon juice they contain. This method of separating the volatile oil from the peel is termed the 'sponge' process; 3,000 lemons yield about a kilogramme of essence.

In the south of France a different procedure is adopted, of which the following description has been given: 'The object being to set free and to collect the oil contained in the vesicles of the peel, an apparatus is employed which may be thus described: a stout saucer or shallow basin of pewter, about 8½ inches in diameter, with a lip on one side for convenience of pouring. Fixed in the bottom of this saucer are a number of stout, sharp, brass pins standing up about half an inch; the centre of the bottom is deepened into a tube about an inch in diameter and five inches in length, closed at its lower end. This vessel, which is called an *écuelle à piquer*, has therefore some resemblance to a shallow, dish-shaped funnel, the tube of which is closed below.

'The workman takes a lemon in the hand and rubs it over the sharp pins, turning it round so that the oil-vessels of the entire surface may be punctured. The essential oil which is thus liberated is received in the saucer, whence it flows down into the tube; and as this latter becomes filled it is poured into another vessel that it may separate from the turbid aqueous liquid that accompanies it. It is finally filtered, and is then known as *Essence de Citron au Zeste*' (Flückiger and Hanbury).

A machine, constructed on a similar principle, has been devised by which the scarification of the lemons is much more rapidly effected than is possible by the tedious hand process, and by which at the same time an increased yield of oil is obtained; it has not, however, as yet been generally adopted.

Essence of lemon is also prepared by distilling the peel with water, but this distilled essence is inferior in fragrance to those prepared by either of the foregoing processes.

RAISINS

(Uvæ Passæ)

Source &c.—The grape vine, *Vitis vinifera*, Linn. (N.O. *Ampelideæ*), probably a native of the Caucasian provinces of Russia, is cultivated in numerous varieties in most of the warmer parts of temperate regions where the mean summer temperature ranges from 21° to 25° C., particularly in *central and southern Europe*, California, and Australia.

Description.—The ovary of the grape vine is superior and two-celled, each cell containing two ovules. As the fruit reaches maturity the interior becomes pulpy, the dissepiment disappears, and the ripe fruit may be regarded as a superior berry. It is usually ovoid or nearly globular in shape, and varies in colour according to the variety. Within the thin skin is a very juicy pulp containing few seeds or none at all. The grapes are dried either on the vine or after they have been cut from it, partly by the heat of the sun, partly by artificial heat. They are exported either in entire bunches carefully packed in boxes (Muscatel raisins), or the fruits are separated from the stalks and packed loose in boxes (Valencia raisins). They present a more or less shrivelled appearance, are of a dark purplish-black colour, and have an agreeable odour and a sweet pleasant taste.

Sultanas are the fruits of a seedless variety of grape imported from Smyrna. *Currants* are the small globular fruits of a variety cultivated on the islands of the Grecian Archipelago &c.

Constituents.—Raisins contain in the pulp *dextrose* (grape sugar) and *potassium acid tartrate*, both of which may be found crystallised in small granular masses in old raisins. The skin and the seeds contain *tannin*, and the latter a *fixed oil* in addition. As raisins are used officially for the sake of the sweetness they impart, the seeds are directed to be separated.

Uses.—Raisins possess demulcent, refreshing, and nutrient properties, and are also slightly laxative.

CASSIA PODS

(Purging Cassia, Fructus Cassiæ Fistulæ)

Source &c.—Cassia pods are the ripe fruits of *Cassia Fistula*, Linn. (N.O. *Leguminosæ*), a tree of moderate size, indigenous to *India*, but naturalised in other tropical countries. It bears a pendulous raceme of fragrant flowers, each with a one-celled many-seeded ovary, which develops into a long leguminous fruit. As the latter ripens the seeds become separated from one another by the formation of numerous thin, transverse, spurious dissepiments, and the fruit, which was originally one-celled, becomes spuriously many-celled. It differs from a typical legume in being indehiscent as well as many-celled, and may be described therefore as a many-celled indehiscent legume.

Description.—The ripe pods, as met with in commerce, are long, nearly straight, cylindrical fruits of a dark chocolate-brown colour. They attain commonly 18 to 24 inches in length and ¾ to 1 inch in thickness. The surface, which appears smooth and shining to the naked eye, is seen under a lens to be marked with minute transverse striations; both the dorsal and ventral sutures are evident but not prominent. To one end of the fruit a short stalk is attached; the other terminates very abruptly in a short point.

The pericarp, although thin, is hard and woody. The interior of the fruit is divided into a number of compartments by transverse dissepiments placed about a quarter of an inch apart. Each compartment contains a single seed attached to the ventral suture by a long dark thread-like funiculus. A thin layer of nearly black firm pulp, which in the fresh fruit is soft and fills the compartment, adheres to each side of the membranous dissepiments.

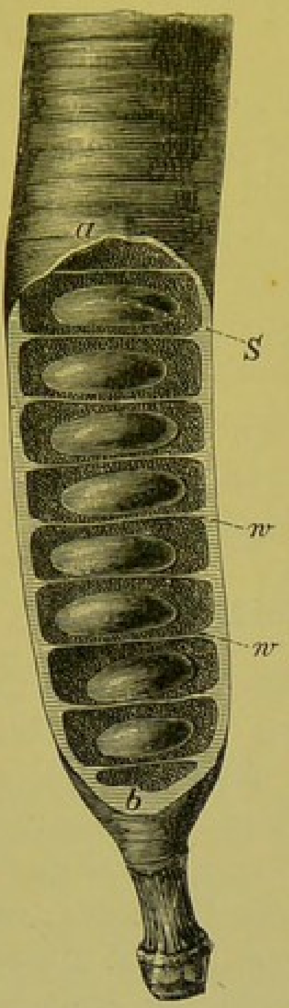


FIG. 40.—*Cassia Fistula.* Lower portion of a pod partly opened to show the seeds. *S*, seed; *w*, transverse dissepiments; *b*, pericarp of fruit. (Moeller, after Wiesner.)

The seeds are flattened-ovoid in shape, of a shining reddish-brown colour, smooth, and extremely hard. When cut transversely they exhibit a curved yellow embryo obliquely crossing a whitish horny endosperm. The pulp has a sweetish taste and a somewhat sickly odour.

The student should observe

(*a*) The *smooth surface* and *long cylindrical shape*,
(*b*) The *spurious dissepiments with adhering pulp*,
(*c*) The *odour* and *taste*.

Constituents.—The pulp, which is the only official part of the fruit, contains, according to the analysis of Henry (1826), upwards of half its weight of *sugar*. It is not known to what constituent of the pulp its laxative action is due.

Substitutes &c.—The pods of *Cassia grandis*, Linn. (Brazil and Central America), and of *Cassia moschata*, H.B. & K. (New Granada), are official in the French Codex and have been occasionally imported. The former are usually longer, thicker, and heavier than those of *C. Fistula*; the surface is rough and the fruit laterally compressed, exhibiting therefore an elliptical outline in transverse section. It has one prominent ridge on the dorsal and two on the ventral suture.

The pods of *C. moschata* are smaller and narrower, and the pulp, which is paler in colour, exhales a musky odour when warmed.

TAMARINDS

(Tamarindus, Fructus Tamarindi)

Source &c.—The tamarind tree, *Tamarindus indica*, Linn. (N.O. *Leguminosæ*), a large and handsome tree indigenous to tropical Africa, is cultivated throughout *India* and the *West Indies*; to the inhabitants of these countries it forms a valuable article of diet. The Arab name of the fruit (tamare hindi, or Indian date) would indicate that the Arabians became acquainted with the fruit from the Hindoos; it was probably introduced into Europe by the Arabian physicians of the school of Salerno.

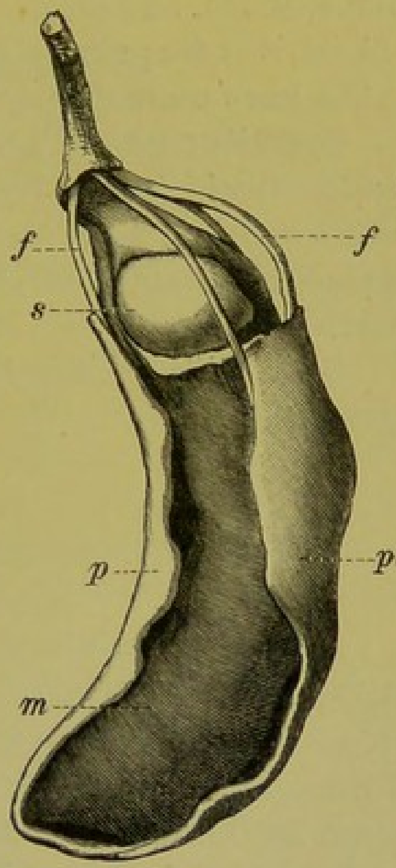


Fig. 41.—Fruit of the Tamarind tree with part of the pericarp removed, showing *s*, seed; *f*, fibres; *p*, pericarp; *m*, pulp. Natural size. (Vogl.)

The tree produces an erect raceme of flowers succeeded by indehiscent legumes from 2 to 8 inches in length. The epicarp of the legumes is rough, brownish, firm, but easily broken and separated from the pulp; the latter (mesocarp) is juicy and acid, and traversed by a number of stout branching fibro-vascular bundles passing from the stalk towards the apex of the legume. The seeds are few in number and enclosed in a leathery membrane (endocarp).

In the West Indies tamarinds are collected when ripe, and prepared for the market by removing the epicarp, packing them in barrels, and preserving them with hot syrup. In India the pulp is simply pressed into cakes, with or without the addition of 10 per cent. of salt as a preservative.

Description.—The official tamarinds are the fruits preserved with syrup, as above described. They form a reddish-brown moist sugary mass, in which, without difficulty, the branching fibres and the seeds enclosed in the leathery endocarp can be found. The seeds are of a reddish-brown colour, hard and shining, and of a flattened ovoid or obscurely quadrangular shape. Such tamarinds have an agreeable odour and a pleasant sweet and acid taste. They are usually imported preserved in this manner from the West Indies, and are known as West Indian tamarinds, although the Pharmacopœia does not restrict the official drug to any particular geographical source.

From India tamarinds are sent in the form of firm black cakes consisting of the pulp of the fruit, together with the fibres, seeds, and small portions of the epicarp. Although not official it is frequently employed, and yields a good pulp. The cakes have scarcely any odour, but a rather strongly acid taste.

Constituents.—The chief constituents of tamarinds are *tartaric acid* (about 7 per cent.), *citric acid* (about 3 per cent.), and *potassium acid tartrate* (about 5 per cent.). West Indian tamarinds contain much added sugar and proportionately less acid.

Uses.—Tamarinds are a pleasant acid refrigerant and gentle laxative.

1

N.O.

PRUNES

(Prunum)

Source &c.—The prune, French prune or French plum, is the dried fruit of *Prunus domestica*, Linn., var. *Juliana*, DC. (N.O. *Rosaceæ*), a variety of the plum tree cultivated in France, especially in the valley of the Loire. Many varieties of the plum are known, but this is considered to be the proper prune and the best for medicinal use.

The fruit, a large ovoid purple drupe, is collected when ripe, and dried partly by artificial, partly by solar heat.

Description.—Prunes are of irregular flattened-ovoid shape, and about 1¼ inch long. The surface is shrivelled and nearly black; the pulp, which should be soft and fleshy, is dark-coloured and surrounds a hard oval flattened stone; the latter is broadly rounded at one end and provided at the other with a shallow, slightly oblique depression. They have an agreeable odour and sweet fruity taste.

The student should direct his attention to the shape of the stone, as by that means the prune may be distinguished from other varieties of dried plums that are occasionally substituted for it.

Constituents.—The pulp contains about 40 per cent. of *sugar* and about 2 per cent. of *vegetable acids* (malic, tartaric, &c.), the composition varying with the season, degree of ripeness, &c.

Uses.—The prune is nutritive, demulcent, and slightly laxative; it is frequently ordered as an article of diet in habitual constipation.

HIPS

(Fructus Rosæ Caninæ)

Source &c.—In the British Pharmacopœia of 1885, in which the fruits of the dog rose, commonly called hips, were official, they were described as the fruit of *Rosa canina*, Linn. (N.O. *Rosaceæ*), and other indigenous allied species. The only other species of *Rosa* the fruits of which could be collected in any quantity is *R. arvensis*, Huds., the field rose, which is distinguished from the dog rose by its trailing habit and nearly globular fruit, from which the styles protrude in the form of a distinct column. The dog rose has a more erect habit and an ovoid fruit, with a number of separate styles scarcely protruding from the mouth. The fruits are collected when ripe, and used in the fresh state for the preparation of the confection.

Description.—The fruit of the dog rose consists of the hollowed thalamus (to which the calyx-tube is united), on the inner surface of which a number of achenes are borne, each provided with a style and stigma, the whole forming a spurious fruit that is sometimes distinguished by the name 'cynarrhodon.'

The ripe fruit is ovoid, smooth and shining, and scarlet or red in colour. It is crowned with five calyx-teeth, beyond which a dense tuft of hair-like styles slightly protrudes. Cut longitudinally it is seen to consist of a fleshy deeply concave receptacle, on the inner surface of which are borne a number of hairs as well as of small, very hard, hairy achenes. The fleshy receptacle has an agreeable acid taste, and is separated for pharmaceutical use from the achenes &c. by beating the fruits in a mortar and rubbing the pulp through a hair-sieve.

The fruits of *R. arvensis* are distinguished, as already observed, by their globular shape and by the styles being united in a column and protruding well beyond the orifice of the fruit.

The student should observe

(*a*) The *fleshy hollow receptacle*,

(*b*) The *small hard hairy achenes* within it.

Constituents.—The pulp contains *citric* and *malic acids*, *sugar*, and a *trace of tannin*.

Uses.—Confection of hips was used as a pill excipient. It is sometimes mixed with water to form an agreeable acid cough linctus.

PIMENTO

(Allspice, Fructus Pimentæ)

Source &c.—The pimento tree, *Pimenta officinalis*, Lindley (N.O. *Myrtaceæ*), is a handsome tree indigenous to and common in the *West Indies*, and found also in Central America and Venezuela. It is cultivated, especially in *Jamaica*, in plantations known as pimento walks.

The tree bears large panicles of fragrant white flowers with two-celled inferior ovaries, each cell containing a single ovule. The flowers are succeeded by small fruits; as soon as these have attained their full size, but before they ripen, the whole panicle is collected and dried in the sun, during which the green colour changes to a reddish brown. The stalks are then separated and the fruits are ready for packing. Had they been allowed to ripen they would have become dark purple and filled with a sweet pulp, but would have lost much of their aroma; hence they are collected whilst unripe.

Pimento berries appear to have been long known to the Mexicans, who used them, together with vanilla, for flavouring chocolate; through them the Spaniards became acquainted with the spice towards the end of the sixteenth century, and introduced it into Europe, where great quantities were consumed. It was supposed to possess the combined flavour of cloves and other spices; hence its name of 'allspice.'

Description.—Pimento berries are small, nearly globular fruits about the size of peas, varying from $\frac{1}{6}$ to $\frac{1}{3}$ inch in diameter, and of a dull rusty- or reddish-brown colour. The fruits have a rough surface, and are crowned with the remains of the calyx in the form of a raised ring, in which the four calyx-teeth are scarcely discernible; in the centre of this ring are the short remains of the style. The pericarp is thin, woody, and brittle. At the base a small scar indicates the point of attachment of the pedicel.

Cut transversely, the fruit is seen to be two-celled, each cell containing a single flattened or irregularly plano-convex, nearly black seed, within which there is a dark coiled embryo but no endosperm.

The thin pericarp contains a large number of oil-glands embedded in it; many are situated just below the outer epidermis, and elevate it at intervals, thus producing the roughness of the pericarp; these glands are just visible in a transverse section when examined with a lens. The seeds also contain oil-glands, but they are much less aromatic than the pericarp.

The odour of pimento berries is agreeably aromatic; it is especially perceptible when the fruits are crushed. The taste is warm and aromatic, resembling, but distinct from, that of cloves.

The student should observe

(*a*) The *remains of the calyx crowning the fruit*, which is therefore inferior,

(*b*) The *two cells, each containing a single seed*;

and should compare these fruits with

(i) *Cubebs*, which are one-celled, dark grey in colour, and reticulated on the surface,

(ii) *Black pepper*, which is one-celled and one-seeded.

Constituents.—Pimento berries contain from 3 to 4·5 per cent. of *volatile oil* consisting principally of eugenol, which is also the chief constituent of oil of cloves. They contain, further, a notable quantity of *tannin*. In this, as in many other cases, the change in the colour of the unripe fruit from green to reddish brown during the process of drying, is to be ascribed to a change in the tannin, by which a reddish-brown 'phlobaphene' is produced.

Uses.—Pimento is used as a flavouring agent and as an aromatic stimulant.

POMEGRANATE

(Fructus Granati)

Source &c.—The pomegranate tree, *Punica Granatum*, Linn. (N.O. *Lythrarieæ*), is a shrub or small tree indigenous to north-western India, but cultivated generally in the warmer parts of the temperate regions, especially in the countries bordering on the *Mediterranean*. More than one variety is known, but that producing crimson flowers is the commonest. The flowers are succeeded by handsome orange-red fruits, about the size of a large orange, quantities of which are imported; they are esteemed for their agreeable juicy contents. The leaves and flowers, as well as the fruits, were employed in medicine by the ancients; the Romans used the peel of the fruit for tanning, and in the south of Europe it still serves the same purpose.

Description.—The pomegranate is a large handsome fruit of sub-globular shape and brownish-yellow colour, passing into dull crimson-red. It is crowned with a large, deeply five-toothed, tubular, coriaceous calyx, within which are the remains of the stamens and style. The pericarp, the outer surface of which is granular in appearance, is about $\frac{1}{16}$ inch thick, hard, and coriaceous. The large cavity is divided by thin membranous dissepiments into a number of cells, each of which is completely filled with numerous seeds.

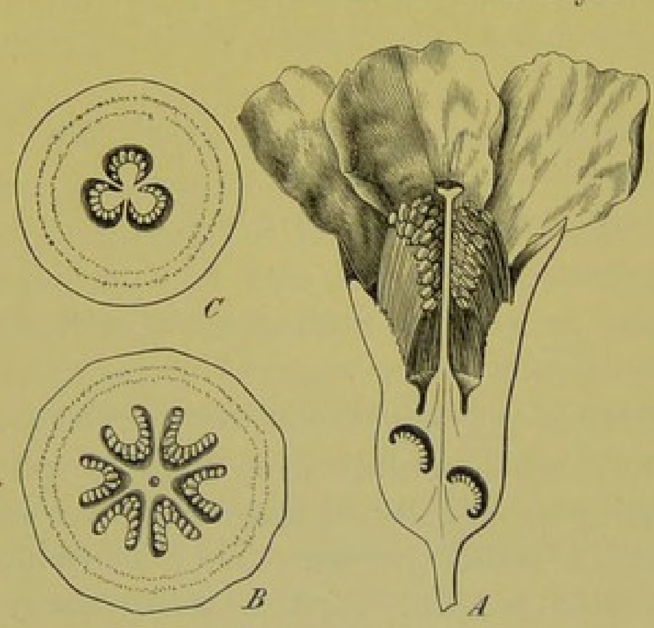


FIG. 42.—Pomegranate (*Punica Granatum*). *A*, flower cut vertically; *B*, transverse section of the upper part of the fruit, showing six loculi, magnified; *C*, transverse section of lower part, showing three loculi, magnified. (Luerssen.)

When cut longitudinally the fruit is seen to be divided by a membrane into an upper and lower portion. Transverse sections show the former to be divided by radiating dissepiments into six cavities, in each of which the placentation of the seeds is parietal, whilst in the lower portion from three to five cavities are irregularly arranged. The seeds are about $\frac{1}{2}$ inch long, sub-pyramidal in shape, and contain a sweetish acidulous juice in a translucent outer portion. The fruit is sometimes called a 'balausta;' it may be regarded as an inferior, polycarpellary berry.

The peel of the fruit, separated from the seeds, was formerly much used as an astringent. It occurs in thin curved fragments, granular and brownish yellow or reddish on the outer surface, uniformly yellowish brown within, and there exhibiting distinct, shallow, angular depressions left by the seeds; to some fragments the remains of the coriaceous calyx are attached. It breaks with a short granular fracture, has little odour, but a powerfully astringent taste.

The student should observe

(*a*) The *astringent taste*,
(*b*) The *impressions of the seeds*,
(*c*) The occasional *fragments of the superior calyx*;

and should compare the peel with pieces of Indian bael.

Constituents.—The principal constituent is *tannin*, of which it contains as much as 28 per cent. (Kramer, 1883); whether the peel contains any alkaloids allied to, or identical with, those of the bark of the stem and root, is not known.

Uses.—The drug is sometimes used as an astringent.

BITTER APPLE

(Colocynth, Fructus Colocynthidis)

Source &c.—The colocynth plant, *Citrullus Colocynthis*, Schrader (N.O. *Cucurbitaceæ*), is, like many other members of the same natural order, a scabrous prostrate plant with a perennial root. It enjoys an extensive distribution throughout *northern Africa*, *Syria*, and north-western India. In the African and Egyptian deserts it frequently occurs in enormous quantities; it is cultivated to a certain extent in Spain and Cyprus, and also in the north-western provinces of India.

The remarkable properties of this fruit must necessarily have attracted attention very early. Dioscorides and Pliny were both acquainted with it, and so also were the Arabian physicians, by whom probably its use was introduced into Europe.

The fruit, which is about the size of an apple, is at first green, but changes to yellow as it ripens; it is collected when ripe, freed from the thin rind by peeling with a sharp knife, and dried. Occasionally (in Persia) the peeled fruits are pressed for convenience of carriage, and sometimes (from Mogadore) the unpeeled fruit is imported; the latter, however, are usually used for filling the show-jars in the pharmacist's window.

Description.—The fruit of the colocynth plant is, when young, three-celled and bears numerous ovules attached to axile placentas. The placentas, however, grow from the centre towards the circumference of the fruit, and when they have nearly reached the pericarp divide in two, each half curving inwards and bearing numerous seeds on its margins. During these changes the carpellary walls disappear, and the fruit, originally three-celled, becomes spuriously one-celled.

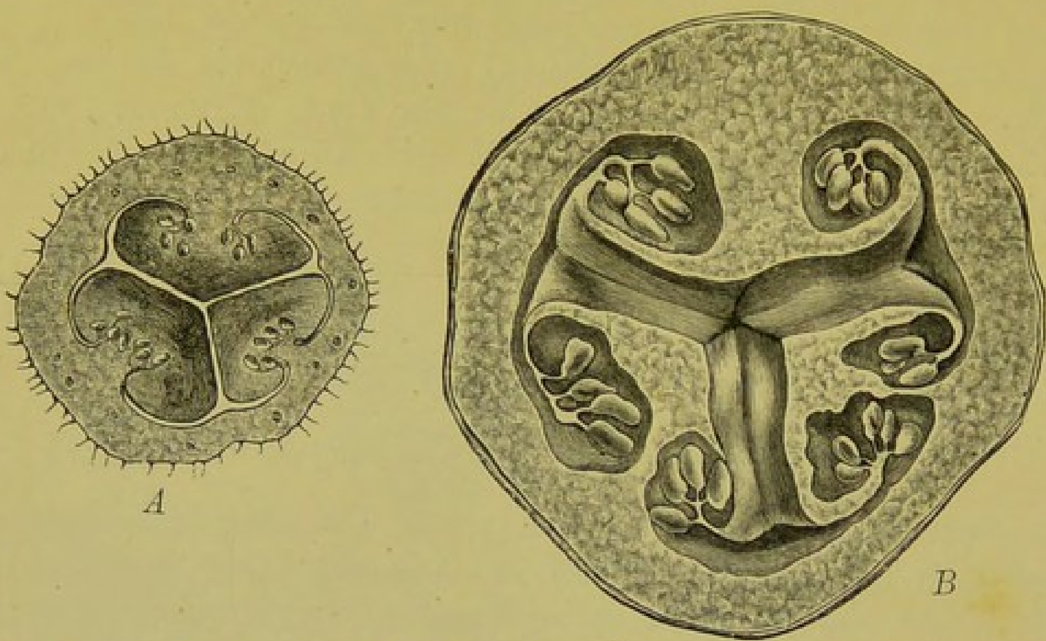


FIG. 43.—Colocynth fruit. *A*, transverse section of young fruit, showing the placentas dividing near the margin and curving inwards; *B*, ripe fruit, showing each placenta fissured. (Moeller.)

The pulp consists largely of the fleshy placentas which, in the fresh state, are not juicy; they usually split in a radial direction throughout the greater part of their length, and in the dried fruit they are deeply fissured.

As seen in commerce, colocynth fruits form more or less broken white balls, 2 inches or less in diameter and light in weight. The rind has generally been carefully peeled off, and the outer surface is formed by part of the thin whitish mesocarp, which, however, has in places itself been removed, disclosing the yellowish or nearly brown seeds or the fleshy placentas. If a fruit is cut transversely the placentas will generally exhibit radiating fissures dividing the fruit into three portions, in each of which, near the periphery, a half of each placenta curves inwards and bears on its inner margin several vertical rows of seeds. These number from 200 to 300, and constitute about three-quarters of the weight of the fruit; they vary in colour from yellowish white to dark brown according to the degree of ripeness. They have a flattened ovoid shape, possess a hard seed-coat, and contain a small oily kernel which, however, strange as it may seem, forms, when properly prepared, a valuable addition to the scanty diet of certain tribes of Arabs.

For medicinal use the light, whitish, spongy, pith-like pulp, the bulk of which is furnished by the placentas, should be freed from the seeds, as the pulp alone is official. It possesses a slight odour, but an intensely bitter taste; the latter is much less marked in the seeds.

Colocynth pulp contains no starch, and should not therefore give the reactions characteristic of that substance. It yields, when incinerated, about 11 per cent. of ash, whereas the seeds yield about 2·5 per cent., and the whole fruit 4·6 per cent. The Pharmacopœia requires the pulp to furnish not less than 9 per cent., thus excluding the seeds. The latter contain moreover about 17 per cent. of fixed oil, which can be extracted by ether, whilst the pulp contains only traces. These, the official tests, are intended for application to the powdered pulp supplied by wholesale dealers to the pharmacist. Much more reliable and definite than these tests is the detection of the characteristic tissues of the seed-coats in the powder, by means of the microscope.

Constituents. — Colocynth contains an intensely bitter amorphous glucoside, *colocynthin*, residing in the pulp, not in the seeds. Of the nature of colocynthin little definite is known; it appears to be easily hydrolysed by dilute alkalies as well as by dilute acids, and it is doubtful whether it has been yet obtained quite pure.

Uses.—Colocynth is a gastro-intestinal stimulant and one of the most powerful of the official purgatives, acting as a hydragogue cathartic. It is employed as an occasional purgative to produce free evacuation of the bowels in bilious derangements or chronic constipation.

Varieties.—Two varieties of colocynth are regularly imported, viz. *Turkey colocynth* and *Spanish colocynth*; the former is the finer fruit and commands the higher price, though there is no information to show that the pulp is more active than that of the Spanish. Persian colocynth is only occasionally seen on the market.

CARAWAY FRUITS

(Fructus Carui)

Source &c.—Caraways are the ripe fruit of *Carum Carvi*, Linn. (N.O. *Umbelliferæ*), an erect biennial herb distributed over *central and northern Europe*. The plant is found in Britain, apparently wild, but possibly only naturalised. It is cultivated principally in Holland, but Sweden, Norway, Russia, and Germany also produce caraways, whilst a small quantity is grown in England. When the fruit ripens, the plant is cut and the caraways separated by thrashing.

Description.—The ovary of the caraway is inferior and two-celled; it develops as it ripens into a schizocarp, that is, a fruit which separates into its component carpels by their splitting away from the central axis (carpophore); but this separation does not result in the liberation of the seeds, and the fruits are therefore indehiscent. In the case of the caraway (and other official umbelliferous fruits), the two carpels of which the fruit is composed are joined face to face to a common axis (carpophore), to which they remain attached. Each complete fruit is termed a cremocarp (a variety of schizocarp), each half-fruit is termed a mericarp, the mutually apposed inner faces of which are the commissures or commissural surfaces.

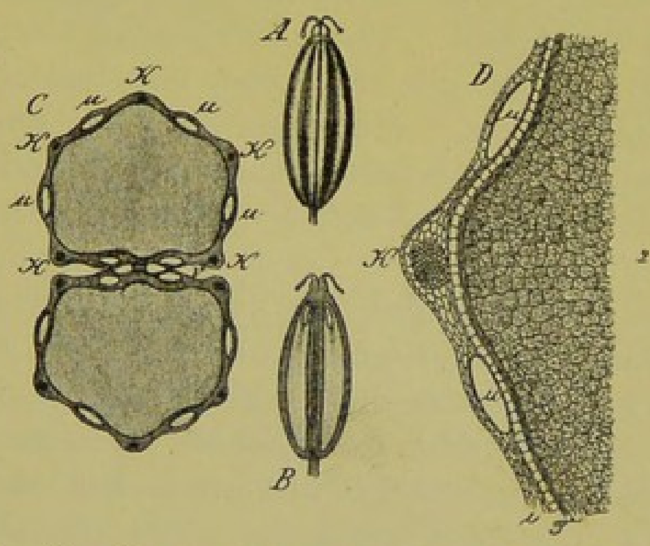


FIG. 44.—Caraway fruit. *A*, entire fruit, side view, magnified 3 diam. *B*, longitudinal section, magnified 3 diam. *C*, transverse section: μ, vittæ; κ, ridges, magnified 14 diam. *D*, portion of the same, further enlarged. (Berg.)

The cremocarp of the caraway easily separates into its constituent mericarps, and the commercial drug consists almost entirely of separate mericarps, about $\frac{1}{6}$ to $\frac{1}{4}$ inch long, very narrow, tapering at each end, and slightly curved. They are quite glabrous, brown in colour, and traversed from base to apex by five narrow raised yellow ridges (fig. 44, *C* and *D*, κ). Each of these (primary) ridges contains a fibro-vascular bundle, and this distinguishes them from other (secondary) ridges which some umbelliferous fruits (coriander) possess. In caraway fruits no secondary ridges are present. In the depressions between these ridges, embedded in the pericarp of the fruit and extending from base to apex, lie elongated oil-glands (vittæ, fig. 44, *C* and *D*, μ). In the caraway there are four such vittæ on the dorsal and two on the commissural surface of each mericarp. Very many umbelliferous fruits contain six vittæ, but some contain more (anise), some fewer (coriander), some, again, none at all (hemlock). They are generally best seen in transverse section under a strong lens, when they appear as dark brown minute spots or cavities (compare fennel, in which they are conspicuous).

The transverse section exhibits also a narrow pericarp and a large oily endosperm, the commissural surface of which is not grooved. The small embryo lies near the apex of the fruit. (Compare fig. 44.)

Caraways exhale, when crushed, an agreeable aromatic odour, and possess a pleasant aromatic taste.

The student should observe

(*a*) The *glabrous surface* of the fruit,
(*b*) The *six vittæ* on the transverse section,
(*c*) The *endosperm, which is not grooved.*

Constituents.—Caraways yield by distillation about 5 per cent. of *volatile oil*, which imparts their agreeable odour and taste. The Pharmacopœia directs that they should not yield more than 8 per cent. of ash, a test apparently intended to be applied to powdered caraways to exclude inferior qualities of the drug containing much extraneous mineral matter (sand &c.).

Uses.—Caraways, or the volatile oil obtained from them, are extensively used as an aromatic carminative.

HEMLOCK FRUITS

(Fructus Conii)

Source &c.—The common or spotted hemlock, *Conium maculatum*, Linn. (N.O. *Umbelliferæ*), is a biennial plant widely spread throughout temperate Europe and generally distributed over *Great Britain*. It is distinguished by its smooth hollow stem with purple spots, the general and partial involucres on the inflorescence, its glabrous, decompound leaves and ovoid fruit without vittæ but with deeply grooved endosperm (compare also the details given under 'Hemlock Herb'). This plant was in all probability the one employed by the Greeks in the preparation of poisonous draughts. It was used in Anglo-Saxon medicine, but has latterly lost much of its reputation owing to the uncertain action of its preparations. Modern researches have indicated the reason of this and suggested a remedy.

The fruits should be gathered from wild plants when full-grown, but before they ripen—that is, before the colour changes from green to yellow; they should then be dried, and if carefully preserved will long retain their activity unimpaired.

Description.—Hemlock fruits, gathered when unripe, possess after drying a distinct greenish-grey colour, which changes by long keeping to yellowish grey. They are small, being only about $\frac{1}{8}$ inch long, broadly ovoid in shape and slightly compressed laterally. They are crowned with small stylopods bearing the remains of the stigmas. In the commercial drug the mericarps are usually separate and freed from the stalks. Each mericarp is glabrous and exhibits five paler sharply prominent primary ridges, which, from the presence of small protuberances, are irregularly crenate and wavy, a character not equally well shown by all fruits, and more conspicuous in the fresh than in the dried. Cut transversely and examined with a strong lens, the endosperm exhibits a deep furrow or groove on its commissural surface (fig. 45, *C*). This furrow, being filled with the tissue of the pericarp, is not visible on the external commissural surface of the mericarp, but only on the transverse section; its presence should be carefully noted, as it indicates that the fruits are derived from a plant belonging to the sub-order *Campylospermeæ*, and distinguishes them at once from anise, fennel, &c., that have an endosperm nearly flat on its commissural surface (suborder *Orthospermeæ*), and from coriander and other fruits that have an endosperm strongly curved in both radial and transverse section (suborder *Cœlospermeæ*). The pericarp contains no vittæ, and this is also an

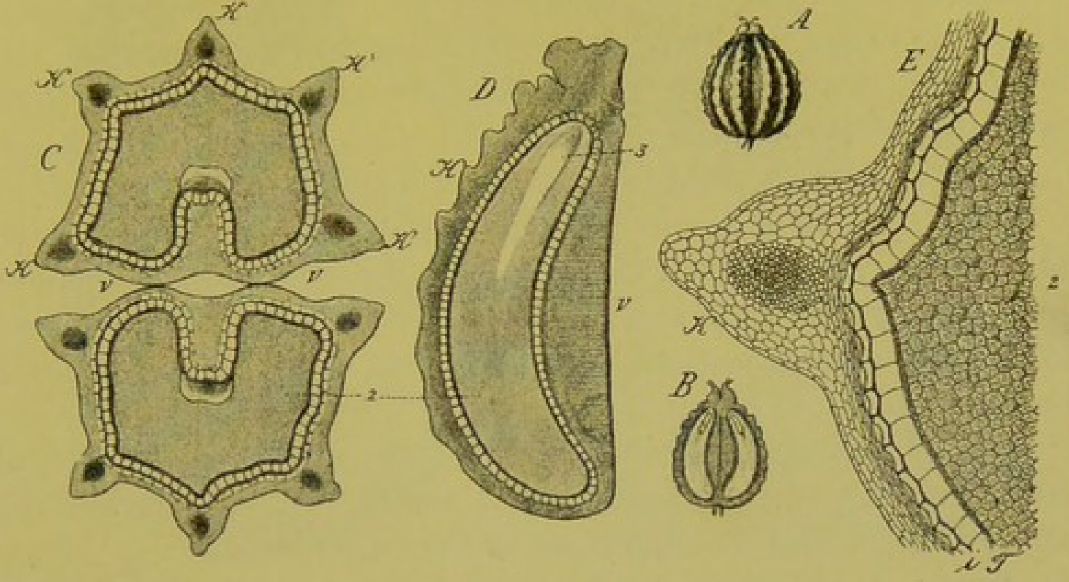


FIG. 45.—Hemlock fruit. *A*, side view of entire fruit. *B*, longitudinal section of the same, showing endosperm and embryo, magnified 3 diam. *D*, half of the same, further enlarged. *C*, transverse section: *v*, commissural surface; *κ*, ridges; magnified 14 diam. *E*, portion of the same, further enlarged. (Berg.)

important character, but one that can be ascertained only by subjecting a transverse section to examination under the microscope.

The fruit has scarcely any odour or taste, but when to the crushed fruit a solution of caustic potash is added a strong mouse-like odour is developed.

The student should observe

(*a*) The *glabrous surface*,
(*b*) The *irregular crenate ridges*,
(*c*) The *grooved endosperm*, and if possible, under the microscope, the *absence of vittæ*;

and should compare the fruits with anise fruits, which are distinguished by the short bristly hairs with which they are provided, by the presence of numerous vittæ, and by the endosperm, which is not grooved, the latter being the most definite character visible under a lens.

Constituents.—The principal constituent of hemlock fruits is the poisonous, volatile, liquid alkaloid *coniine*, of which they contain, when collected at the proper time and dried, 3·36 per cent. (Farr and Wright). This alkaloid is the source of the strong odour produced when hemlock fruits are crushed and mixed with caustic potash, the alkali liberating the alkaloid previously combined with vegetable acids.

The proportion of coniine present attains its maximum when the fruits are full- or nearly full-grown, but before the colour changes from green to yellow; during this change (the ripening of the fruit) the proportion of coniine rapidly diminishes. Commercial fruits yield from 0·5 to 1·3 per cent. of coniine.

Pure coniine is a colourless, oily, very poisonous liquid with an extremely unpleasant odour. It boils at 166·5° C. without decomposition in an atmosphere free from oxygen, but exposed to the air, even at ordinary temperatures, it rapidly assumes a brown colour.

It is accompanied in the fruit by small quantities of *methylconiine*, which is oily and resembles coniine, and by *conhydrine*, which is colourless and crystalline.

Uses.—Hemlock is not much used in medicine. It has been recommended in spasmodic and convulsive diseases, such as tetanus, chorea, and epilepsy; in asthma, whooping-cough, and spasmodic affections of the larynx. By some physicians it is, however, still frequently prescribed.

CORIANDER FRUITS

(Fructus Coriandri)

Source &c.—The coriander, *Coriandrum sativum*, Linn. (N.O. *Umbelliferæ*), is an erect herbaceous annual that has become naturalised throughout temperate Europe. It is *cultivated* principally in *Russia* and *Thuringia*, as well as in northern Africa, Malta, and India; the drug from the latter country differs somewhat in the ovoid instead of globular shape of the fruit. The whole plant, and especially the unripe fruit, is characterised by a strong disagreeable odour, whence the name coriander (from the Greek κόρις, a bug). As the fruit ripens, this gives place to an agreeable aroma, and the plant is then cut and thrashed. It has been cultivated for many centuries for use as a spice, but the offensive odour of the plant has occasionally led to its being considered poisonous.

Description.—The two mericarps of which the fruit consists remain firmly united by their margins, and enclose between them a small cavity, the cremocarp being nearly globular in shape. The fruit is of small size, averaging only about

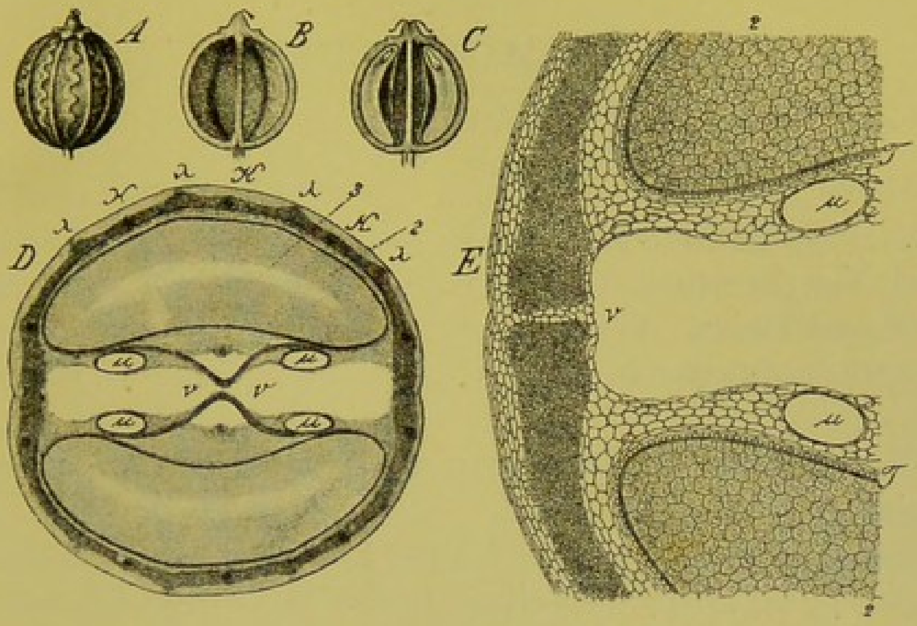


FIG. 46.—Coriander fruit. *A*, whole fruit (cremocarp), magnified 3 diam.; *B*, commissural surface of half-fruit (mericarp), showing the vittæ as dark lines; *C*, longitudinal section through both mericarps, showing the endosperm and embryo, magnified 3 diam.; *D*, transverse section, showing the vittæ, μ, magnified 14 diam.; *E*, portion of the same, further enlarged. (Berg.)

$\frac{1}{5}$ inch in diameter, of a uniform brownish-yellow colour, and quite glabrous. It is crowned by the remains of the calyx-teeth and styles, and bears on each mericarp five inconspicuous wavy primary ridges (containing fibro-vascular bundles) and four more conspicuous, straight, secondary ridges alternating with the primary. Both transverse and radial sections show a curved endosperm (suborder *Cœlospermeæ*), and on the former only two vittæ, both of which are situated on the commissural surface, can be discerned.

The odour of the bruised fruit is aromatic, and the taste agreeable and spicy.

The student should observe

(*a*) The *firmly united mericarps*,
(*b*) The *wavy primary* and *straight secondary ridges*,
(*c*) The *two vittæ on each commissural surface*.

Constituents.—Coriander fruits yield about 1 per cent. of *volatile oil.* That distilled from unripe fruit has a fetid odour, which, however, disappears on keeping.

Use.—The fruit and the oil distilled from it are used as aromatic carminatives.

CUMMIN FRUITS

(Fructus Cumini)

Source &c.—The cummin, *Cuminum Cyminum*, Linn. (N.O. *Umbelliferæ*), is a small annual plant indigenous to the upper *Nile territory*, and cultivated in *northern Africa, Sicily, Malta*, and India. The fruits were well known to the ancients, and were much used in Europe in the middle ages as a culinary spice.

The plants are cut down when the fruits are ripe, and thrashed.

Description.—Cummin fruits are brown in colour, of elongated-oval shape, tapering towards both base and apex, and somewhat laterally compressed. In the commercial drug the mericarps are sometimes united and attached to a short stalk; sometimes they are free. Each mericarp is nearly straight, about $\frac{1}{4}$ inch in length, and furnished with five yellow smooth or scabrous primary ridges. In the depressions between the primary ridges are secondary ridges, which, being furnished with short bristly hairs, are conspicuous when the fruit is examined with a lens.

The transverse section of a mericarp exhibits an oily endosperm, which is not deeply grooved, and six vittæ—four on the dorsal surface below the bristly secondary ridges and two on the commissure.

Cummin fruits resemble caraways in appearance, odour, and taste. The mericarps differ, however, in being nearly straight instead of curved (as caraways usually are), and in being bristly instead of smooth. The odour and taste, though similar to those of caraways, are by no means so agreeable.

The student should observe

(*a*) The *straight mericarp*,
(*b*) The *bristles on the secondary ridges*,
(*c*) The *characteristic odour*.

Constituents.—Cummin fruits yield from 3 to 4 per cent. of *volatile oil.*

Uses.—The fruits have been used as a stimulant and carminative; they are now chiefly employed in veterinary medicine.

FENNEL FRUITS

(Fructus Fœniculi)

Source &c.—Fennel, *Fœniculum capillaceum*, Gilib. (N.O. *Umbelliferæ*), is apparently indigenous to the shores of the Mediterranean, extending eastwards, but is cultivated for medicinal use in the *south of France*, in *Saxony* and Württemberg, in Russia and Galicia, and also in India, Japan, &c. Like other aromatic umbelliferous fruits, fennel was well known to the ancients, and was largely used in Europe during the middle ages. For medicinal use the fruits of cultivated

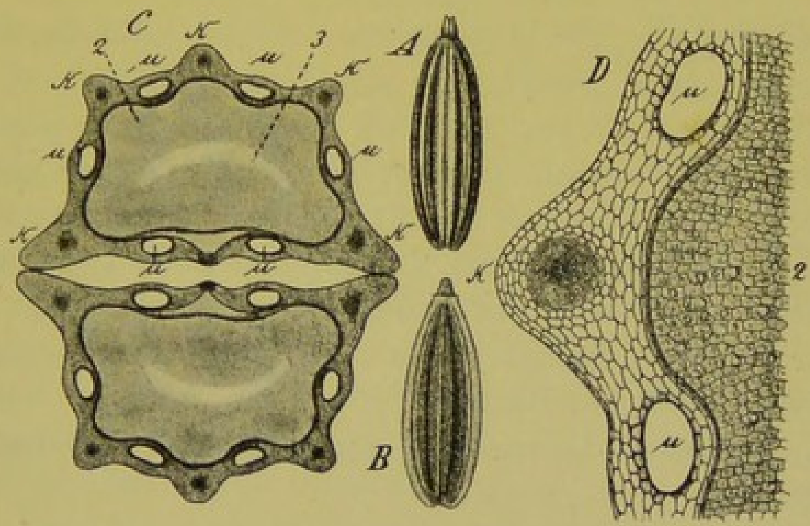


Fig. 47.—Fennel fruit. *A*, entire fruit, side view, magnified 3 diam. *B*, half-fruit, showing commissural surface, magnified 3 diam. *C*, transverse section: μ, vittæ; κ, ridges; magnified 14 diam. *D*, portion of the same, further enlarged. (Berg.)

plants, especially those grown in Saxony (Saxon fennel), are to be preferred, as it has been shown that they yield most volatile oil, and that the latter contains fenchone (see below).

Description.—Fennel fruits occur in numerous commercial varieties, varying considerably in size and appearance. Saxon fennel fruits, which may be regarded as the best, are of a greenish-brown or yellowish-brown colour and oblong in shape, attaining ¼ inch or occasionally rather more in length. The mericarps frequently remain united and attached to a pedicel about the same length as the fruit. They are glabrous, and bear five paler primary ridges that are so prominent as to render the fruit almost winged. In a transverse section four large vittæ can be distinguished by the naked eye on the dorsal surface, and two on the commissural surface of each mericarp; the endosperm is dark in colour, oily, and not deeply grooved. They have an aromatic odour, recalling anise, and a sweet, agreeable, aromatic taste.

French sweet fennel resembles the Saxon, but the fruit is rather larger, often exceeding ¼ inch in length, and frequently curved instead of being straight. It is admitted by the official description.

The student should observe

(*a*) The *very prominent ridges*,
(*b*) The *large vittæ*,
(*c*) The *characteristic odour and taste*.

Constituents.—The best varieties of fennel (Saxon, Galician, and Russian) yield between 4 and 5 per cent. of *volatile oil* containing about 20 per cent. of *fenchone*, a colourless liquid having the same formula as camphor ($C_{10}H_{16}O$) and possessing a pungent, camphoraceous odour and taste. The presence of fenchone imparts to the fruit a camphoraceous taste, and probably contributes also to its medicinal properties. The French sweet (or Roman) fennel yields only about 2 per cent. of oil which is free from fenchone.

Uses. — Fennel is used as an agreeable aromatic and carminative.

DILL FRUITS

(Fructus Anethi)

Source &c.—The dill, *Peucedanum graveolens*, Benth. and Hook. f. (N.O. *Umbelliferæ*), is a short erect annual herb indigenous to the *Mediterranean* districts and southern Russia, but *cultivated in England* as well as in other parts of Europe. The plant was formerly placed in a separate genus, *Anethum*, whence the name 'Fructus Anethi;' it is now included in the genus *Peucedanum*.

The drug has been in use in this country from very early times.

Description.—In the commercial drug the two mericarps of which the fruit is composed are usually separate and freed from the pedicel; they are broadly oval in outline, and so strongly dorsally compressed as to be nearly flat. They average about $\frac{1}{6}$ inch in length and $\frac{1}{10}$ inch in breadth.

Each mericarp is glabrous, brown in colour, and traversed from base to apex by five primary ridges, of which the three dorsal are only slightly raised, brown in colour, filiform, and inconspicuous; whilst the lateral are prolonged into thin, yellowish, membranous wings. The transverse section exhibits under the lens six vittæ, viz. four on the dorsal and two on the commissural surface; the endosperm is oily, and is not grooved on its commissural surface either in transverse or longitudinal section. Both the odour and taste are agreeably aromatic.

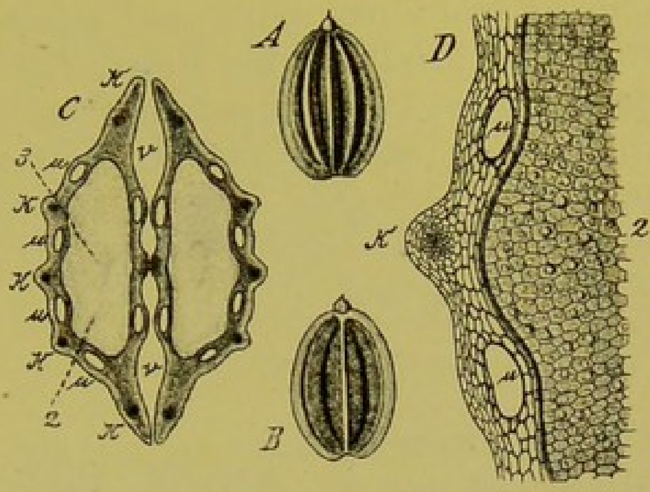


FIG. 48.—Dill fruit. *A*, entire fruit, side view, magnified 3 diam. *B*, commissural surface of mericarp, showing the vittæ as dark lines, magnified 3 diam. *C*, transverse section: μ, vittæ; κ, ridges; magnified 14 diam. *D*, portion of the same, further enlarged. (Berg.)

The student should observe

(*a*) The *very flat shape of the mericarp*,
(*b*) The *inconspicuous dorsal ridges*, and the *prominent lateral ones* (wings),
(*c*) The *mericarps, usually separate and free from the pedicel*.

Constituents.—Dill fruit contains from 3 to 4 per cent. of *volatile oil*, of which *carvol* (40 to 50 per cent.) is the most important constituent, being the one to which the aroma is chiefly due.

Uses.—Dill is employed as an aromatic stimulant and carminative.

Substitutes.—Considerable quantities of dill fruit are imported from Bombay; they are the fruits of a species of *Peucedanum* that has been considered by some botanists entitled to rank as a distinct species (*P. Sowa*, Kurz), but is included by others in the species *P. graveolens*. The mericarps of Indian dill are frequently united and attached to a pedicel of about the same length as the fruits; the dorsal surfaces are more convex than in European dill, the ridges are paler and more conspicuous, and the mericarps are rather narrower and less prominently winged. The oil is not identical in composition with that of European dill, and the fruits are excluded by the official description.

ANISE FRUITS

(Aniseed, Fructus Anisi)

Source.—The anise, *Pimpinella Anisum*, Linn. (N.O. *Umbelliferæ*), is an annual plant indigenous to Greece, Egypt, and Asia Minor, but *cultivated* largely in *southern Russia*, in *Spain*, *Italy*, &c., as well as in South America. Aniseed is one of the oldest of medicines and spices; it was cultivated by the ancient Egyptians, and was known to Dioscorides and Pliny; in this country it has been in use since the fourteenth century. The drug consists of the ripe fruits.

Description.—Anise fruits, or aniseed as they are commonly termed, are greyish brown in colour, ovoid or pear-shaped, and somewhat compressed laterally. They are broad near the base, and taper gradually towards the apex, which is crowned with a stylopod and two short divergent styles. The fruit averages about $\frac{1}{5}$ inch in length. The mericarps usually remain united and attached to a pedicel longer than the fruit. Each mericarp possesses five distinct but not prominent primary ridges which are usually slightly wavy, but do not exhibit the prominent crenations characteristic of hemlock fruits; the depressions between them are more or less distinctly bristly from the presence of short, stout hairs.

The transverse section exhibits under the microscope from thirty to forty vittæ in each mericarp; these, however, are so small that they are scarcely visible under even a powerful lens.

The endosperm is slightly concave on the commissural surface, but is not deeply grooved.

Anise fruits possess a sweet aromatic taste, and exhale, when crushed, an aromatic odour.

The student should observe

(*a*) The *short, stout, bristly hairs*, which are sometimes inconspicuous,

(*b*) The *united mericarps* and *the pedicel attached* to them,

(*c*) The *absence of any deep groove in the endosperm*,

(*d*) The *characteristic odour and taste*,

(*e*) The *absence of prominent crenations on the primary ridges*, which are themselves not conspicuous;

and should carefully compare the fruits with those of *Conium maculatum*, noting the absence of any deep groove in the endosperm, this being the best macroscopic diagnostic feature.

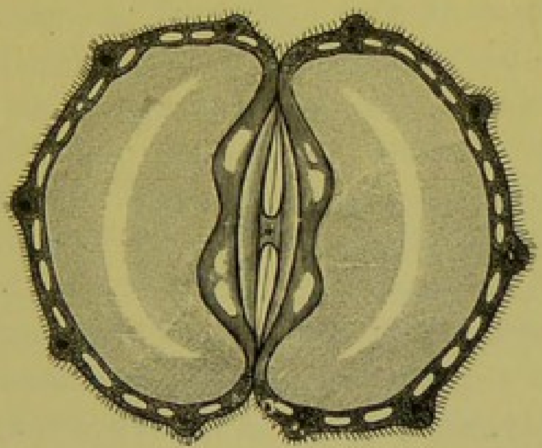


Fig. 49.—Anise fruit. Transverse section, indicating the position of the vittæ, not all of which (about forty in each mericarp) are shown. Magnified. (Moeller.)

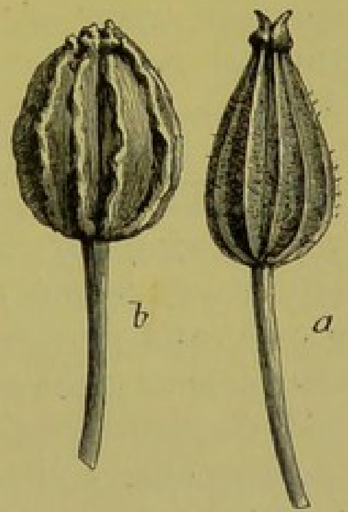


Fig. 50.—*a*, Anise fruit. *b*, Hemlock fruit. Magnified. (Vogl.)

Constituents.—The fruits yield about 2 per cent. of *volatile oil*, of which *anethol*, present to the extent of about 90 per cent., is the principal aromatic constituent.

Varieties &c.—Mediterranean aniseed (Alicante, Malta, &c.) is usually the largest and best, but Russia furnishes great quantities that are used for the production of the volatile oil.

Italian aniseed is frequently contaminated with hemlock fruits, which may be identified by their glabrous surface, by the irregularly crenate ridges, by the absence of the pedicel, and (best of all) by the deep groove in the endosperm and the absence of anise odour.

CAPSICUM FRUITS

(Cayenne Pepper, Fructus Capsici)

Source &c.—The capsicum fruits official in the British Pharmacopœia are derived from *Capsicum minimum*, Roxb. (N.O. *Solanaceæ*), a small erect shrub with spreading branches, producing oblong-conical fruits commercially known as chillies or, when powdered, as cayenne pepper. It is apparently a native of southern India, where at least it grows freely as a common weed of cultivation ; it is also cultivated in other tropical countries, especially in eastern Africa, in South America, &c. Not only does the plant itself show a great disposition to vary, but the fruits of other species are probably imported under the same name ; hence the chillies of commerce vary exceedingly in their shape and pungency. In Europe (Hungary, Spain, and Italy) *C. annuum*, Linn., is widely grown, and produces large fruits with a short peduncle and conspicuous green calyx, but in tropical countries *C. minimum* and *C. frutescens*, Linn., are most largely cultivated ; they yield smaller and more pungent fruits, those of *C. minimum* being alone official.

The fruits are collected when ripe, and dried.

Description.—The fruits of *C. minimum* have, when fresh, a scarlet colour which changes on drying to a dull orange-red. They are oblong-conical in shape, and obtuse at the apex ; they vary usually from ½ inch to ¾ inch in length, and do not exceed ¼ inch in diameter. They are superior, and not unfrequently remain attached to a small inconspicuous five-toothed inferior calyx and straight slender peduncle, which is as long as, or rather longer than, the fruit itself. The pericarp is somewhat flattened, shrunken, and shrivelled. It is quite glabrous and shining, thin and leathery in texture, and more or less translucent.

Cut transversely, the fruit is seen to consist of two cells separated by a thin reddish membranous dissepiment. Each cell contains from five to ten small, flat, nearly circular, whitish seeds with a characteristic thickened margin; they are originally attached to the dissepiment, but are frequently found loose in the cavity.

Capsicum fruits have a characteristic but not powerful odour, and an extremely fiery, pungent taste. The latter resides principally in the membranous dissepiment that divides the fruit into two cells.

The student should observe

(*a*) The *shape and size of fruit and peduncle*,
(*b*) The *dissepiment* and its *pungent taste*,
(*c*) The *shape of the seeds*.

Constituents.—The only important constituent of capsicum fruit is the pungent principle *capsaicin* (Thresh, 1876). This substance is extremely interesting, as it is one of the very few pungent principles that have been isolated in a pure crystalline form, most of them (paradol, gingerol, &c.) being obtainable only in the form of oily liquids. Capsaicin melts at 59° C., and when carefully heated volatilises, producing vapours that are extremely irritating to the throat and nostrils. It is contained chiefly in the dissepiment, being secreted by the cells of the epidermis between the cuticle and the outer cell-wall.

Capsicum fruits contain also a *volatile alkaloid* and a *crystalline alkaloid* (*capsicine*), neither of which possesses pungency. *Fixed oil* and *resin* are also constituents of the fruits, which should yield not more than 6 per cent. of ash (British Pharmacopœia), a test intended to detect adulteration of the powdered drug with inorganic substances.

The definite crystalline substance capsaicin, which is not an alkaloid and does not exhibit glucosidal properties, must be carefully distinguished from capsicin, a soft red substance dissolved by ether from an alcoholic extract (Braconnot, 1816). The same term is also applied to an alcoholic extract of capsicum fruits. Both of these capsicins contain capsaicin associated with much oil, resin, colouring matter, and other substances, and are therefore not to be regarded as active constituents.

Uses.—Cayenne pepper is applied externally as a stimulant and counter-irritant; internally it is used as a pungent stomachic carminative and stimulant, to dispel flatulence and rouse the appetite.

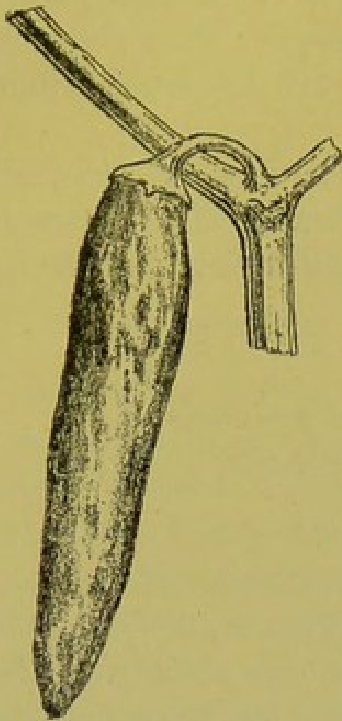


FIG. 51.—*Capsicum annuum*, fruit. Natural size. (Bentley and Trimen.)

Varieties.—The fruits of *Capsicum annuum*, Linn., are largely used in Hungary, Spain, and Italy, in which countries the plants are cultivated. They vary much in size and shape, as well as in colour; they are usually much larger than those of *C. minimum*, of a deeper colour and less pungent taste. The pericarp is more leathery, and the dissepiment does not extend throughout the entire length of the fruit, which is therefore two-celled near the base, but becomes one-celled towards the apex. The seeds are similar in shape to those of *C. minimum*, and not much larger.

The fruits of *C. annuum*, like those of *C. minimum*, contain capsaicin, chiefly in the dissepiment between the two cells.

LAUREL BERRIES

(Bay Berries, Fructus Lauri)

Source &c.—Laurel berries are the ripe fruits of *Laurus nobilis*, Linn. (N.O. *Laurineæ*), a shrub that has already been referred to under the heading 'Laurel Leaves' (see p. 40).

Description.—The laurel produces one-celled, one-seeded, drupaceous fruits, which are collected when ripe, and dried. As seen in commerce, they are nearly black in colour and ovoid in shape, attaining a little over ½ inch in length; they are slightly pointed at the apex, and bear at the base the scar of the peduncle. The surface is glabrous, shining, and coarsely wrinkled. The pericarp is thin and brittle, and encloses a single seed, the kernel of which lies loose in the cavity, the seed-coats remaining closely adherent to the inner surface of the pericarp. The kernel is yellowish or brownish yellow in colour, and easily separable into two large firm cotyledons. It has an aromatic odour and aromatic bitter taste, the pericarp being less aromatic but much more bitter.

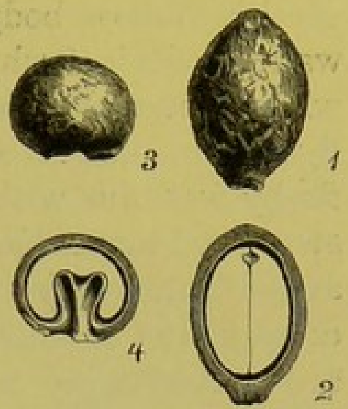


FIG. 52.—1 and 2, Laurel berries, whole and cut transversely. 3 and 4, *Cocculus indicus*, whole and cut transversely. Slightly magnified. (Vogl.)

The student should observe

(*a*) The *ovoid shape*,
(*b*) The *loose kernel of the seed*,
(*c*) The *aromatic odour and taste* ;

and should compare these fruits with those of *Anamirta paniculata* (Cocculus indicus), which are reniform in shape and destitute of aroma.

Constituents.—Laurel berries contain about 1 per cent. of an aromatic *volatile oil* and upwards of one-fourth of their weight of *solid fat*. The latter, separated by hot pressure, is the Oleum Lauri Expressum of commerce ; when pure it has a dull green colour, granular consistence, and aromatic odour. The principal constituent is laurostearin, the odour being due to a little volatile oil, and the green colour to chlorophyll.

The nature of the bitter principle contained in the pericarp of the fruit is unknown.

Uses.—The expressed oil is sometimes used as a stimulant in veterinary practice.

FIGS

(Ficus)

✓

Source &c.—The fig tree, *Ficus Carica*, Linn. (N.O. *Urticaceæ*), is a native of Persia and the surrounding countries. The fruits, figs, have long constituted an important article of food in eastern countries ; they have been found provided as food for the dead in Egypt as early as 2,400 years before the Christian era ; from Egypt the tree was probably introduced into Greece and thence into southern Europe. It is now cultivated in most temperate and warm climates, and even ripens its fruit in England.

The fruit is produced by the abnormal growth of a lateral shoot, by which a green, hollow, pear-shaped body is produced, having a small aperture closed by bracts. On the inner walls of this hollow body numerous small flowers are borne; the wall itself is fleshy and contains laticiferous vessels which, when wounded, discharge a milky latex. In this condition figs are inedible. As the fruit ripens the latex disappears, the fleshy wall fills with sugar and becomes pulpy, and the taste sweet and agreeable. They are then eaten in the fresh state, or are collected and dried in the sun. The latter constitute the dried figs of commerce. If, without further manipulation, they are packed loose, retaining more or less their original shape, they are called 'natural' figs; but if subjected to a process of pressing and kneading by which they become supple and the skin translucent, they are called 'pulled' figs; the latter are usually pressed into small boxes for exportation, and are considered the best.

Description.—The ordinary fig is too well known to need much description. The fruit, which is sometimes called a syconus, is a collective fruit formed from the enlarged, succulent, hollow receptacle which bears on its inner wall very numerous, minute, one-seeded true fruits (achenes), commonly called the seeds. Figs are usually irregular in form, compressed, soft and tough, brownish or yellowish in colour, and sweet in taste. The chief commercial varieties are the Smyrna, which are thin-skinned, soft, and luscious, and the Greek, which are thicker-skinned, tougher, less pulpy, and consequently less esteemed.

Constituents.—The principal constituent of figs is the *sugar*, of which they may contain upwards of 50 per cent.

Uses.—Dried figs have agreeable demulcent, nutritive, and laxative properties, and are therefore sometimes prescribed as an article of diet in habitual constipation. They form one of the ingredients in confection of senna.

HOPS

(Lupulus, Humulus, Strobili Lupuli)

Source &c.—The hop, *Humulus Lupulus*, Linn. (N.O. *Urticaceæ*), is a scabrous climbing plant with perennial root, widely diffused over the whole of Europe and common in

England, growing in hedges and thickets. It is largely cultivated in England, Germany, Russia, California, &c.

The hop is diœcious, but the pistillate plant only is cultivated, since from that alone the fruits (hops) can be obtained; these are preferred with undeveloped seeds, to ensure which the staminate plants are usually excluded.

The axis of the pistillate inflorescence is a sympodium, and bears at intervals pairs of stipules. From the common axil of each pair a rudimentary branch arises, which divides into two branchlets. Each branchlet divides again into two, and each of the four ultimate divisions so produced bears a single flower in the axil of a bract, there being thus four bracts to each pair of stipules. Both stipules and bracts develop into broadly ovate membranous leafy bodies which, crowded on the sympodial axis, form a cone-like collective fruit termed a strobile (fig. 53, *a*). These are picked from the plant when fully developed, and dried; they are frequently exposed to fumes of burning sulphur (sulphur dioxide), by which the colour is preserved and change in the aroma is said to be hindered. They are sometimes dried loose, but usually they are pressed into compact bales known as 'pockets.'

FIG. 53.—Hop. *a*, strobile of the Hop, natural size. *b*, bract enfolding at its base a small fruit, and showing lupulin glands, natural size. *c*, fruit magnified, showing lupulin glands. (Tschirch.)

Description.—The strobile of the hop averages about 1¼ inch in length and is ovoid or rounded in shape, the most conspicuous part being the yellowish-green imbricated membranous bracts and stipules. If these leafy organs are removed from the strobile, the axis will be seen to be hairy and have a zigzag course, bearing rudimentary branches on alternate sides. Some of the leafy bodies enfold at their bases minute fruits: these are the bracts (fig. 53, *b*); others, the stipules, do not. The fruits are minute achenes, and are partially surrounded by a perianth (fig. 53, *c*). Both the minute fruits and the bases of the bracts are sprinkled over with yellowish shining translucent glands, which contain volatile oil and constitute, when separated, the drug lupulin.

The odour of fresh hops is strong and characteristic, although scarcely agreeable ; the taste strongly aromatic and disagreeably bitter and acrid. By keeping, the volatile oil undergoes change and the aroma becomes less powerful, the bracts and stipules turn yellow, and the glands acquire a brown colour.

The student should strip the bracts and stipules from the strobile and observe

(*a*) The *zigzag hairy axis,*
(*b*) The *bracts enclosing fruits and bearing glands.*

Constituents.—The odour of hops is due to a *volatile oil,* of which they contain about 0·7 per cent. One of the constituents of this oil is *valerol* (Personne, 1854), which by oxidation yields *isovaleric acid* (Ossipow, 1856), a decomposition to which the gradual change in the odour of hops is ascribed. The bitter principle, *lupamaric ac:d,* has been obtained in a crystalline form, and resides, together with the volatile oil, in the glands found on the bracts.

Both bracts and stipules (but not the glands) contain about 5 per cent. of *tannin.* According to Heron (1897) the tannin in hops gradually disappears, changing first into phlobaphene and subsequently into gallic acid and other compounds.

Uses.—The volatile oil produces sedative and soporific effects, whilst the lupamaric acid is stomachic and tonic ; hops accordingly improve the appetite and promote sleep.

CUBEBS

(Fructus Cubebæ)

Source &c.—Cubebs are the fruits of *Piper Cubeba,* Linn. f. (N.O. *Piperaceæ*), a diœcious woody climber indigenous to *Java, Sumatra,* and *Borneo,* and apparently cultivated also in those islands, although exact information concerning the cultivation is difficult to obtain. The endeavour has been made to cultivate cubebs in Sierra Leone and also in Ceylon, where the staminate plants have thriven well, but the pistillate ones have not been very successful. The fruits have long been known in Europe ; in the middle ages they were occasionally used as a spice, and it is only since the beginning of this century that they have been recommended in certain affections of the urinary organs.

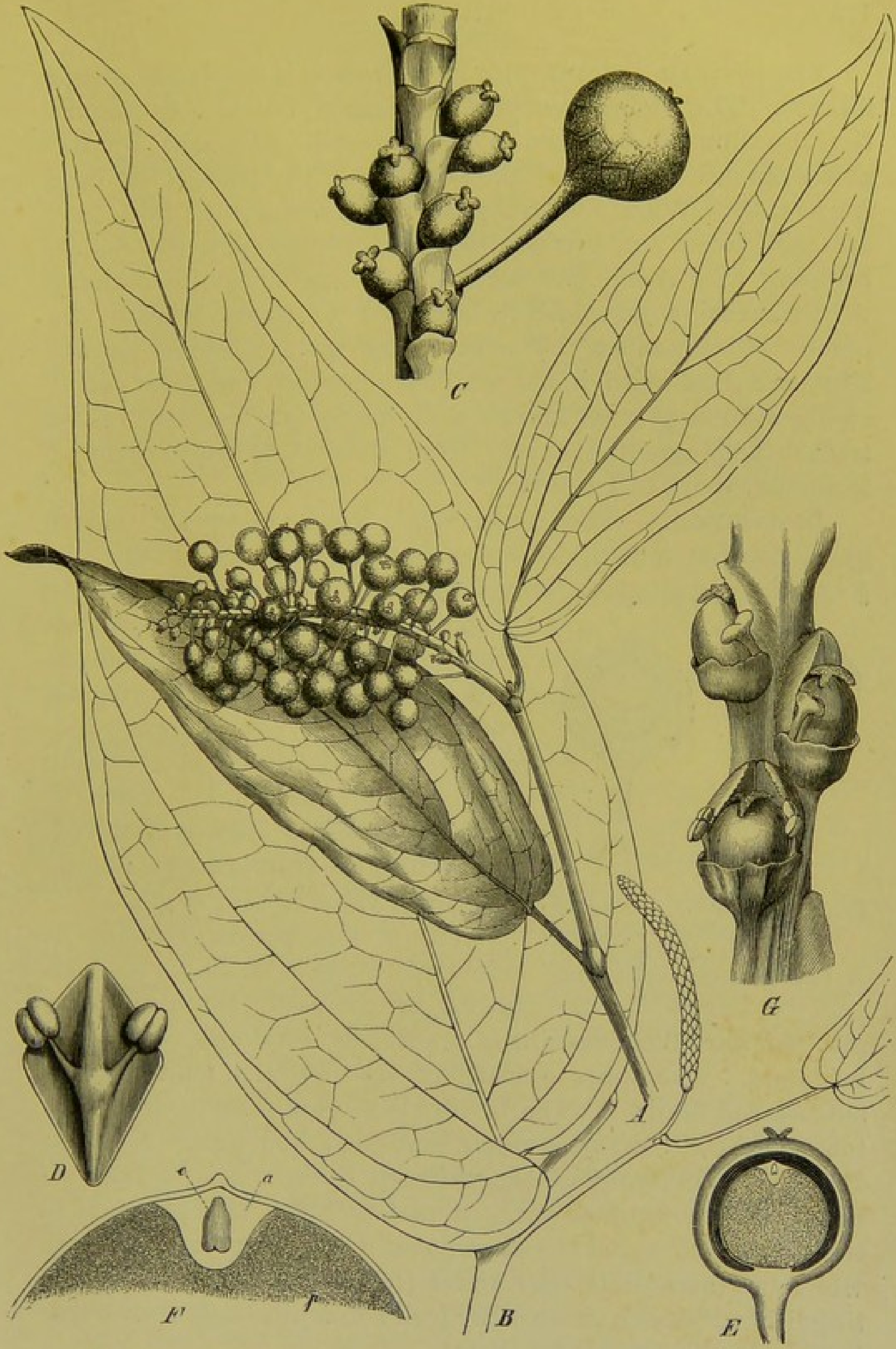
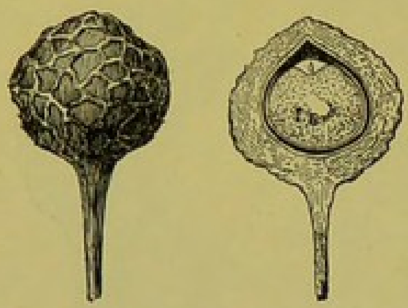


FIG. 54.—*Piper Cubeba.* *A*, fruiting branch, natural size. *C*, portion of the same magnified, showing the stalk-like elongation of the pericarp. *B*, branch of staminate plant, natural size. *D*, bract and stamens, magnified. *E*, Fruit cut to show the endosperm and perisperm, magnified. *F*, portion of same, more highly magnified, showing the embryo, *e*, endosperm, *a*, and perisperm, *p*. *G*, *Piper nigrum*; portion of flowering spike, magnified. (Luerssen.)

The pistillate inflorescence of the cubeb is a spike of sessile flowers. The young fruits are also sessile, but as they mature they become elevated on a slender stalk produced by the abnormal development of the pericarp of the fruit at its base (fig. 54, *C*). When the fruits are full-grown, but whilst they are still green and unripe, they are stripped from the rachis, bringing with them the stalk-like prolongation of the pericarp which remains permanently attached to them, whence the name 'tailed pepper' by which they are sometimes known. They are then dried in the sun, during which the green colour changes to a greyish black; they are bought up by Chinese traders and exported chiefly from Batavia to Amsterdam or from Singapore to London.

Description. — The commercial drug consists of nearly globular fruits, sometimes depressed at the base, measuring about $\frac{1}{6}$ inch in diameter, and usually of a greyish-brown or nearly black colour. The pericarp is reticulately wrinkled (due to the shrinking as the fresh fruit dries) or, in very young fruits, shrivelled, and abruptly prolonged at the base into a slender stalk about $\frac{1}{4}$ inch in length which is usually rounded or slightly flattened. The apex of the fruit bears the minute remains of three or four stigmas.



A *B*

Fig. 55.—Cubeb. *A*, entire fruit, magnified. *B*, entire fruit, cut vertically, magnified. (Planchon and Collin.)

Within the pericarp, which is thin and brittle, is a single seed attached by the base; frequently only the dark shrunken remains of a partially developed seed are to be found. The inner surface of the pericarp (endocarp) is smooth and hard; it consists of radially elongated parenchymatous cells that are very much thickened and lignified. Near the outer epidermis of the pericarp there is also a layer of thickened and lignified parenchymatous cells; the presence of these two layers, and the characters of the cells forming them, which are discernible only under the microscope, serve to distinguish true cubebs from other fruits of similar appearance that have been substituted for them.

The fully developed seed is reddish brown in colour. The embryo is very small and embedded near the apex of the seed in a somewhat scanty endosperm surrounded by a copious perisperm, which constitutes the greater part of the seed.

Cubebs exhale, when crushed, a strong, characteristic, spicy odour, and possess a strong, spicy, somewhat bitter taste. The crushed fruit, sprinkled upon the surface of concentrated sulphuric acid, produces a crimson coloration. This reaction is an important one, as most of the substitutes for cubebs yield only a brownish-red under the same conditions. It is especially valuable when taken in conjunction with the microscopical characters, for there is no substitute known that possesses an anatomical structure identical with that of genuine cubebs, and also yields the crimson colour with sulphuric acid (Hartwich, 1898).

The student should observe

(*a*) The *slender stalk*, which is not easily detached,
(*b*) The *seed attached only by its base* to the pericarp,
(*c*) The *characteristic odour and taste*,
(*d*) The *reaction with sulphuric acid*.

Constituents.—Cubebs yield about 14 per cent. of *volatile oil*, which is contained in oil-cells both in the pericarp and perisperm; similar oil-cells are contained also in the rachis, stem, leaves, &c., but the rachis, which is frequently found mixed with the cubebs, contains only about 1·7 per cent.

Cubebs contain further an indifferent substance, *cubebin*, an acid resin, *cubebic acid*, and an *indifferent resin*.

Cubebin has been obtained in colourless crystals, yielding with sulphuric acid a cherry-red colour; it appears to be devoid of any remarkable physiological action.

Cubebic acid (0·96 per cent.) is white and amorphous; it gives with sulphuric acid a crimson colour, and together with the indifferent resin (2·5 per cent.) produces purely diuretic effects. These two principles may therefore be regarded as active constituents of cubebs.

Substitutions.—The exportation of cubebs has been subject to considerable variation, and during times of scarcity the drug has been liable to adulteration and substitution. Many other plants belonging either to the same or to other natural orders produce fruits resembling cubebs in appearance, a fact which has doubtless facilitated sophistication. Genuine cubebs can, however, be easily distinguished by the crimson colour they impart to sulphuric acid, taken in conjunction with the anatomical characters of the pericarp as above described.

The fact that the fruits on the spike mature in succession from base to apex necessitates the presence in the drug of some immature fruits, but too many of these, which may be recognised by their small size and shrivelled appearance, should not be present. Portions of the rachis also find their way into the commercial drug; they too should not be present in large quantity, as they contain less cubebic acid and resin, and much less volatile oil.

Uses.—Cubebs are chiefly used in gonorrhœa and affections of the bladder, sometimes also in chronic bronchitis, the active constituents of the drug leaving the body by the kidneys and urinary passages, the skin and the respiratory organs.

BLACK PEPPER

(Piper Nigrum)

Source &c.—The pepper vine, *Piper nigrum*, Linn. (N.O. *Piperaceæ*), is a perennial climbing plant indigenous to *southern India*, but spread by cultivation over the islands of the *Malay Archipelago* and to the West Indies and South America. It is now cultivated chiefly in Sumatra, Singapore, Johore, and the islands of the Rioux-Lingga Archipelago, Penang and Siam. Probably no drug or spice has been so sought after, or has played so important a part, as pepper. It was apparently brought to Europe soon after the expedition of Alexander the Great to India. During the middle ages the trade in it was concentrated in Venice, and the desire to divert so profitable a commerce acted as a direct inducement to the Genoese and Portuguese to seek a sea route to India, which resulted in the discovery by Vasco da Gama in 1498 of the route round the Cape of Good Hope to India. At the present moment the centre of the pepper trade is Singapore, whence about one-half of the world's supply is exported (Tschirch, 1892).

The pepper vines are cultivated in gardens as hops are in this country, but instead of poles being used, trees are planted to afford the necessary shade and support. The plant bears a pendulous spike of sessile flowers (fig. 54, *G*), which are succeeded by small drupaceous fruits; these do not become raised upon stalks as the cubebs do, but remain sessile. As soon as the lower berries on the spike begin to ripen, which is shown by their colour changing from green to red, the whole spike is picked and dried in the sun. During the drying the fruits turn black, a change due to a decomposition of the tannin they contain. They are then separated from the rachis, sorted, and constitute the black pepper of commerce.

For the production of white pepper the fruits are allowed to become nearly ripe; they assume a crimson colour, and the mesocarp acquires a pulpy consistence. They are then (usually) soaked in water, by which the outer part of the pericarp is loosened; from this they are separated by rubbing between the hands, after which they are washed and dried. White pepper is therefore the nearly ripe fruit from which the outer part of the pericarp has been removed.

Description.—Black pepper consists of small dark brown or nearly black spherical fruits, measuring about $\frac{1}{5}$ inch in diameter, with a more or less regularly and deeply reticulate wrinkled surface. At the apex the remains of the sessile stigmas can be traced; the base bears a scar indicating the point of attachment to the rachis, but, the fruits being sessile, there is no stalk.

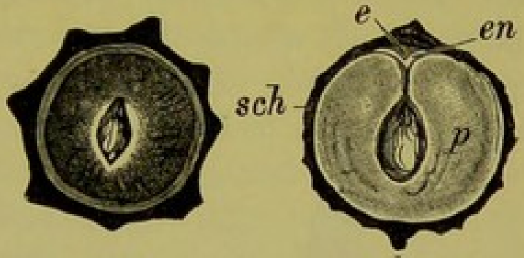


FIG. 56.—Black Pepper. *a*, transverse section. *b*, longitudinal section, showing pericarp, *sch*; perisperm, *p*; endosperm, *en*; and embryo, *e*. Magnified. (Tschirch.)

If a fruit be cut longitudinally or transversely and examined with a lens, the pericarp will be seen to be thin and dark and completely filled with a seed to which it is closely adherent. The seed is globular and covered with a brown seed-coat. It contains a small endosperm, near the apex of the fruit, in which the minute embryo is situated; but the major part of the seed is composed of perisperm which is yellowish and horny near the periphery, whitish, mealy, and frequently hollow in the centre.

Both pericarp and seed have an aromatic odour and pungent taste; they both contain oil-cells, visible under the microscope.

White pepper is of about the same size and shape as black. The surface is greyish-white in colour, and nearly smooth.

From the base to the apex there run about sixteen light lines; these are the fibro-vascular bundles that traverse the pericarp; they are left, together with the inner part of the pericarp, attached to the seed when the outer part of the fruit is removed. By gently scraping white pepper the adherent part of the pericarp can be removed and the dark brown seed disclosed; the latter possesses the characters above described.

The student should observe

(*a*) The *absence of stalk*,
(*b*) The *seed completely filling the pericarp and adherent to it*,
(*c*) In *white pepper the adherent inner part of the pericarp, with its fibro-vascular bundles.*

Constituents.—Both the seed and the pericarp contain numerous oil-cells in which a *volatile oil*, a *resin*, and a crystalline alkaloid, *piperine*, are contained. To the volatile oil (about 2 per cent.) the characteristic aroma of pepper is to be ascribed, whilst the piperine produces, in part at least, the pungent taste. Analyses have shown that black pepper contains from 5 to 8·25 per cent. of piperine, whilst white pepper contains from 4 to 6·5 per cent. The nature of the resin is not accurately known. The seeds contain, further, a large quantity of starch in minute angular grains united into polygonal masses.

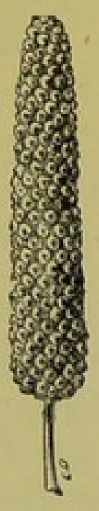


Fig. 57.—Long Pepper. (Planchon and Collin.)

Uses.—Applied externally pepper acts as a rubefacient, anodyne, and counter-irritant; it is given internally as a local stimulant, and as a stimulant to the urethra and rectum; it is occasionally used for hæmorrhoids and other diseases of the rectum.

Varieties &c.—*Long Pepper.*—Long pepper is the dried unripe fruit of *Piper officinarum*, C.DC., a native of the Malay Archipelago. It consists of a large number of minute sessile fruits which, together with the bracts that support them, are crowded together on and partially embedded in an elongated axis so as to form a dense spike. Each spike is about 1½ inch long and ¼ inch thick; it is nearly cylindrical, tapering to a rounded apex, and covered with a greyish earthy powder. When washed free from this the spikes are seen to be reddish brown in colour, and the minute fruits are then more easily visible; they are arranged in a close spiral, and each bears the remains of the stigma at its apex. Cut transversely, the section of the spike shows eight or ten fruits with starchy perisperm arranged around a central axis.

The taste and odour resemble those of black pepper, but are not so strong. The active constituents are the same, but they are present in smaller proportion.

The student should cut long pepper transversely and observe the minute fruits, which appear white and starchy in section.

JUNIPER BERRIES

(Fructus Juniperi)

Source &c.—The juniper, *Juniperus communis*, Linn. (N.O. *Coniferæ*), is a small diœcious evergreen shrub with linear spreading prickly leaves, indigenous to *Great Britain*, and widely distributed over Europe.

In the axils of certain of the upper leaves small rudimentary branches are produced, each of which bears a number of minute bracts; in the axils of the uppermost whorl of three such bracts three ovules are produced, which, as in all gymnosperms, are not enclosed in an ovary. After fertilisation the three supporting bracts increase in size, become fleshy, grow round, and finally, with the exception of a minute canal at the apex, completely enclose the three ovules. At the same time the ovules develop to seeds and become surrounded with hard coats developed partly from the integuments, partly from the tissue of the enclosing bracts. The fruit ripens in the second year, and forms then a purple berry-like fruit which is termed a 'galbulus.'

Juniper berries are collected in various parts of Europe, but especially in Hungary, where they are largely used in the preparation of certain national spirits.

Description.—Ripe juniper berries are of a dark purplish colour and nearly globular in shape, measuring about $\frac{1}{3}$ inch in diameter. The apex bears a very distinct tri-radiate scar indicating the sutures of the three bracts by which the seeds are enclosed; at the base are (usually) six minute pointed bracts arranged in two whorls. The outer skin (corresponding to the epicarp) is thin and often covered with a bluish 'bloom;' the tissue corresponding to the mesocarp is loose and soft, of a yellowish-brown colour, and contains embedded in it three hard triangular seeds. These usually bear, partly sunk in the hard tissue, large oil-glands filled with volatile oil, or, in old fruits, with yellowish transparent resin; they are often concealed by the soft surrounding tissue which adheres to the resinous secretion. Smaller oil-glands are present in the pulp of the fruit, but they are less conspicuous.

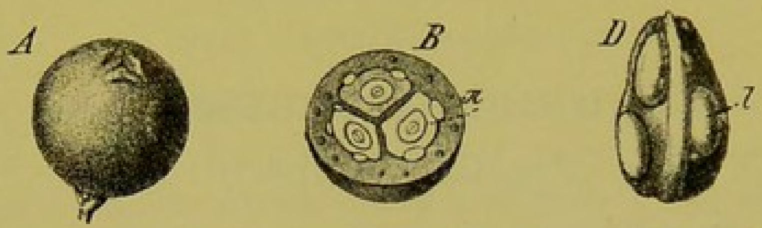


FIG. 58.—Juniper berry. *A*, entire fruit, magnified 3 diam. *B*, transverse section of the same: *κ*, seed. *D*, Seed, magnified 3 diam.: *l*, oil-gland. (Berg.)

Juniper berries have an agreeable aromatic odour resembling turpentine, and sweetish taste.

Whilst green and unripe they contain starch and are devoid of the sweet taste. According to the British Pharmacopœia the unripe fruits should be used for the distillation of the volatile oil, but for this purpose the ripe fruits are said to be usually employed (Schimmel, 1898).

The student should observe

(*a*) The *scar at the apex*,
(*b*) The *minute bracts at the base*,
(*c*) The *three hard seeds with oil-glands* partly embedded in them.

Constituents.—Ripe juniper berries yield about 1 per cent. of *volatile oil*, and contain a considerable quantity of *sugar*.

Uses.—The volatile oil is diuretic as well as being stomachic and stimulant. It is employed chiefly as a diuretic in certain forms of dropsy.

VANILLA

(Fructus Vanillæ)

Source &c.—The vanilla plant, *Vanilla planifolia*, Andrews (N.O. *Orchideæ*), is a climbing plant growing wild in the moist woods on the eastern coast of *Mexico*. It is now largely cultivated in the islands *Réunion*, the *Seychelles*, *Mauritius*, *Java*, &c., where the climate resembles in temperature and humidity that of its native country, The genus includes many species, but *V. planifolia* is the chief vanilla-yielding one.

Like other members of the same natural order, the fertilisation of the Mexican wild plant is effected by insects ; but when the plant is cultivated in other countries, in the absence of these insects, the fertilisation is accomplished by hand. This is effected by introducing a pointed stick into flower after flower, selecting the strongest, and must be quickly done, as they last but a short time. Before the fruits ripen, when the colour begins to change from yellowish-green to brown, they are picked and subjected to a process of 'curing,' during which certain aromatic principles are formed and the fruits acquire the well-known vanilla odour. This process, the details of which vary considerably, consists essentially of slow drying by exposure to the warmth of the sun or to artificial heat. Latterly a process of drying in closed vessels over quicklime has been introduced (in Réunion), by which loss of aroma by volatilisation of the aromatic principles is avoided ; it would seem therefore that the usual tedious methods of curing are capable of simplification. The cured fruits, which are of a dark brown or nearly black colour, are bound in bundles and packed in tins, in which they gradually become coated with minute crystals.

Description.—Commercial vanilla occurs in slender flexible stick-like pods about 6 or 8 inches in length, and of a dark brown or nearly black colour. They have a flattened-cylindrical shape, due to the mutual pressure of the pods in the bundle, and taper towards both base and apex. The surface is longitudinally wrinkled and frequently more or less covered with numerous minute glistening crystals (of vanillin). The fruits are one-celled and contain innumerable, minute, black seeds embedded in a dark-coloured, aromatic, balsamic fluid secreted by the cells of the inner epidermis of the pericarp, which are developed into short hairlike processes projecting into the cavity of the fruit. The drug has an extremely fragrant odour and an agreeable aromatic taste.

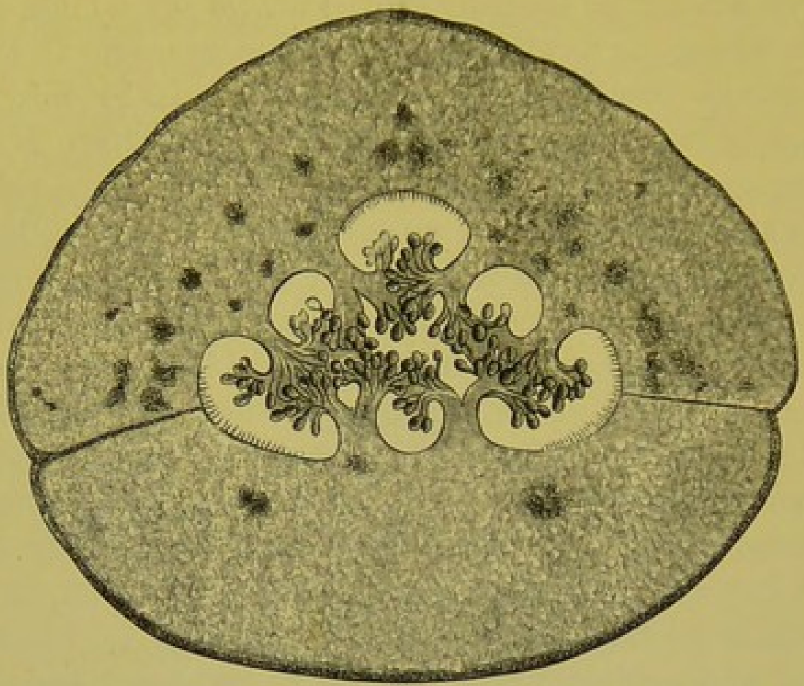


FIG. 59.—Vanilla. Transverse section of fruit, showing the placentas, seeds, and secreting hairs on inner epidermis of the pericarp. Magnified. (Moeller.)

Constituents.—The principal aromatic constituent of vanilla pods is *vanillin*, though probably other aromatic substances are present; it is contained in the fluid secreted by the inner epidermis of the pericarp, which gradually permeates the whole fruit; and constitutes the crystalline deposit that gradually accumulates on the pods.

Vanillin can be obtained in colourless acicular crystals with a fragrant vanilla-like odour. It is methylprotocatechuic aldehyde and can be prepared synthetically from coniferin, a glucoside occurring in the sapwood of pine-trees &c., or from eugenol, one of the constituents of oil of cloves.

CARDAMOMS

(Fructus Cardamomi)

Source &c.—Cardamoms are the dried, nearly ripe fruits of *Elettaria Cardamomum*, Maton (N.O. *Scitamineæ*), a reed-like plant that grows wild in the forests of southern India, especially near the Malabar coast. It is cultivated there as well as in Ceylon, the fruits of commerce being obtained from cultivated plants.

The plant produces a long loose raceme of flowers, succeeded by small inferior capsular fruits, which are cut from the rachis in succession as they ripen, but before they are quite ripe. This is necessary, as they do not all ripen at once, and fruits may be found in various stages of development, from quite unripe to ripe, on the same spike; if they are left till they ripen they are liable to spring open when they are dried and discharge the seeds. After collection they are cured by dipping them in water and exposing them to the sun, by which they are bleached and assume a pale yellow colour; sometimes the bleaching is assisted by sulphurous acid. The cured fruits are trimmed and freed from impurities by picking.

Cardamoms were well known to the Greeks and Romans, but probably not the species now under consideration.

Description.—Cardamom fruits differ considerably in size and shape. They vary usually from $\frac{2}{5}$ to $\frac{4}{5}$ inch in length, the smallest variety being frequently nearly globular in shape, whilst the longer are more or less distinctly three-sided, with rounded angles and an ovate or oblong outline. They are of a pale buff or yellowish colour, and longitudinally striated or sometimes nearly smooth. To the base, which is rounded, is attached a short stalk; towards the apex they taper more or less abruptly, and are sometimes crowned by a short beak formed of the remains of the calyx, from which, however, they have often been freed by trimming. They are three-celled, and contain in each cell two rows of small seeds attached to axile placentas. From good plump cardamom fruits the seeds usually separate in a cohering mass from each cell. They are of a dark reddish-brown colour, about $\frac{1}{8}$ inch in length, and irregularly angular in shape; they are hard and marked with transverse wrinkles, which are very distinct when examined with a lens. The thin, colourless, membranous aril that covers

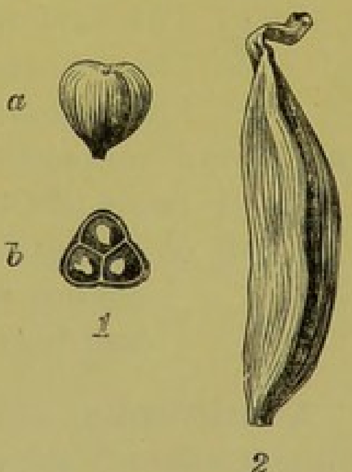


FIG. 60.—Cardamom fruits. 1, Malabar Cardamom. *a*, whole fruit; *b*, cut transversely. 2, Ceylon (wild) Cardamom, natural size. (Vogl.)

the seed becomes more evident when the seeds are soaked in water. The hilum is depressed, and a channel, extending on one side from the base to the apex of the seed, indicates the position of the raphe.

Cut transversely, the seed exhibits a thin dark seed-coat, a whitish perisperm grooved on one side, and in the centre a small yellowish translucent endosperm and minute embryo.

The seeds have a powerful aromatic odour and an agreeable pungent aromatic taste, but the pericarps possess neither aroma nor taste.

The student should observe in the fruits

(*a*) The *pale colour* and *plump appearance*,
(*b*) The *abruptly tapering apex* ;

and should compare them with Ceylon (wild) cardamoms. (See below.)

He should also observe in the seeds

(*a*) The *dark reddish-brown colour* and *aromatic taste*,
(*b*) The *transverse wrinkles, depressed hilum and raphe*,
(*c*) The characters of the *transverse section* ;

and should compare them with

(i) Seeds of *Ceylon cardamoms* (see below),
(ii) *Grains of Paradise*, which have a rich reddish-brown colour, minutely and irregularly wrinkled surface, and bear the remains of a thick fibrous funicle.

Constituents.—Cardamom seeds contain as principal constituent about 5 per cent. of *volatile oil*. The Pharmacopœia requires that they should not yield more than 4 per cent. of ash, a test intended to detect the pericarps in the powdered seed, the entire fruits yielding about 5·5 per cent. of ash (Squire). The detection of such an adulteration is, however, much better and more accurately determined by microscopic examination.

Varieties.—*Ceylon* (*wild*) *Cardamoms*.—Under the name 'wild cardamoms' the fruits of a variety of *E. Cardamomum* (*E. Cardamomum* var. *β major*, Smith) are regularly imported from Ceylon and appear on the London market. The fruits vary from 1 to $1\frac{1}{2}$ inch in length, are distinctly triangular and strongly longitudinally striated. They taper gradually towards the apex, which is usually curved and often bears the remains of the calyx. The colour is commonly greyish brown, and the fruits lack the plumpness that characterises genuine cardamoms.

The seeds are mostly rather larger than those of the Malabar cardamom, and paler in colour, but they have a similar, though not so aromatic, and rather bitterish taste.

The fruits of this variety are easily identified, but the seeds are not readily distinguished except by careful microscopical examination. Cardamom seeds obtained from the ripe fruits that burst during the drying are imported in considerable quantity, and the British Pharmacopœia, to guard against substitution, excludes these from pharmaceutical use by making the entire fruits alone official.

Uses.—Cardamoms are employed as an aromatic carminative and as an agreeable flavouring agent.

SECTION IV

SEEDS

STAVESACRE SEEDS

(Semina Staphisagriæ)

Source &c.—Stavesacre, *Delphinium Staphisagria*, Linn. (N.O. *Ranunculaceæ*), a stout erect herb attaining 4 feet in height, is indigenous to Asia Minor and southern Europe. The plant is cultivated in France and Italy, our supplies being chiefly derived from Trieste and from the south of France.

Stavesacre was well known to both the Greeks and the Romans. Dioscorides mentions it, and Pliny describes its use as a parasiticide. It continued to be extensively employed throughout the middle ages, but is now in much less demand.

The fruit consists of three follicles, in each of which a few seeds are closely packed; these are collected when ripe.

Description.—The blackish-brown colour that stavesacre seeds exhibit when fresh is said to change by keeping to a dull earthy brown or dark grey. The seeds, as seen in commerce, are of small size, averaging about ¼ inch in length and rather less in breadth. They usually appear to be dark grey in colour, but when freed from the dust with which they are covered are seen to be dark brown, and then the characteristic markings on the surface of the seed become more evident. In shape they are usually irregularly or obscurely four-sided, one side being curved and larger than the others, which are nearly flat or even depressed. The surface of the seed is more or less uniformly reticulate and entirely covered, both as to elevations and depressions, with minute papillæ which are visible when the seed is examined with a lens. One

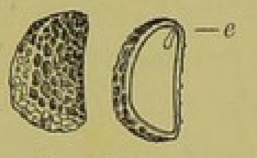


FIG. 61.—Stavesacre seed, entire and cut longitudinally, showing embryo, *e*. Magnified 2 diam. (Maisch.)

end of the seed is usually more pointed than the other; near the pointed end the hilum is visible as a narrow line. By soaking a seed in water and cutting it transversely just below the hilum, the minute embryo may be found embedded in a large whitish or often yellowish oily endosperm.

The seed-coat is nearly tasteless, but the endosperm is intensely bitter and acrid; the seeds have no marked odour.

The student should observe

(*a*) The *dull earthy colour of the seed,*
(*b*) The *characteristic obscurely quadrangular shape,*
(*c*) The *rough as well as pitted surface.*

Constituents. — The principal constituents of stavesacre seeds are the alkaloids that they contain. Four have been described, viz. *delphinine*, *delphinoidine*, *delphisine*, and *staphisagrine.*

Delphinine and delphinoidine are the most important; they resemble one another in physiological action, and constitute the major part of the total amount (about 1 per cent.) of alkaloid present. Delphinine is crystalline; delphinoidine is amorphous.

Staphisagrine is probably a mixture of several bases.

In addition to these alkaloids, stavesacre seeds contain about 20 to 25 per cent. of *fixed oil.* This oil, when extracted by solvents such as petroleum spirit, ether, &c., retains dissolved in it a considerable proportion of alkaloid, especially delphinine, and shares therefore the physiological action of the seed.

Uses.—Stavesacre seeds are extremely poisonous, delphinine and delphinoidine resembling aconitine in action, but being weaker; the seeds are used only as a parasiticide to kill pediculi, chiefly in the form of the official ointment, the expressed oil, or the powdered seeds.

BLACK MUSTARD SEEDS

(Semina Sinapis Nigræ)

Source &c.—The black mustard plant, *Brassica nigra*, Koch (N.O. *Cruciferæ*), an erect annual plant attaining a height of 3 feet or more, is doubtfully a native of this country, although found apparently wild. It is now largely cultivated for the sake of its seed in *England*, *Holland*, Italy, Germany, and many other countries. The fruits are smooth, erect, appressed siliquas, which dehisce, when ripe, by both sutures, disclosing about ten or twelve minute dark seeds. These are separated when ripe, and dried.

Description.—Black, or, as they are sometimes termed, brown or red, mustard seeds are of a dark reddish-brown or greyish-brown colour, sometimes nearly black, and are frequently partially covered with a very thin whitish membranous coat. They are very small, being only about $\frac{1}{25}$ inch in diameter (from fifty to sixty weighing a grain), and are nearly spherical or flattened-ovoid in shape. Under the lens the surface appears

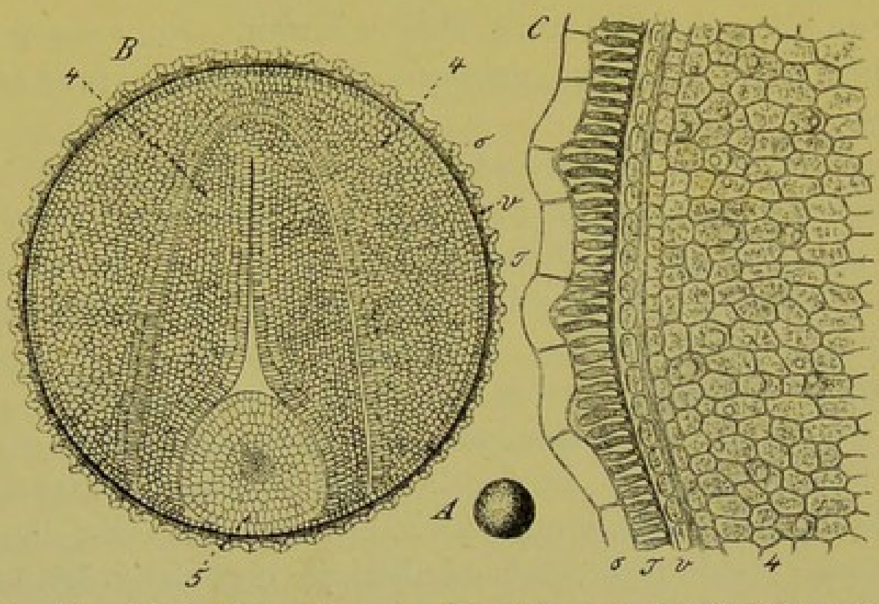


Fig. 62.—Black Mustard seed. *A*, entire seed, magnified 3 diam. *B*, transverse section, magnified 65 diam.: 4, 4, the two cotyledons; 5, the radicle. *C*, portion of the same, further enlarged: σ, epidermis containing mucilage. (Berg.)

minutely pitted, and the hilum can be distinguished as a paler point.

Although the seeds are hard, the seed-coats are thin and brittle. The kernel is greenish-yellow and oily, and consists of the two folded cotyledons embracing the small radicle. The position of cotyledons and radicle can be well seen by cutting a seed in halves midway between the hilum and the apex. After the seed has been soaked in water, during which it surrounds itself with mucilage, the seed-coats can be easily removed, disclosing the cotyledons folded over and incumbent upon the radicle. No endosperm being present, the seeds are termed exalbuminous.

Black mustard seeds, even when powdered, have no marked odour. The taste is at first bitter, but rapidly becomes strongly pungent, and although the dry seeds are almost inodorous they develop, when moistened with water, a volatile substance of extreme pungency that rapidly attacks both the nostrils and the eyes. This volatile substance is not, however, developed if the seeds have been previously thrown into boiling water.

The student should observe

(*a*) The *minute size and spherical shape*,

(*b*) The *pitted surface*,

(*c*) The *incumbent and folded cotyledons*, as exhibited by seeds that have been cut transversely, or that have been soaked in water and divested of their seed-coats,

(*d*) The *pungent taste*;

and should compare these seeds with colchicum seeds, which are larger, rougher, harder than black mustard, and have a bitter, not pungent, taste.

Constituents.—The kernel of black mustard seeds contains about 33 per cent. of *fixed oil*, which can be obtained from the seed by crushing and pressing. In the seed-coat (in the cells of the epidermis) there is *mucilage*, which dissolves when the seeds are soaked in water. The seeds contain in addition two substances, *sinigrin* and *myrosin*, which, by interaction in the presence of water, yield the volatile pungent body previously referred to; the latter is not a constituent of the seed, but is produced only from two of its constituents under certain conditions.

Sinigrin (also called potassium myronate) is a definite crystalline glucoside that can be extracted from black mustard seed by boiling with strong alcohol. Myrosin is an enzyme—that is to say, an unorganised ferment, capable, under suitable conditions of temperature &c., of inducing certain decompositions in other substances. When myrosin is added to an aqueous solution of sinigrin, allyl isosulphocyanide, potassium acid sulphate, and dextrose are formed. The following equation represents the reaction that takes place:

$$C_{10}H_{16}KNS_2O_9 + H_2O = C_3H_5CSN + C_6H_{12}O_6 + KHSO_4$$

This reaction does not, however, take place in the seed, since the myrosin and sinigrin are stored up in separate cells.

$C_{10}H_{18}NKS_2O_{10}$

isothiocyanate

Allyl isosulphocyanide, or volatile oil of mustard, is a mobile volatile liquid with an extremely pungent odour and taste, and is the body to which the pungent odour and taste of black mustard seeds (after crushing and moistening with water) are due. The power of the myrosin to effect this decomposition is destroyed by boiling water, and the seeds therefore that have been subjected to such treatment do not develop allyl isosulphocyanide when treated with cold water.

The cake that is left after the fixed oil has been expressed from the seed contains both the sinigrin and the myrosin. It is from this cake that volatile oil of mustard is usually prepared by crushing it, macerating it in water for several hours, and distilling; a mobile liquid collects on the surface of the distillate, and this, after redistillation, constitutes volatile oil of mustard.

The same body can also be produced artificially by decomposing allyl iodide with potassium sulphocyanide; allyl sulphocyanide is formed, which on distillation is converted into the isomeric, pungent allyl isosulphocyanide.

The seeds yield about 0·5 to 0·8 per cent. of volatile oil. Many plants belonging to Cruciferæ and some belonging to other natural orders yield under similar conditions a similar volatile oil, sometimes, apparently, associated with other allyl compounds. In some cases the presence of sinigrin has been proved; in other cases it is assumed.

Starch, which is present in unripe mustard, is not found in any of the cells of the ripe seed.

Uses.—Applied externally, black mustard acts as a rubefacient and nervous stimulant; this effect is followed by loss of sensibility in the part, and consequently relief from previous pain. Prolonged action may result in vesication. Internally, mustard is used as a condiment, and in full doses as an emetic.

WHITE MUSTARD SEEDS

(Semina Sinapis Albæ)

Source &c.—*Brassica alba*, Boiss. (N.O. *Cruciferæ*), the white mustard, is cultivated like the black mustard, which it closely resembles, but not to so large an extent. It differs from the black mustard in producing more or less horizontal hairy fruits, those of the black mustard being erect, appressed, and smooth. Each fruit contains from four to six seeds.

Description.—White mustard seeds are yellow in colour and nearly spherical in shape; they are distinctly larger than the black, measuring about $\frac{1}{12}$ inch in diameter, and weighing about $\frac{1}{10}$ grain. The seed-coat is very minutely pitted, the pits being so small that the seed appears smooth until examined with a lens. Internally the seed is yellow, and the oily kernel consists, as that of the black mustard seed does, of the two folded cotyledons embracing the small radicle; the seed becomes coated with mucilage when soaked in water, and can afterwards be easily deprived of its seed-coats.

White mustard seeds, either whole or powdered, are almost inodorous, and, unlike black mustard seeds, remain inodorous when triturated with water. They have, nevertheless, a pungent taste.

The student should soak some white mustard seeds in water, remove the seed-coats, and observe the cotyledons and radicle, noting that the seed is exalbuminous; he should also crush the seeds, moisten them with water, and note that the taste is pungent, but the odour is not.

Constituents.—White mustard seeds contain a *fixed oil* (about 23 per cent.) and *mucilage* (in the epidermis of the seed-coat). Starch is not present in the ripe seeds.

They contain, in addition, a crystalline glucoside, *sinalbin*, and the same enzyme ferment as is found in the black mustard seed—viz. *myrosin*. Under the influence of myrosin, and in the presence of water, sinalbin yields acid sinapine sulphate, dextrose, and acrinyl sulphocyanide. The decomposition may be represented by the following equation:

$$\underset{\text{Sinalbin}}{C_{30}H_{42}N_2S_2O_{15}} + H_2O = \underset{\text{Acrinyl sulphocyanide}}{C_7H_7O,CNS} + \underset{\text{Dextrose}}{C_6H_{12}O_6} + \underset{\text{Acid sinapine sulphate}}{C_{16}H_{24}NO_5HSO_4}$$

Of these three substances, acrinyl sulphocyanide is a yellow oily liquid with a pungent taste and powerful rubefacient action; but as it is not volatile it is destitute of pungent odour or pungent effect on the eyes. In this particular the pungent principle obtained from white mustard differs essentially from that yielded by black, and since this principle is not volatile, it is evident that volatile (or essential) oil of mustard can be obtained only from the black. It is very remarkable, considering the close relationship of the two plants and similarity in other constituents, that white mustard should contain no sinigrin and black no sinalbin.

Black mustard is said to be frequently deficient in myrosin, whilst white mustard contains an excess; ~~by mixing the~~ powder of the two seeds the whole of the sinigrin is decomposed as well as all the sinalbin, and the maximum of pungency is developed. Hence the official 'Mustard' is a mixture of both black and white mustard.

Uses.—White mustard possesses rubefacient and vesicant properties similar to those of black mustard.

LINSEED

(Flax Seed, Semina Lini)

Source &c.—The flax plant, *Linum usitatissimum*, Linn. (N.O. *Lineæ*), is a tall erect annual, spread by cultivation over *all temperate and tropical regions.* Not only has the plant been known and cultivated for so many centuries that its geographical origin cannot be identified, but the use of its fibre can be traced back to the thirteenth or fourteenth century before the Christian era. Flax seeds, as well as cloth woven from flax, have been found in Egyptian tombs, and the process of weaving is depicted on their buildings. The seeds were used as a food; the medicinal use of the mucilage and the value of the oil contained in them appear not to have been known till later.

The flax plant bears a small globular capsular fruit containing ten seeds; these are separated when ripe.

Description.—The seeds are commonly dark brown in colour, smooth and shining. They are of an elongated ovoid outline and much compressed so that an acute edge is formed; in length they vary from $\frac{1}{6}$ to $\frac{1}{4}$ inch. One end of the flax seed is rounded, but the other has an oblique point, on one side of which, just below the apex, is a slight depression. In this depression both hilum and micropyle are situated, the seed being anatropous. The surface of the seed is glossy and appears smooth to the naked eye, but is seen under a lens to be minutely pitted.

Cut transversely and examined under a lens they exhibit a yellowish-white oily kernel consisting of two large cotyledons surrounded by a narrow endosperm, the latter not being always distinctly visible. Soaked in water they become covered with mucilage, which gradually dissolves, the seeds at the same time losing their glossy appearance. They have but a slight odour, and an oily mucilaginous taste.

Both in colour and size linseed exhibits notable variations according to its source. As a general rule, warm climates yield larger and paler seeds than cold climates.

The student should observe

(*a*) The *glossy pitted surface*,
(*b*) The *mucilage extracted by water*,
(*c*) In the transverse section the *two oily cotyledons* and *narrow endosperm* (under a powerful lens).

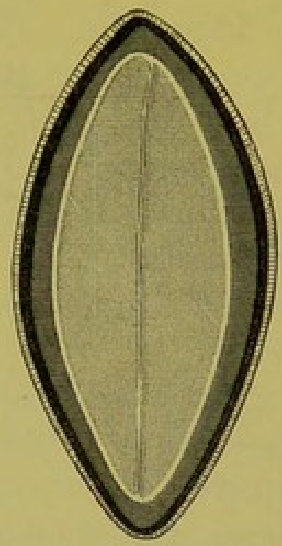


Fig. 63.—Linseed. Transverse section, showing the seed-coats, endosperm, and cotyledons. Magnified. (Moeller.)

Constituents.—Linseed contains from 30 to 40 per cent. of *fixed oil*, about three-fourths of which can be extracted by pressure. The epidermis of the seed-coat contains *mucilage*, which, together with the *proteids* present in the seed and part of the oil, are left in the cake obtained when the seeds are pressed. It is the presence of oil, proteid, and carbohydrate (mucilage) in the cake that renders it valuable as a cattle food. Unripe seeds contain numerous small starch grains, but the ripe seeds are free from starch.

Uses.—Linseed is used externally, in the form of crushed linseed, to convey heat and moisture to certain parts, or internally as a demulcent infusion containing a large quantity of mucilage.

Crushed linseed, Linum Contusum, B.P., consists of the seeds reduced to a coarse powder without being deprived of any part of their constituents. It should, when mixed with water, have a bland, not pungent or rancid odour. Many cruciferous seeds, if present, would yield a pungent odour, whilst stale crushed linseed becomes rancid. It should yield not less than 30 per cent. of oil, indicating the absence of ground cake left after removal of part of the oil. It should not give the characteristic reactions with the tests for starch, nor leave, when incinerated, more than 5 per cent. of ash (absence of added starch and undue proportion of mineral matter).

COLA SEEDS

(Semina Colæ)

Source &c.—Cola seeds, sometimes called Cola or Kola nuts, Gooroo nuts, or Bissy nuts, are obtained from *Cola acuminata*, Schott and Endl. (N.O. *Sterculiaceæ*), a large and handsome tree resembling in habit the Spanish chestnut. It is a native of *tropical Africa*, but is cultivated in other tropical countries, such as the West Indies, Brazil, Java, &c., our supplies being derived either from the west coast of Africa or from the West Indies.

The woody capsular fruit of the tree contains from five to fifteen large white or crimson seeds which are removed and deprived of their seed-coats, the kernels only being used. These are chewed whilst still fresh, either before or after germination, and have been highly valued by the negroes for many centuries for their stimulating properties, in which they resemble tea, coffee, cocoa, &c.

Large quantities of the seeds are collected and consumed by the natives, who also carry on a considerable trade in them. Packed in baskets with the leaves of the cola tree they can be kept fresh, and in this state are brought chiefly to Timbuctoo, whence they are distributed to other parts of Africa. They are also occasionally exported in this state, but more commonly the kernels are separated into the two large fleshy cotyledons and dried, during which the white or crimson colour changes to a dull reddish brown.

Description.—Dried cola seeds, as commonly seen in this country, consist of the kernels only of the seeds, entire if they are of small size, but separated into the two cotyledons if large. Externally, they have a dull dark-brown or reddish-brown colour; internally they are usually somewhat paler. They are hard and solid, and exhibit, when cut, no particular structure. They vary in length from about $\frac{3}{4}$ inch to 2 inches, and are rather less in breadth and in thickness. In shape, too, they exhibit considerable differences, being frequently flat on one side and curved on the other, or wedge-shaped (like a Brazil nut) or irregularly six-sided.

A shallow furrow encircles the kernel, dividing it into two cotyledons; transverse to this furrow at one end of the seed a distinct cleft may be found, partially separating each cotyledon into two portions. Complete kernels may easily be separated into their constituent cotyledons, and the small radicle will be found towards the bottom of this transverse cleft.

The seed is said to contain occasionally three or even four cotyledons; this is, however, by no means the rule.

Fresh cola seeds have a bitterish astringent taste, which is scarcely perceptible in the dry seed; the latter are also destitute of any marked odour.

The student should observe

(*a*) The *two large fleshy cotyledons* and *small radicle*,
(*b*) The *absence of seed-coats*, the drug consisting of the *kernel only*.

Constituents.—The principal constituent of cola seeds is the alkaloid *caffeine*, of which they yield from 1 to 2 per cent.; they contain also a little *theobromine* and *tannin*, the latter yielding by oxidation kola-red, a change to which the reddish-brown colour of the dried seed is due.

The assertion has been made (Knebel, 1894) that the fresh seeds contain a glucoside, kolanin, which by the action of certain ferments or of dilute mineral acids yields caffeine, kola-red, and dextrose. The existence of kolanin as a homogeneous substance is, however, doubted (Dieterich, Knox, and Prescott); it is probably a tannate of caffeine and theobromine.

Uses.—Cola seeds have properties similar to those of tea, coffee, &c.; they are used as a nerve stimulant, to prevent fatigue &c.

Substitutes.—The seeds of a species of *Cola* named by M. Cornu *C. Ballayi*, sent from the Gaboon, have been offered as cola seeds; the seed has six cotyledons, and, as it contains very little caffeine, should be rejected.

Other seeds have from time to time been substituted for cola seeds, but the genuine are easily distinguished by the characters given.

COCOA SEEDS

(Semina Theobromatis)

Source &c.—The cocoa tree, *Theobroma Cacao*, Linn. (N.O. *Sterculiaceæ*), is a native of *tropical America*, and is cultivated there as well as in other tropical countries, such as *Java, Ceylon*, the *West Indies*, &c.

The seeds had without doubt long been an important article of diet to the Mexicans when they were conquered by the Spaniards. Their use soon spread to Spain and thence over Europe.

The flowers of this tree are small, and spring directly from the trunk; they are succeeded by large orange or deep red fruits of the shape of a small pointed vegetable marrow and some 6 or 8 inches in length. Each fruit contains about forty or fifty nearly colourless fleshy seeds embedded in a scanty mucilaginous pulp. The seeds are separated and packed in boxes, in which they undergo a process of fermentation, considerable heat being developed; they are then dried in the sun. During these processes the seeds acquire a reddish-brown colour, and the taste, which at first is astringent and bitter, becomes mild and oily.

Sometimes the seeds are simply freed from the pulp and dried in the sun; they have then a more astringent and bitter taste and are less valuable.

Description.—Cocoa seeds, as they occur in commerce, are about an inch in length and of a flattened-ovoid shape. The seed-coat is reddish- or chocolate-brown in colour, thin and brittle. It can easily be separated from the kernel, which consists mainly of two irregularly folded, chocolate-coloured cotyledons; the latter are so brittle that they easily separate into small angular fragments (cocoa nibs of commerce) which have a mild, agreeable oily taste.

Constituents.—Both the kernels and the shells contain the alkaloid *theobromine*, the former yielding as much as 2 per cent., the latter about 1 per cent. The kernels contain, further, about half their weight of *solid fat*, which is obtained as a bye-product in the manufacture of cocoa essences and chocolate by submitting the heated seeds to strong pressure. It is official in the British Pharmacopœia under the name of Oleum Theobromatis.

Uses.—Cocoa is largely used as a more nutritious and less stimulating beverage than tea or coffee. Its principal active constituent, theobromine, has an action similar to, but stronger than, that of caffeine.

GUARANA

(Pasta Guarana)

Source &c.—The drug known as guarana is prepared from the seeds of *Paullinia Cupana*, H.B. & K. (N.O. *Sapindaceæ*), an elegant climbing shrub indigenous to and common in *Brazil* and *Uruguay*. The difficulty of collecting the seeds from the wild plants, which though common are not easily accessible, has apparently led to their cultivation. They are planted as vines are in a vineyard and trained to poles like hops. When the pods open to discharge the ripe seeds they are collected, and the seeds, which resemble small horse-chestnuts in shape and colour, are separated by shelling. They are first washed and then roasted to loosen them from a papery shell, from which they are freed by beating. The broken kernels are made into a dough with water; this is then divided into masses of varying size and shape, which are finally dried at a gentle heat by means of a slow fire. From the hard mass thus obtained portions are grated off with a large file and served in glasses of water, forming a refreshing drink.

Description.—Guarana commonly appears on the market in the form of extremely hard, heavy, sausage-shaped masses, varying from 4 to 12 inches in length and from 1 to 1½ inch in thickness. The outer surface is dark chocolate brown in colour, and would be smooth and uniform were it not that small angular fragments, often of lighter colour than the rest, project slightly; these fragments are evidently the larger pieces of the broken seed. The fractured surface, smoothed with a knife, is reddish in colour, and exhibits, like the outer surface, small paler irregular fragments embedded in a darker reddish mass, but no definite structure is discernible. The powder, in which form the drug is administered, is of a pale red colour; it has a scarcely perceptible odour and slightly astringent bitter taste.

The student should observe

(*a*) The extremely *hard heavy masses* in which the drug occurs,

(*b*) The presence of *small fragments* embedded in them.

Constituents.—Guarana contains from 2·5 to nearly 5 per cent. of *caffeine*, together with a little *tannin* (catechu-tannic acid). There is abundance of starch present also, but only a little fat.

Adulteration.—The detection of foreign substances in such a drug as guarana is attended with considerable difficulty. The amount of caffeine should not be less than 2·5 per cent. Microscopical examination has shown the presence of the seed-coats, which therefore are only imperfectly separated, and frequently of foreign starches; the latter, according to Schär (1897), are regularly present. Thoms (1894) found in guarana 8·63 per cent. of moisture, 1·68 per cent. of ash, and 2·68 per cent. of caffeine, the seeds themselves yielding closely concordant figures.

Uses &c.—Guarana is employed as a nervine stimulant in the same way that tea and coffee are, and produces similar effects. It has been long in common use in Brazil.

TONCO BEANS

(Semina Tonco)

Source &c.—Tonco or, as they are sometimes called, tonka or tonquin beans are the seeds of two species of Dipteryx (N.O. *Leguminosæ*), viz. *D. odorata*, Willdenow, and *D. oppositifolia*, Willdenow, both trees of considerable size, the former a native of Guiana, the latter of Brazil.

The tree produces an indehiscent drupaceous fruit about the size of an egg, with a fibrous pericarp containing a single seed; these are separated when ripe, and dried. Sometimes they are placed upon the market without further treatment, but large quantities are brought from South America to Trinidad, where they are prepared for the European and American markets. This preparation consists in steeping them in rum and spreading them on floors to a depth of 9 or 12 inches, by which a white crystalline crust is produced on the surface of the seeds. Two varieties of seeds are therefore to be found in commerce, viz. with and without a crystalline crust, the former being distinguished as 'frosted.'

Description.—Tonco beans closely resemble a Jordan almond in size and shape; they are usually rather longer, averaging from 1¼ to 1½ inch in length, and differ from the almond in having a very dark, nearly black, coarsely wrinkled surface which, in the frosted seeds, is covered with minute whitish crystals. The beans are rounded at one extremity, but terminate at the other in a broad flat point, just below which on the obtuse margin of the seed the micropyle may easily be discerned as a brownish scar. Internally they are dark yellow, yellowish brown, or nearly black, and consist of two large oily cotyledons, without endosperm, enclosing a plumule with two folded leaves and a short thick radicle directed towards the micropyle, which is situated on the flattened extremity of the seed near the hilum.

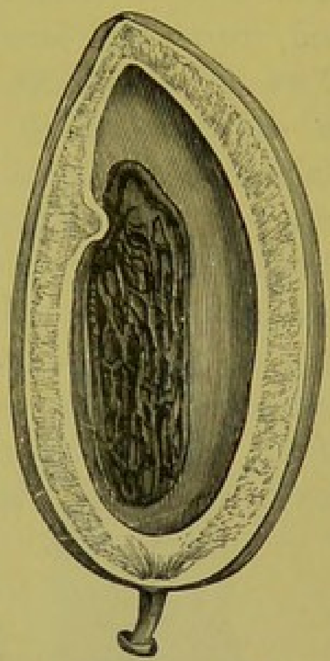


FIG. 64.—Tonco Bean. Fruit cut vertically, showing the seed. (Planchon and Collin.)

Tonco beans have a powerful and agreeably fragrant odour and an aromatic pungent taste.

Constituents.—The seeds owe their fragrance to a crystalline substance, *coumarin*, of which they may contain as much as 3 per cent. It is this body that in the frosted seeds has been induced to crystallise on their surface and thus imparts to them their frosted appearance. It has been isolated from a variety of plants belonging not only to Leguminosæ, but several other natural orders, especially Gramineæ and Orchideæ. Cherry wood (*Prunus Mahaleb*, Linn.), woodruff (*Asperula odorata*, Linn.), and melilot (*Melilotus officinalis*, Desv.) owe their pleasant aroma to this substance.

Uses.—Tonco beans find their principal use in perfumery; they are frequently mixed with vanilla beans in the preparation of extract of vanilla.

CALABAR BEANS

(Semina Physostigmatis)

Source &c.—Calabar beans are the ripe seeds of *Physostigma venenosum*, Balfour (N.O. *Leguminosæ*), a woody climbing plant indigenous to the *west coast of Africa*, especially near the mouths of the Old Calabar and Niger rivers. It ascends trees and, drooping down, bears pendulous racemes of flowers. These are succeeded by legumes about 6 or 7 inches in length, in each of which two or three large seeds are contained. Calabar beans have long been used on the west coast of Africa as a test to demonstrate the guilt or confirm the innocence of suspected criminals or witches. The accused was compelled to swallow the crushed seeds mixed with water: if he succumbed to the poison, his guilt was considered proved; hence they were termed 'ordeal' beans. They became known in England in 1840; their power of contracting the pupil of the eye was discovered by Fraser in 1862.

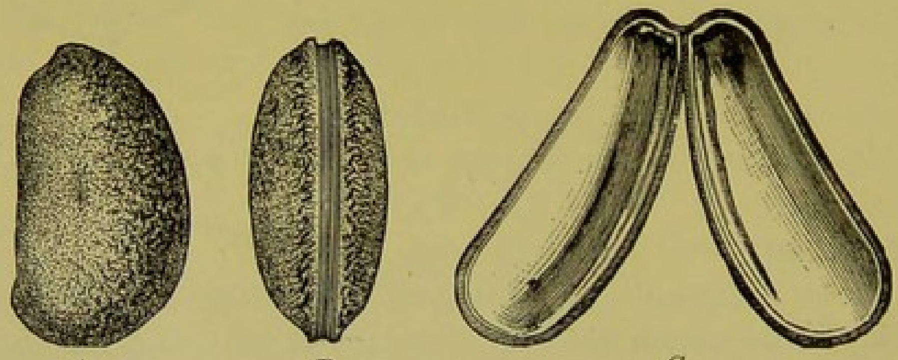


Fig. 65.—Calabar Bean. *A*, side view, showing the sub-reniform shape. *B*, edge, showing the long hilum. *C*, Seed split open, showing the concave cotyledons. (Maisch.)

Description.—Calabar beans are dark reddish brown or chocolate brown in colour and of considerable size, averaging about 1 inch in length, ¾ inch in breadth, and ½ inch in thickness. They are usually oblong-reniform in shape, being nearly flat or only slightly convex on one side, but boldly curved on the other. Along nearly the entire length of the curved side, and passing completely round one end of the seed, runs a broad deep groove, the lips of which are thickened and paler in colour, and the bottom of which is black and bears a distinct fine brown furrow in its centre. This deep groove is the hilum, and in it may frequently be found portions of a white papery funiculus; at one end a minute depression (the micropyle) can be detected.

The outer seed-coat (testa) is hard and thick, and appears nearly smooth to the naked eye, but under the lens is seen to be rather rough. After the seeds have been well soaked in water they can easily be split longitudinally, and exhibit then two firm white starchy cotyledons, which are curved so as to include between them a large lenticular cavity filled with air; this enables the seed to float when thrown on the surface of water. Near the micropyle is the small white radicle attached to one of the cotyledons; there is no endosperm.

The seeds have no marked odour or taste beyond those of an ordinary bean; they are nevertheless extremely poisonous.

The student should observe

(*a*) The *reniform* (not cylindrical) *shape*, and the *hilum passing round one end of the seed*,

(*b*) The *white cotyledons* and *small radicle* directed towards the micropyle.

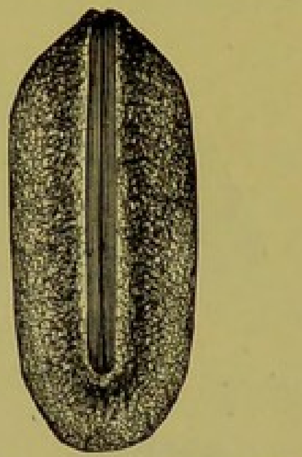


FIG. 66.—Seed of *Physostigma cylindrospermum*, showing the shorter hilum. (Maisch.)

Constituents.—Calabar beans contain a small proportion (0·25 per cent.) of a crystalline alkaloid, *physostigmine* (also called eserine, from 'esere,' the native name for the bean); it is present in the cotyledons only, the seed-coats being free from it.

Three other alkaloids of minor importance have been reported as constituents of the Calabar bean, viz. calabarine (Hartnack and Witkowski, 1876), eseridine (Eber, 1888), eseramine (Ehrenberg, 1894).

Substitutes.—The only substitute bearing any resemblance to the Calabar bean is the seed of *P. cylindrospermum*, Holmes, which was imported in 1879. The seeds are, as the specific name of the plant indicates, nearly cylindrical (instead of subreniform), and the hilum is shorter; they are said to contain physostigmine. Other seeds, such as those of *Mucuna urens*, DC. (horse-eye beans) and of *Entada scandens*, Benth., are occasionally offered as Calabar beans, for which, however, it would be impossible to mistake them.

Uses.—Calabar beans are chiefly used as a source of the alkaloid physostigmine, which is much employed to produce contraction of the pupil of the eye.

FŒNUGREEK SEEDS

(Semina Fœni-græci)

Source &c.—Fœnugreek, *Trigonella Fœnum-græcum*, Linn. (N.O. *Leguminosæ*), is an annual herb indigenous to the countries bordering on the eastern shores of the Mediterranean and largely *cultivated in India, Egypt, and Morocco.* It was well known to the ancients, who used the herb as cattle fodder and employed the seeds medicinally. Even the modern Egyptians roast and eat the seeds, whilst in India the young shoots form a favourite vegetable. In England the seeds are chiefly used in veterinary practice. They are contained in long, narrow, sickle-shaped pods, from which they are separated, when ripe, by thrashing. Our supplies are derived chiefly from Mogadore and Bombay.

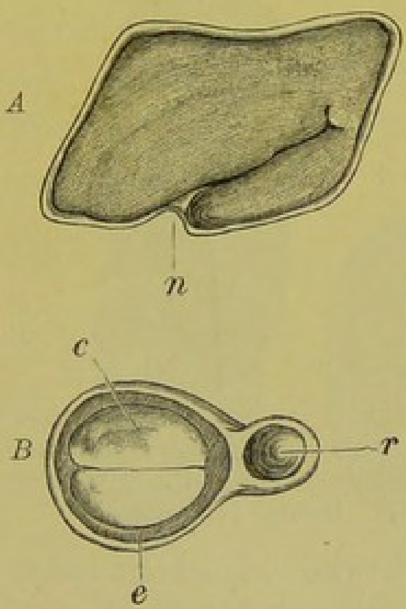


Fig. 67.—Fœnugreek seed. *A*, vertical section, showing the radicle, one of the cotyledons, and hilum, *n*. *B*, transverse section, showing the radicle, *r*; both cotyledons, *c*; and endosperm, *e*. Magnified. (Moeller.)

Description.—Fœnugreek seeds are small and hard, and although they vary somewhat in colour they are usually brownish-yellow. The average length of well-developed seeds is about $\frac{3}{16}$ inch, and they are about half as wide as they are long. They are flattened and have a very characteristic rhomboidal outline. Nearly in the centre of one of the long narrow sides is a small depression in which both hilum and micropyle are situated, the former being distinctly visible as a whitish point; this depression is continued in the form of a furrow running diagonally across part of each of the adjoining sides, thus dividing the seed into two unequal lobes. If the seed is cut in a direction transverse to the side in which the hilum lies, so as to pass through both lobes of the seed (fig. 67, *B*), it will be found that the larger lobe contains two accumbent cotyledons—the smaller, the radicle; both are yellowish in colour and surrounded by a darker, horny translucent endosperm, which also separates the radicle from the cotyledons. Soaked in water the endosperm swells and yields mucilage to the surrounding liquid. Entire seeds macerated in warm water burst their seed-coats by the swelling of the mucilage, and disclose the structure of the seed. (Compare fig. 67, *A*.)

The odour of fœnugreek, especially if powdered, is strong and characteristic; the taste is disagreeable.

The student should observe

(*a*) The characteristic *shape*,
(*b*) The *cotyledons*, *radicle*, and *endosperm* (in transverse section),
(*c*) The characteristic *odour*.

Constituents.—Fœnugreek contains 28 per cent. of *mucilage*, which resides in the endosperm, not, as in the case of mustard and linseed, in the seed-coats. It contains, further, about 22 per cent. of *proteids*, 6 per cent. of *fixed oil*, and two alkaloids, *trigonelline* and *choline*, the latter being a frequent constituent of both animal and vegetable substances.

Uses.—The seeds are now chiefly used in veterinary medicine.

SWEET ALMONDS

(Amygdala Dulcis)

Source &c.—The sweet almond is the seed of the sweet almond tree, *Prunus Amygdalus*, Stokes, var. *dulcis*, Baillon (N.O. *Rosaceæ*). The tree is a native probably of Persia and Asia Minor, but is cultivated in all the countries that border on the *Mediterranean*, and produces ripe fruit even in the south of England. The seeds—almonds—as well as the oil pressed from them, were well known in Greece and Italy long before the Christian era; during the middle ages they became an important article of commerce in Central Europe.

The almond tree produces in early spring handsome pink flowers, which are succeeded by green velvety drupaceous fruits about the size of a plum, but differing from it in possessing a firm, felt-like mesocarp. As the fruit ripens the mesocarp gradually dries, splits, and falls away (or is easily removed), carrying the thin epicarp with it, and leaving the seed enclosed in the endocarp or shell attached to the tree. Sometimes almonds are exported enclosed in their endocarps (almonds in the shell), but more frequently the shells are broken and the seeds alone exported.

Sicily and southern Italy are the chief almond-producing countries. Spain, Portugal, and the south of France also export considerable quantities.

Description.—The endocarp or shell of the almond is yellowish buff in colour and flattened-ovoid in shape, the outer surface being usually pitted with small holes; frequently it has a more or less fibrous nature. Sometimes it is thin and friable (soft-shell almonds), sometimes extremely hard and woody (hard-shell almonds). The seed varies a little in shape according to the variety, Valencia almonds being rather broadly ovoid, whilst Jordan almonds, the only official variety, are longer and narrower. Both varieties are rounded at one end, pointed at the other, and covered with a thin, brown, scurfy seed-coat. The hilum is long, and situated on the acute edge of the seed near the pointed end; the raphé is distinguishable as a dark line running from the hilum to the broad end of the seed, where it terminates in a dark spot, the chalaza, from which a number of veins radiate.

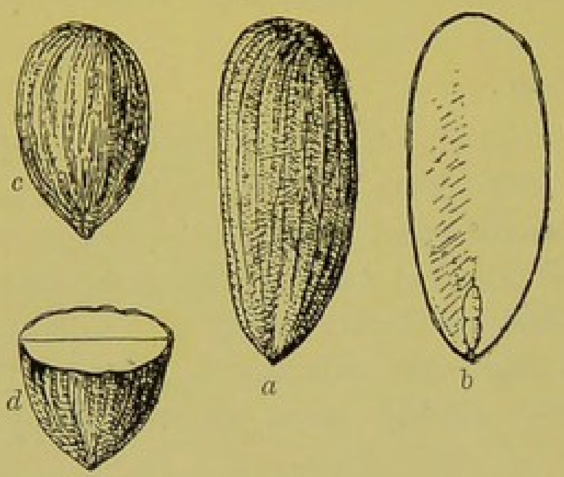


FIG. 68.—Almond. *a*, Sweet Almond; *b*, same, cut longitudinally. *c*, Bitter Almond; *d*, same, cut transversely. Natural size. (Holmes.)

After maceration in water the thin seed-coat is easily separated; the kernel consists of two large plano-convex oily cotyledons, enclosing a small plumule and radicle. The seed is exalbuminous, there being no endosperm. Sweet almonds have a bland nutty taste, and yield, when triturated with water, a white emulsion that is destitute of any marked odour. The latter character is important, as it is the only definite one by which the sweet almond can be readily distinguished from the bitter.

The student should observe

(*a*) The *elongated shape* of the Jordan almond,
(*b*) The *thin seed-coats* and *two cotyledons without endosperm*,
(*c*) The *bland taste and odour* (of the emulsion).

Constituents.—Sweet almonds contain about half their weight of a bland *fixed oil*, which can be obtained by pressing the seeds, and about 20 per cent. of *proteids*, amongst which is included an enzyme ferment, *emulsin*.

Uses.—Sweet almonds are demulcent and nutritive. They do not contain starch, and have therefore been used for the preparation of a nutritive food for diabetic patients, to whom starchy foods are forbidden.

BITTER ALMONDS

(Amygdala Amara)

Source &c.—The bitter almond tree (*Prunus Amygdalus*, Stokes, var. *amara*, Baillon) is indistinguishable from the sweet by any permanent botanical character, and enjoys the same geographical distribution, although it is not cultivated to so large an extent. It is remarkable therefore that the seeds—bitter almonds—should invariably contain a constituent—amygdalin—that is never present in the seed of the sweet almond tree. The poisonous properties of the water distilled from the bitter almond (and the cherry-laurel leaf), due to the presence and subsequent decomposition of the amygdalin, have long been known ; it was the discovery of hydrocyanic acid in it that led to the recognition of the poisonous nature of this acid, which, curiously enough, had up till then (1802) escaped observation.

Bitter almonds are imported chiefly from *northern Africa*, from *Sicily*, and the *south of France*.

Description.—In form and appearance bitter almonds closely resemble the sweet, especially the Valencia, but they are usually smaller and less regular. They have, however, a bitter taste, and yield with water an emulsion easily distinguished from that of the sweet almond by its characteristic odour.

Constituents.—Bitter almonds resemble the sweet in containing both a *bland fixed oil* and *proteids*, the former of which is obtained by subjecting the seeds to heavy pressure. But they differ essentially from the sweet in containing a colourless crystalline glucoside, *amygdalin*, of which the sweet are entirely destitute. This substance is left in the cake obtained after the oil has been expressed, and can be extracted from it by digestion with alcohol. It is tasteless and odourless, but when an aqueous solution is mixed with an emulsion of sweet almonds a characteristic odour due to the presence of hydrocyanic acid and benzaldehyde becomes at once perceptible. These substances are produced by a decomposition of the amygdalin that may be represented by the following equation :

$$\underset{\text{Amygdalin}}{C_{20}H_{27}NO_{11}} + 2H_2O = \underset{\text{Dextrose}}{2C_6H_{12}O_6} + \underset{\text{Benzaldehyde}}{C_7H_6O} + \underset{\text{Hydrocyanic acid}}{HCN}$$

This change is effected by an enzyme ferment—emulsin—contained in the almond. The same ferment is also contained in the bitter almond itself, but, being localised in particular cells of the seed, is unable to act upon the amygdalin until the seeds are crushed and water added. When therefore bitter almonds, or the cake left after the oil has been expressed, are crushed and mixed with water, the characteristic odours of benzaldehyde and hydrocyanic acid are developed. If, after standing a few hours, the mixture is subjected to distillation, an oily liquid of strong bitter-almond odour is obtained, together with a quantity of watery distillate; the oil is volatile or essential oil of bitter almonds, and consists of benzaldehyde and hydrocyanic acid, partly in the free state and partly combined as benzaldehyde-cyanhydrin. It is, of course, extremely poisonous, on account of the hydrocyanic acid it contains. From this it can be freed by shaking it with milk of lime ; all the hydrocyanic acid, both free and combined, forms calcium cyanide. The addition of ferrous sulphate then converts the cyanide into ferrous ferrocyanide (Prussian blue), and the oil can be obtained free from hydrocyanic acid by redistilling in a current of steam. No benzaldehyde or hydrocyanic acid is developed by the sweet almond, because it contains no amygdalin.

Bitter almonds yield on an average 0·87 per cent. of volatile oil and 0·25 per cent. of hydrocyanic acid.

Many other rosaceous plants contain amygdalin, such as the peach, apricot, plum, &c., various species of *Sorbus*, *Cratægus*,

&c., not only in the seed, but also in the young shoots and flower-buds.

Amygdalin is closely allied to, but not identical with, laurocerasin, and is also distinct from a similar glucoside that occurs in the bark of *Prunus serotina*, Ehrh.

Uses.—Bitter almonds are sedative, but as the poisonous hydrocyanic acid yielded by them varies in quantity they are unreliable. They are also employed for flavouring, but they should for a similar reason be used with caution.

STROPHANTHUS SEEDS

(Semina Strophanthi)

Source &c.—The official strophanthus seeds are obtained from *Strophanthus Kombé*, Oliver (N.O. *Apocynaceæ*), a climbing plant of considerable size, indigenous to *eastern tropical Africa*, notably the valley of the Shiré river, the Nyanza district, and the Kombé country. An extract prepared from them (and possibly other species of strophanthus) is used in Africa as an arrow poison, specimens of which were sent to England in 1861–64 and recognised by Sharpey (1862) to contain a cardiac poison. The seeds were examined by Fraser (1885), who isolated the active principle strophanthin, and subsequently recommended the seeds as a substitute for foxglove.

The fruit of the plant consists of two follicles about 12 inches in length and 1 inch in breadth, slightly narrowed at the base and tapering at the apex. Each follicle contains, closely packed together, a large number of seeds provided with long awns. The fruits are collected when ripe, and are sometimes exported after having been freed from their epicarp and fleshy mesocarp. More commonly the seeds, separated from the fruits and deprived of their awns, are sent into commerce, being exported chiefly from Somba, Quilimane, Inhambane, and other east African ports.

Description.—These very beautiful seeds are remarkable for the long plumose awn of white silky hairs that is attached to them. The integuments of the seed are prolonged at the apex to a slender brittle extension, which is terminated by a handsome feathery tuft of hairs about 2 inches long and the same in breadth, the entire seed measuring about $3\frac{1}{2}$ to $4\frac{1}{2}$ inches in length. These awns are commonly removed before the seeds are exported, and commercial seeds measure only from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, and about $\frac{1}{6}$ inch in breadth. They are of an elongated oval shape, acuminate towards the apex, and narrowed towards the base, which is obtuse. They are flattened and provided on one side with a ridge running from the centre to the apex of the seed, and terminating in a broken point left by the removal of the awn. In colour they vary from greyish green to fawn; they are covered with silky appressed hairs that impart to them a conspicuous sheen.

The seeds break easily; the transverse section exhibits a white oily kernel consisting of two straight cotyledons surrounded by a narrow endosperm. The odour of the crushed seed is characteristic, though not very powerful; the taste is intensely bitter.

The student should observe

(*a*) The *colour of the seed* and the *silky hairs*,
(*b*) The *straight cotyledons* and *narrow endosperm*,
(*c*) The *green colour* produced when a section is touched *with strong sulphuric acid* (see below).

Constituents.—The active constituent of strophanthus seeds is the glucoside *strophanthin*, of which they are said to contain about 3·0 per cent. This substance is present in the endosperm, and frequently also in the cotyledons, and may be detected by the green colour which it yields in contact with strong sulphuric acid, a reaction which is observable when a section of the seed is moistened with the acid, and serves as a distinguishing feature of the official seeds.

The seeds contain, in addition, about 30 per cent. of fixed oil.

Although strophanthin has been the subject of numerous investigations, its composition and properties are not yet accurately known.

Uses.—Strophanthus is closely allied to digitalis in its action, and is used as a cardiac stimulant and diuretic in the same class of cases. It is a powerful and valuable remedy that has been employed in cases where digitalis has failed or disagreed.

Substitutes.—The official strophanthus have occasionally been mixed with or replaced by the following, which resemble them more or less closely.

1. *Strophanthus hispidus*, D.C.—These have a distinctly brown colour, and bear but few brownish hairs, that are usually short. The seed does not therefore possess the sheen that characterises the official seed. With sulphuric acid they yield a green colour. They are imported from West Africa.

2. *Strophanthus sp.*, White or Woolly Strophanthus.—The seeds are, as their names indicate, covered with white hairs that give to the seed an almost woolly and somewhat glossy appearance. The difference in the colour of the seed and the length of the hairs distinguishes this variety. It comes from the Gaboon, and gives with sulphuric acid a reddish colour. The seeds have been referred to *S. Nicholsoni*, Holmes.

3. *Strophanthus gratus*, Franchet.—The seeds of this plant are brown in colour and about the same size as the official seeds; they are easily distinguished, as they are quite glabrous, the surface being minutely pitted. With sulphuric acid both endosperm and cotyledons assume a reddish colour.

QUINCE SEEDS

(Semina Cydoniæ)

Source &c.—The quince is the fruit of *Pyrus Cydonia*, Linn. (N.O. *Rosaceæ*), a small tree indigenous to Persia, but distributed by cultivation throughout *central Europe* and other warm countries.

The fruit, which resembles a pear, contains five carpellary cavities, in each of which there are about twenty seeds closely packed in two vertical rows. These seeds are separated from the ripe fruit and dried, and, being coated with mucilage, they adhere together more or less firmly.

Description.—Quince seeds bear a general resemblance to apple pips. They are of about the same size, and of a similar mahogany-brown colour. By the mutual pressure to which they are subjected in the fruit, quince seeds, however, are distinctly flattened on the two larger sides, whilst of the two narrow sides or edges one is obtuse and boldly arched, the other only slightly curved and often provided with a distinct acute ridge. They frequently adhere firmly to one another in small irregular masses or in two more or less regular rows, being cemented together by dry mucilage, which is visible in

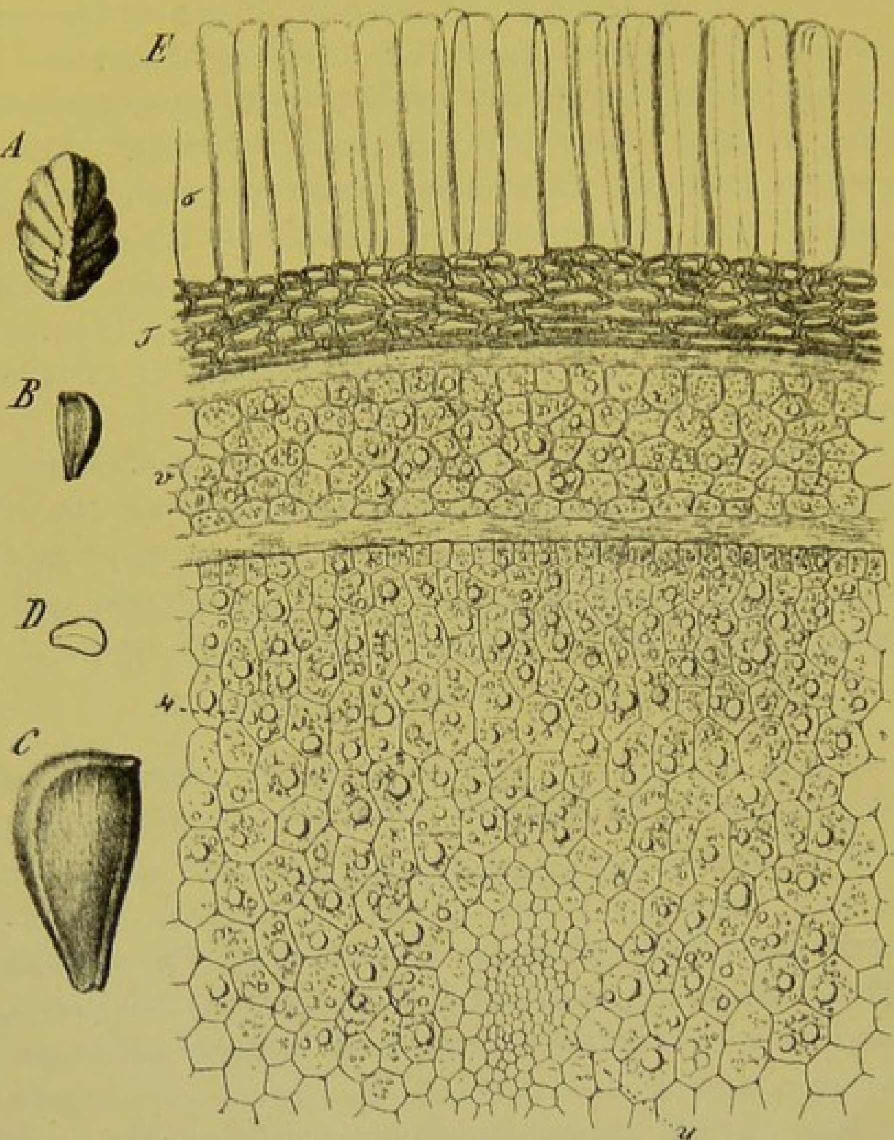


Fig. 69.—Quince seed. *A*, the seeds cemented together by mucilage, natural size. *B*, a single seed, natural size. *C*, the same, softened in water and magnified 3 diam. *D*, transverse section of *B*. *E*, portion of the same, magnified 190 diam.: σ, the epidermis, in which the mucilage is secreted; *v*, endosperm. (Berg.)

the form of whitish flakes on the surface of the seeds and in the interstices between them. This mucilage is derived from the cells of the epidermis of the seed-coat in which it is stored. (Compare fig. 69, *E*.)

The seeds are pointed at one end, where the hilum may be distinguished as a minute paler spot, and obtuse at the other (the chalazal extremity). Transverse sections through the seed, which is rather hard, exhibit two firm yellowish-white cotyledons with a very narrow endosperm. The kernel possesses a taste resembling that of bitter almonds, but much fainter. The seed-coats, when chewed, are simply mucilaginous.

The student should observe

(*a*) The *angular shape of the seed,*
(*b*) The *dry mucilage* which cements them together,
(*c*) The *taste of the cotyledons.*

Constituents.—The principal constituent of quince seeds is the *mucilage*, of which they are said to yield as much as 20 per cent. It is contained in the cells of the outer epidermis of the seed-coat, and swells and dissolves when the seeds are soaked in water. The seeds probably also contain a small proportion of amygdalin and of emulsin, or a ferment allied to it, since they evolve an odour resembling that of bitter almonds when they are crushed and mixed with water.

Uses.—Quince seeds have been employed as a demulcent, but are not now much used in this country.

NUX VOMICA

(Semina Strychni, Nux Vomica)

Source &c.—The nux vomica tree, *Strychnos Nux-vomica*, Linn. (N.O. *Loganiaceæ*), is a small tree indigenous to *India*, where it is widely distributed, and occurring also in *Ceylon*, *Siam*, and northern Australia. Notwithstanding the wide distribution of the tree, and the poisonous properties of the seeds, the Hindoos appear to have been unaware of its medicinal action. It was introduced into Europe in the sixteenth century, but was not much used in medicine, being chiefly employed to poison dogs, cats, crows, &c.

The ovary of the flower is two-celled, with numerous ovules in each cell, but the ripe fruit, which resembles an orange, is one-celled and contains usually from three to five seeds embedded in a bitter whitish pulp, which is, in part at least, derived from the dissepiment between the two cells. The seeds are washed free from adhering pulp and dried in the sun. They are exported from various Indian ports (Madras, Bombay, Cochin, Coconada, &c.).

Description.—The seeds have the shape of small discs, about $\frac{3}{4}$ to 1 inch in diameter and about $\frac{1}{8}$ to $\frac{3}{16}$ inch thick, of an ash-grey or greenish-grey colour, and possessing a distinct sheen. They are usually not quite flat, being a little depressed on one side and arched on the other, or sometimes irregularly bent so as to be less conspicuously disc-shaped.

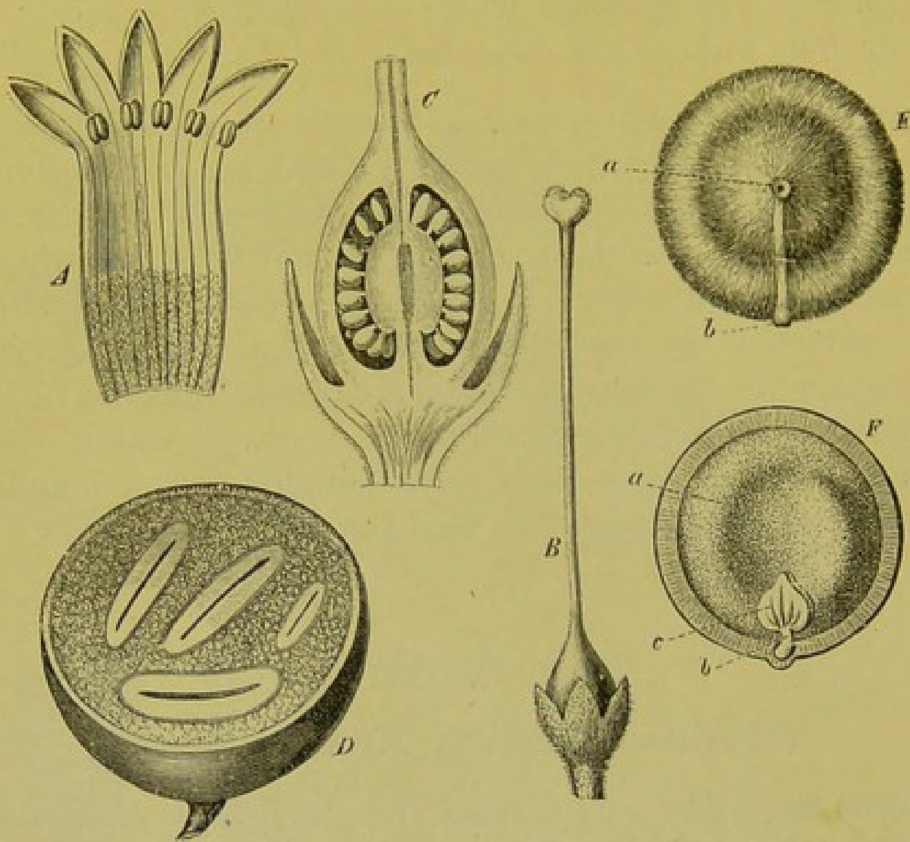


FIG. 70.—Nux Vomica. *A*, corolla opened, magnified. *B*, ovary with style, magnified. *C*, ovary cut longitudinally, more highly magnified. *D*, ripe fruit, cut transversely, showing seeds; reduced to about one-half. *E*, seed entire, natural size: *a*, hilum; *b*, micropyle. *F*, the same, cut vertically: *a*, endosperm; *b*, radicle; *c*, plumule. (Luerssen.)

They are covered with numerous closely appressed hairs radiating from the centre to the circumference; to the presence of these hairs is due the silky sheen of the seeds. The edge of the seed is sometimes rounded, sometimes acute, according to the variety of seed; at one point on the margin there is a distinct prominence (micropyle) from which a raised line passes to the centre of the seed. This line does not exist in the fresh seed, but makes its appearance during the drying; it has frequently been mistaken for the raphé. The hilum is in the centre of either the raised or depressed surface, and may be recognised by the scar left by the funicle.

The dry seed is hard and horny, but by soaking in water it softens, and can then be conveniently examined; it can easily be split into two thinner discs exhibiting the small embryo, consisting of a radicle and two leafy cotyledons embedded in a copious grey, translucent, horny endosperm.

The seeds are almost odourless, but have an intense and persistently bitter taste.

The student should not fail to observe

(*a*) The *characteristic shape* and *silky appressed hairs*,
(*b*) The *horny endosperm* and *small embryo*,
(*c*) The *bitter taste*.

Constituents.—The principal constituents of nux vomica are the two alkaloids *strychnine* and *brucine*, in addition to which they contain a small percentage of a glucoside, *loganin*, and an acid that has been termed igasuric acid, but is probably identical with *caffeotannic acid*.

The proportion of total alkaloid varies from 1·5 to 5·3 per cent., averaging in seeds of good quality about 2·5 to 3·0 per cent. This total alkaloid consists of strychnine and brucine in nearly equal proportions. Strychnine crystallises with facility in rhombic prisms, has an intensely bitter taste, and is extremely poisonous; brucine, which is also crystalline, is much less poisonous than strychnine; hence in the standardisation of preparations of this drug the Pharmacopœia directs the proportion of strychnine to be determined as distinct from total alkaloid, part of which would be brucine.

Uses.—Nux vomica is largely used as a bitter stomachic and tonic; it is also employed in chronic nervous diseases, in various forms of paralysis &c. In large doses it produces twitchings of the muscles, and in poisonous doses violent convulsions and death.

IGNATIUS BEANS

(Semina Ignatii)

Source &c.—Ignatius beans are the seeds of *Strychnos Ignatii*, Bergius (N.O. *Loganiaceæ*), a stout climbing plant with woody stem, indigenous to the southern *Philippine Islands*.

It became known to Europeans through a Jesuit, Father Camellus, towards the end of the seventeenth century, and the seeds were called Faba Sancti Ignatii, in honour of the founder of the order. The large ovoid fruit contains about twelve seeds embedded in a pulp, from which they are separated and dried. When fresh they are covered with whitish satiny hairs, resembling those of the nux vomica; these, however, are very easily rubbed off, and in the commercial drug are mostly lost, together with much of the thin seed-coats.

Description.—Ignatius beans are of a dull dark-grey colour, and vary considerably in shape. In general they have an irregularly ovoid outline, measuring about 1 inch in length and rather less in breadth and thickness. Frequently there is one large curved side and three or four smaller flattish surfaces with rounded angles, but some seeds are irregularly bluntly angular; they look, in fact, like a number of small stones. Here and there are patches of the dull ash-grey seed-coat, which under a lens is seen to be covered with appressed hairs, but these, unlike the hairs of nux vomica, are not so regularly arranged and are destitute of any silky sheen. Usually, however, the seed-coat, which is very thin, has been removed by the friction of the seeds against one another, and the surface presented to view is that of the dark translucent horny endosperm. The hilum is generally distinguishable with ease at one extremity of the seed.

To facilitate the examination of the seeds it is desirable to soak them in warm water until they are thoroughly softened. The large endosperm can then be divided into two portions, enclosing between them a cavity in which lies the embryo with its small radicle and leafy cotyledons. The seeds are inodorous, but have an extremely bitter taste.

Constituents.—Ignatius beans contain *strychnine* and *brucine* to about the same extent as nux vomica, viz. 2·5 to 3 per cent. (of total alkaloid). According to Ransom, about one-half of this is strychnine (46 to 55 per cent.), whereas later analyses have indicated nearly two-thirds to be strychnine (60·7 to 62·8 per cent.—Sandor, 1896).

Uses.—The drug possesses a medicinal action similar to that of nux vomica, over which it has no evident superiority.

STRAMONIUM SEEDS

(Thornapple Seeds, Semina Stramonii)

Source &c.—The leaves of the thornapple, *Datura Stramonium*, Linn. (N.O. *Solanaceæ*), have already been described (p. 30), and the attention of the student has been directed to the white flower and spiny fruit. The latter attains, when ripe, about the size of a walnut, and dehisces septifragally, the four walls separating from apex to base. The fruit is two-celled in its upper part, but, from the presence of spurious dissepiments, four-celled near the base. It contains a large number of seeds, which are collected when ripe.

Description.—Stramonium seeds are of a dull dark brown or, more commonly, nearly black colour, flattened and distinctly reniform in outline, averaging about $\frac{1}{8}$ inch in length. The hilum is distinct, in the form of a light spot on the concave (or sometimes flattened) edge. The seed-coat is marked with distinct, but not sharp, reticulate depressions, and under a lens the whole surface of the seed, both depressions and ridges, is seen to be minutely pitted.

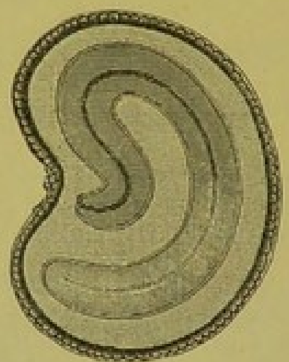


FIG. 71.—Thornapple seed. Longitudinal section, showing curved embryo. Magnified. (Moeller.)

If the seed is split parallel to one of the flattened sides, the crook-shaped embryo may be distinguished embedded in an oily endosperm; in transverse section the embryo appears rounded, and will, owing to its curved shape, be cut at two, or possibly three, different points.

The odour of the seeds is scarcely perceptible until they are crushed, then it becomes rather disagreeable; they have a bitterish oily taste.

The student should observe

(*a*) The *size, reniform outline*, and *dark colour*,
(*b*) The *reticulated and pitted surface*,
(*c*) The *curved embryo* embedded in an *oily endosperm*.

Constituents.—In 1833, two years after the discovery of atropine, Geiger and Hesse extracted an alkaloid from stramonium seeds, to which they gave the name of daturine. Planta proved this alkaloid to be atropine, and Schmidt subsequently showed that these seeds contain as principal alkaloid *hyoscyamine*, associated with which is a small proportion of *atropine* and *scopolamine*, the alkaloids amounting in all to about 0·4 per cent. In addition, the seeds contain about 25 per cent. of fixed oil.

Hyoscyamine is easily converted into atropine during the process of extraction, thus giving rise to the statement that the seeds contained atropine as principal constituent.

Uses.—Stramonium appears to differ slightly in its effect from belladonna; its use is almost confined to spasmodic affections of the respiratory organs, such as bronchitis and asthma. The leaves are also smoked as cigarettes during the paroxysm.

HENBANE SEEDS

(Semina Hyoscyami)

Source &c.—The henbane plant, *Hyoscyamus niger*, Linn. (N.O. *Solanaceæ*), has been already alluded to (p. 31). The fruit of the plant is a small two-celled capsule, which dehisces transversely, the upper part separating from the lower like the lid of a box (pyxis). Within the fruit is a large number of minute seeds; these, separated when ripe, form the commercial drug.

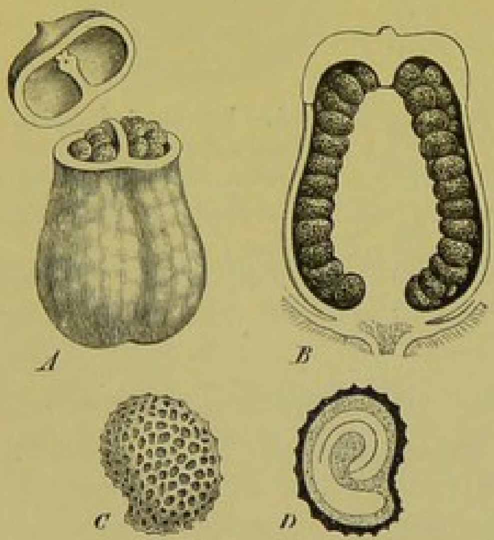


FIG. 72.—Henbane seed. *A*, entire fruit, showing dehiscence. *B*, the same, cut vertically. *C*, seed, magnified 7 diam. *D*, the same, cut longitudinally. (Luerssen.)

Description.—Henbane seeds are of a dark grey colour and very small size, averaging barely $\frac{1}{16}$ inch in length. In shape they are flattened and obscurely reniform, being slightly pointed at one extremity (the hilum). Under a strong lens the surface, which appears dull to the naked eye, is seen to be minutely, regularly, and deeply reticulate, the reticulations being smaller near the hilum. Cut longitudinally, parallel to the flat surface, they exhibit a coiled embryo embedded in an oily endosperm.

The seeds have no odour and only a slightly bitter taste. The student should carefully observe

(*a*) The *small size* and *flattened sub-reniform shape*,
(*b*) The *reticulate surface*;

and should compare them with

(i) *Poppy seeds*, which are distinctly reniform, and have larger and shallower reticulations on the surface,
(ii) *Thornapple seeds*, which are much larger and darker.

Constituents.—The principal constituent of henbane seed is the alkaloid *hyoscyamine*, with which is associated a small proportion of *scopolamine*. Hyoscine, which has been stated to be a constituent of the seed, is, according to Schmidt, not present; indeed this chemist doubts the existence of hyoscine.

The total amount of alkaloid is 0·058 per cent. (Ransom, 1891). In addition, the seed contains about 20 per cent. of *fixed oil*.

Uses.—Henbane seeds are comparatively seldom used in medicine. Thrown upon hot coals they form a domestic remedy for toothache, the vapour that arises being allowed to enter the mouth. They have been used as a source of the alkaloid scopolamine.

NUTMEGS

(Myristica, Semina Myristicæ, Nux Moschata)

Source &c.—The nutmeg tree, *Myristica fragrans*, Houtt. (N.O. *Myristicaceæ*), is indigenous to the Molucca Islands and a few neighbouring islands, as well as north-western New Guinea, but has been introduced into Penang, Sumatra, Malacca, as well as Java, the West Indies, and Ceylon. Up to the present, however, these cultivations have not attained any commercial importance, and our supplies of nutmegs are entirely derived from the *Malay Archipelago*, whence they are exported chiefly to Amsterdam and London.

The use of the spice was introduced into Europe probably during the twelfth century. The Banda Islands, where they were produced, were discovered about 1506, and passed into the possession of the Portuguese, and finally of the Dutch, who, in this case as in that of cloves and cinnamon, made every endeavour to restrict the cultivation of the trees to the islands of Banda and Amboyna, and thus create a profitable monopoly. The nutmeg trees of adjacent islands were destroyed, and the nutmegs themselves soaked in a mixture of slaked lime and water to render them, it was said, incapable of germination, a precaution that was quite unnecessary, as the vitality of the seed was destroyed by the simple process of drying. For some time these efforts were successful, and the nutmeg trade remained in the hands of the Dutch; but eventually the trees were successfully introduced into Malacca, Ceylon, and Jamaica.

The ripe fruit is a fleshy drupe resembling a small peach in size and shape. As it ripens the fleshy pericarp splits longitudinally and discloses a crimson lobed arillus surrounding a brown seed. The fruits are collected, the pericarps removed, and the crimson arillus (mace) stripped off and dried, during which the crimson colour changes to a reddish yellow.

The seeds are then carefully dried, a process that requires several weeks. When quite dry the kernel rattles in a thin, brittle, brown shell. The latter is broken and the kernel removed. They are frequently dusted over with slaked lime, or washed in milk of lime and dried, before they are exported; this protects them from the attacks of insects, to which they are otherwise very liable. Very probably the original 'liming' of nutmegs was intended to protect them from insects and not to destroy the vitality of the seeds, as has been often assumed (Tschirch, 1898). Finally they are sorted, the broken and imperfect seeds being used for the production of the volatile and expressed oil.

Description.—Nutmegs are broadly and bluntly ovoid in shape and about 1 inch in length, but rather less in thickness; they are usually of a greyish-brown colour and marked with shallow reticulate furrows. The hilum lies in a little circular depression surrounded by a raised ring, and from it the raphé can usually be traced in a furrow extending to the chalaza at the apex. When examined with a powerful lens the surface of the nutmeg is seen to be very finely pitted and marked with minute reddish points and larger dark reddish-brown lines and irregularly elongated spots. The nutmeg, which is easily cut, has a waxy consistence, and exhibits in the interior dark reddish-brown wavy lines alternating with pale brownish or greyish interspaces, in a manner resembling the areca nut. The greater portion of the nutmeg consists of the ruminated albumen, the ruminations being produced by the infolding of part of the perisperm and deposition in its cells of dark colouring matter. These infoldings occur near the fibro-vascular

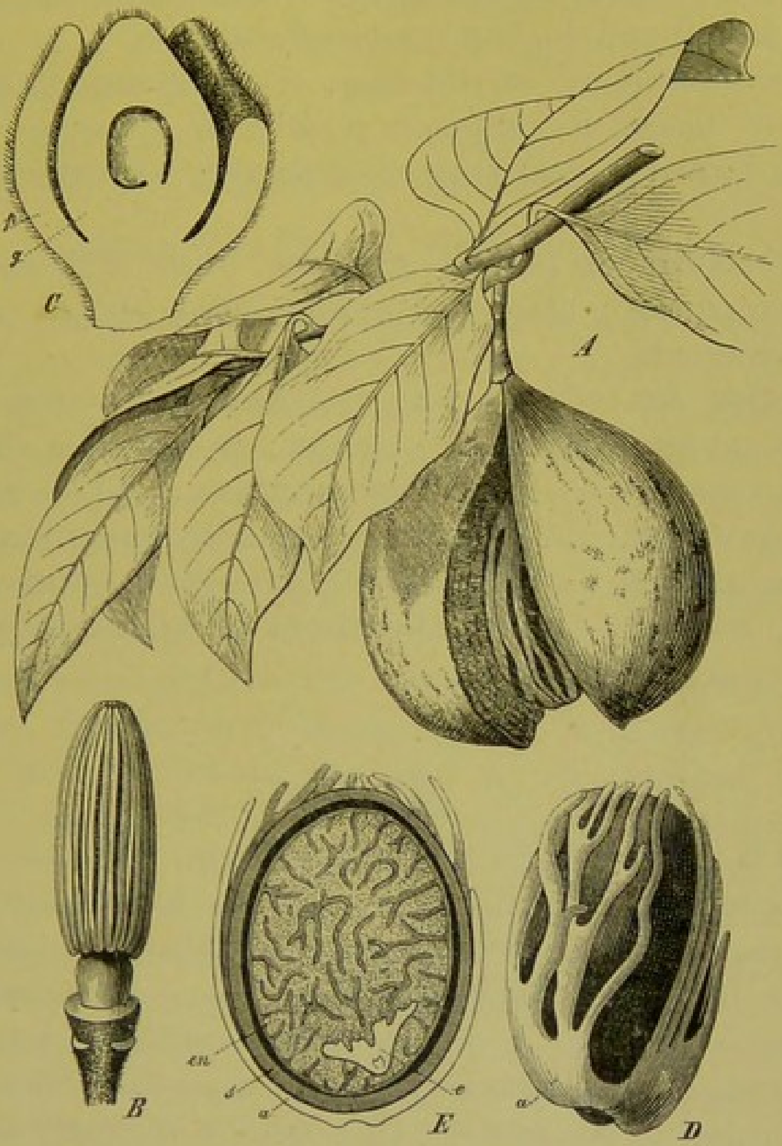


FIG. 73.—Nutmeg. *A*, fruiting branch of *Myristica fragrans*, showing fruit dehiscing. *B*, stamens of staminate flower; magnified. *C*, pistillate flower cut longitudinally: *p*, perianth; *g*, ovary; magnified. *D*, Nutmeg surrounded by the arillus (mace). *E*, the same, cut longitudinally, showing the embryo, *e*. (Luerssen.)

bundles, and produce the depressed lines on the surface of the nutmeg corresponding to the branching bundles.

The cut surface easily yields oil when indented with the nail. The odour is strong and aromatic, the taste aromatic and bitterish.

Constituents.—Nutmegs yield by distillation with water from 8 to 10 per cent. of *volatile oil* (Schimmel, 1888), and contain about 40 per cent. of *solid fat* (Warnecke), three-fourths of which can be separated by submitting the previously crushed and heated seeds to hot pressure. There is also present in the seeds a substance intermediate in properties between starch and dextrin (amylo-dextrin).

The expressed oil of nutmegs, which is sometimes known as oil of mace, is prepared chiefly in Europe. It forms yellowish-brown mottled masses with very aromatic odour and taste.

Uses.—Nutmegs possess aromatic, stimulant, and carminative properties; they are chiefly used as an agreeable flavouring agent.

Varieties &c.—Of the other species of *Myristica* yielding seeds resembling nutmegs, only one, *M. argentea* (Warburg), yields an aromatic seed, the Papua nutmeg. These are longer and narrower than official nutmegs and are less aromatic.

M. malabarica, Lan., yields long and narrow nutmegs, which, however, are easily distinguished from the official by the entire absence of aroma.

MACE

Mace is the dried arillus of the nutmeg. It has its origin in a thickening of the funiculus extending to the outer integument of the seed near the exostome; it is therefore intermediate in nature between an arillus and arillode. As it develops and surrounds the seed it divides into branching lobes which approach one another near the apex of the seed. Both the upper and lower part of the seed are thus more completely surrounded by the mace than the middle, which is only partially enclosed by it. It is carefully separated from the seed and dried, and then forms flattened lobed pieces about 1 inch or rather more in length, somewhat less in breadth, and about $\frac{1}{20}$ inch thick. When soaked in water and restored to its original form, it is seen to be cup-shaped. It is of a dull reddish colour, translucent and brittle. The strong and fragrant odour and aromatic taste resemble those of nutmeg.

Mace contains about 8 per cent. of *volatile oil* (according to Schimmel, 1888, 11 to 16 per cent.).

From Bombay mace, the mace obtained from *Myristica malabarica*, it may be distinguished by the small percentage of substances it yields to ether after previous exhaustion with petroleum spirit. This amounts in the case of genuine mace to at most 3·5 per cent., whereas Bombay mace yields about 30 per cent. (Soltsien, 1894). Bombay mace is in longer, narrower pieces of dark red colour, dividing towards the apex into numerous narrow lobes.

CASTOR SEEDS

(Castor-oil Seeds, Semina Ricini)

Source &c.—The castor-oil plant, *Ricinus communis*, Linn. (N.O. *Euphorbiaceæ*), is a native of *India*, but is diffused now over all tropical and subtropical countries. In India it may attain a height of 40 feet and be a perennial tree, but in cooler climates it is either a shrub or an annual herb. The plant, and with it the seed, are subject to much variation, the larger arborescent forms yielding large seeds, the small annual varieties small seeds.

The oil pressed from the seeds was well known to the Egyptians, Greeks, and Romans, and employed both as a medicine and illuminant, as well as for various technical purposes. It was used in Europe during the early middle ages, but subsequently fell into disuse, being reintroduced from the West Indies towards the end of the last century. The supplies of seeds came then chiefly from Jamaica, but the exports from India increased with great rapidity. The market is now chiefly supplied from India and South America, but considerable quantities of the seed are raised in other countries, as, for instance, in Italy.

The fruit of the plant is a three-celled, three-seeded, thorny capsule. These are collected when ripe; as they dry, they open and discharge the seeds.

Description.—Castor seeds are oblong in outline, somewhat flattened, and vary from about $\frac{1}{3}$ inch to over $\frac{1}{2}$ inch in length. The seed-coat is quite smooth and glossy, and varies in colour from a greyish brown to a beautiful grey marbled with reddish-brown or black spots and stripes. The dorsal surface is arched, the ventral nearly flat; at one extremity is a prominent, usually pale-coloured caruncle, from which a distinct line (raphé) runs along the ventral surface to the other extremity of the seed, where it terminates in a raised point (chalaza), branches and disappears. The caruncle can be easily removed, disclosing a dark spot (hilum) beneath.

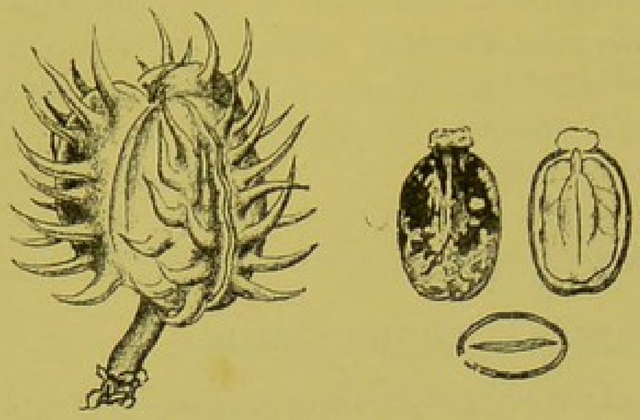


Fig. 74.—Fruit and seed of *Ricinus communis*. Natural size. (Bentley and Trimen.)

The seed-coat is thin and brittle. The marbled outer layer, which, especially after soaking in water, can easily be scraped off, is succeeded by a hard dark layer. Within is the kernel, consisting of a large yellowish-white oily endosperm enclosing a small embryo with two papery cotyledons, which can readily be seen if the kernel is split parallel to one of its larger surfaces. Surrounding the kernel is a delicate silvery-white membrane.

Castor seeds have an almost imperceptible odour and very slightly acrid taste.

The student should observe

(*a*) The *glossy, mottled seed-coat,*

(*b*) The *small caruncle,*

(*c*) The *oily endosperm* and *papery cotyledons* ;

and compare the seeds with croton seeds, which have a uniform dull brown surface.

Constituents.—Castor seeds, when eaten, act as a violent purgative. To what constituent of the seed this property is due is not yet definitely known. They contain about half their weight of *fixed oil*, which is extracted by pressing the seed, and possesses mild purgative properties; it apparently contains, therefore, a portion of the purgative principle. The oil consists of the *glycerides* of *ricinoleic* and *ricinisoleic* acids (Hazura and Grüssner, 1889), but whether these glycerides in their pure state or the fatty acids themselves are purgative or not is undecided.

The press-cake that is left after the expression of the oil is more violent in its action than the whole seeds or the oil obtained from them. From this cake a purgative substance, *ricinone* (Bubnow and Dixon, 1887), has been isolated, as well as an extremely poisonous principle, *ricin* (Stillmark, 1889). The latter body belongs apparently to the class of albumoses; it produces inflammatory symptoms, and is not the purgative principle.

For the extraction of oil for medicinal uses the small greyish-brown seeds are preferred, that obtained from the larger marbled seeds being utilised as a lubricant and illuminant. Much oil is produced in India, but the oil used medicinally is pressed chiefly in Italy, Marseilles, and London. In India the seeds are roasted, pounded, and boiled with water; in Italy they are separated from the seed-coats (shells) and pressed in powerful hydraulic presses, hot iron plates between the press bags promoting the flow of oil. In London the seeds are pressed in the cold without any previous treatment whatever, and the oil obtained is filtered.

Uses.—The oil expressed from the seeds is valuable as a simple purgative, at once rapid and certain, mild and painless. On account of their violent action the seeds themselves are never employed in this country, though in some countries they are said to be a favourite purgative.

CROTON SEEDS

(Semina Crotonis)

Source &c.—Cròton seeds are the seeds of *Croton Tiglium*, Linn. (N.O. *Euphorbiaceæ*), a small tree indigenous to and cultivated in *India*. They were used medicinally in the seventeenth century, but fell into disuse owing probably to the violence and uncertainty of their action. The oil was introduced from India about 1819, and was found to be in certain cases a valuable cathartic.

The tree produces a three-celled, three-seeded capsular fruit resembling that of the castor plant, but devoid of spines. The seeds are exported, and the oil pressed from them in this country.

Description.—Croton seeds are of a dull cinnamon-brown colour and oblong outline; they are about ½ inch in length, and resemble castor seeds in size and shape, though they are rather more angular in transverse section, the ventral and dorsal surfaces being separated by a prominent line. The caruncle which the seed possesses is easily detached, and is therefore seldom to be found in the drug; the hilum is less distinct than in castor seed, and from it the raphé runs along the ventral surface of the seed, terminating in a dark chalaza at the opposite extremity. The outer dull brownish layer is easily removed, disclosing a hard dark coat; in many commercial specimens the friction of seeds against one another has been sufficient to partially effect that, giving the seeds a mottled appearance instead of the uniform brown colour natural to them.

The kernel of the seed is yellowish and oily, and consists of a large endosperm enclosing papery cotyledons and a small radicle.

The taste of the kernel, in ascertaining which great caution is necessary, is at first oily, but this is succeeded by an unpleasant acridity; the seeds have no marked odour.

The student should compare these seeds with castor seeds and observe

(*a*) The *dull brownish outer layer*,
(*b*) The *prominent line* separating the ventral from the dorsal surface.

Constituents.—Croton seeds contain rather more than half their weight of *fixed oil*, which is obtained from them by pressure. It possesses violent cathartic and vesicant properties, which are due to a resinous constituent, *croton-resin* (Dunstan, 1895).

The seeds also contain *toxic albumoses* resembling ricin; they remain in the press-cake left after the expression of the fixed oil.

Uses.—Croton oil is a powerful irritant, producing, when applied to the skin, a burning sensation and redness, followed by severe pustules; it is used as a counter-irritant. Internally it is a very rapid drastic cathartic, and is given in certain cases of apoplexy.

GRAINS OF PARADISE

(Guinea Grains, Grana Paradisi)

Source &c.—Grains of paradise are the seeds of *Amomum Melegueta*, Roscoe (N.O. *Scitamineæ*), a herb attaining 4 or 5 feet in height, indigenous to the *west coast of Africa.*

These seeds were much esteemed as a spice in the twelfth and thirteenth centuries, and the country from which they were derived being unknown, they were called 'grains of paradise.' At that time they were imported from Tripoli, whither they had made the land journey from west Africa. Subsequently they were brought direct from the west coast of Africa to Portugal by Portuguese traders. They are now imported from west Africa.

The plant produces an ovoid pointed fruit 3 or 4 inches long, containing a large number of small seeds.

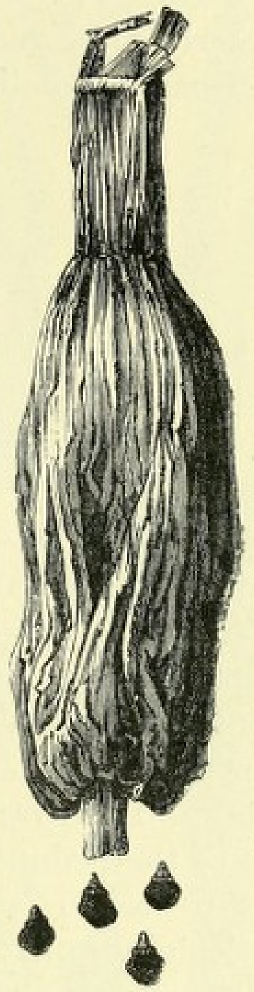


Fig. 75.—Dry fruit of *Amomum Melegueta*, and seeds (grains of paradise). (Pereira.)

Description.—Grains of paradise are small hard shining seeds of a rich reddish-brown colour. They vary very much in shape, but are frequently sub-pyramidal with rounded or obtuse angles, and average in length about $\frac{1}{8}$ inch; the surface is seen under a lens to be minutely but distinctly papillose. Attached to one extremity of the seed are usually the paler fibrous remains of the funiculus, which project in the form of a beak. Cut transversely near the hilum, they exhibit a copious white starchy perisperm surrounding a yellowish horny endosperm in which a minute paler embryo is embedded. The longitudinal section also exhibits the perisperm, endosperm, and embryo, the radicle of the latter being directed towards the funiculus. The crushed seeds have a faintly aromatic odour, but the taste is intensely pungent, rivalling that of capsicum fruit.

The student should observe

(*a*) The *rich, reddish-brown colour*,
(*b*) The *papillose surface*,
(*c*) The *large projecting funiculus*,
(*d*) The *pungent taste*,

and should compare them with cardamom seeds (see page 120).

Constituents.—Grains of paradise contain a little (0·3 per cent.) *volatile oil* and a yellowish pungent oily body, *paradol.* To the latter the intensely pungent taste of the seeds is due; Thresh considers it capable of crystallising, but prevented from doing so by the presence of a trace of impurity.

Uses.—The seeds possess stimulant properties, and were formerly employed as a condiment; now they are chiefly used in veterinary medicine.

COLCHICUM SEEDS

(Semina Colchici)

Source &c.—The meadow saffron, *Colchicum autumnale*, Linn. (N.O. *Liliaceæ*), is widely distributed over Europe, and abundant in some parts of *England* in moist meadows and pastures.

The meadow saffron produces in the autumn a conspicuous reddish-purple flower that springs from the side of an enlarged contracted stem (corm) situated several inches below the surface of the ground. The ovary, which is superior, lies also at about the same depth in the ground. The leaves appear soon after the flower, and attain in the spring a length of 8 or 10 inches. The ovary is then raised to the surface by the elongation of the peduncle, after which the leaves wither. The fruit, a three-celled capsule, ripens in the summer, dehiscing septicidally and disclosing numerous seeds which, when quite fresh, are pale in colour, but darken as they dry, becoming at the same time covered with a saccharine exudation. These were introduced into medicine about 1820 to replace the corm, which was considered uncertain in action.

Description.—Colchicum seeds as met with in commerce are small, very hard seeds of a dull dark reddish-brown colour. They are about $\frac{1}{10}$ inch in diameter, and weigh about $\frac{1}{12}$ grain; in shape they are nearly spherical, the remains of a thick funiculus rendering them somewhat pointed. Under a lens the surface is seen to be rough from the presence of minute pits. They are extremely hard and tough, and are difficult to cut until they have been soaked in water; the section exhibits a yellowish oily endosperm, in which, near the margin and removed from the hilum, the minute embryo is embedded. They are odourless, but have an unpleasantly bitter taste.

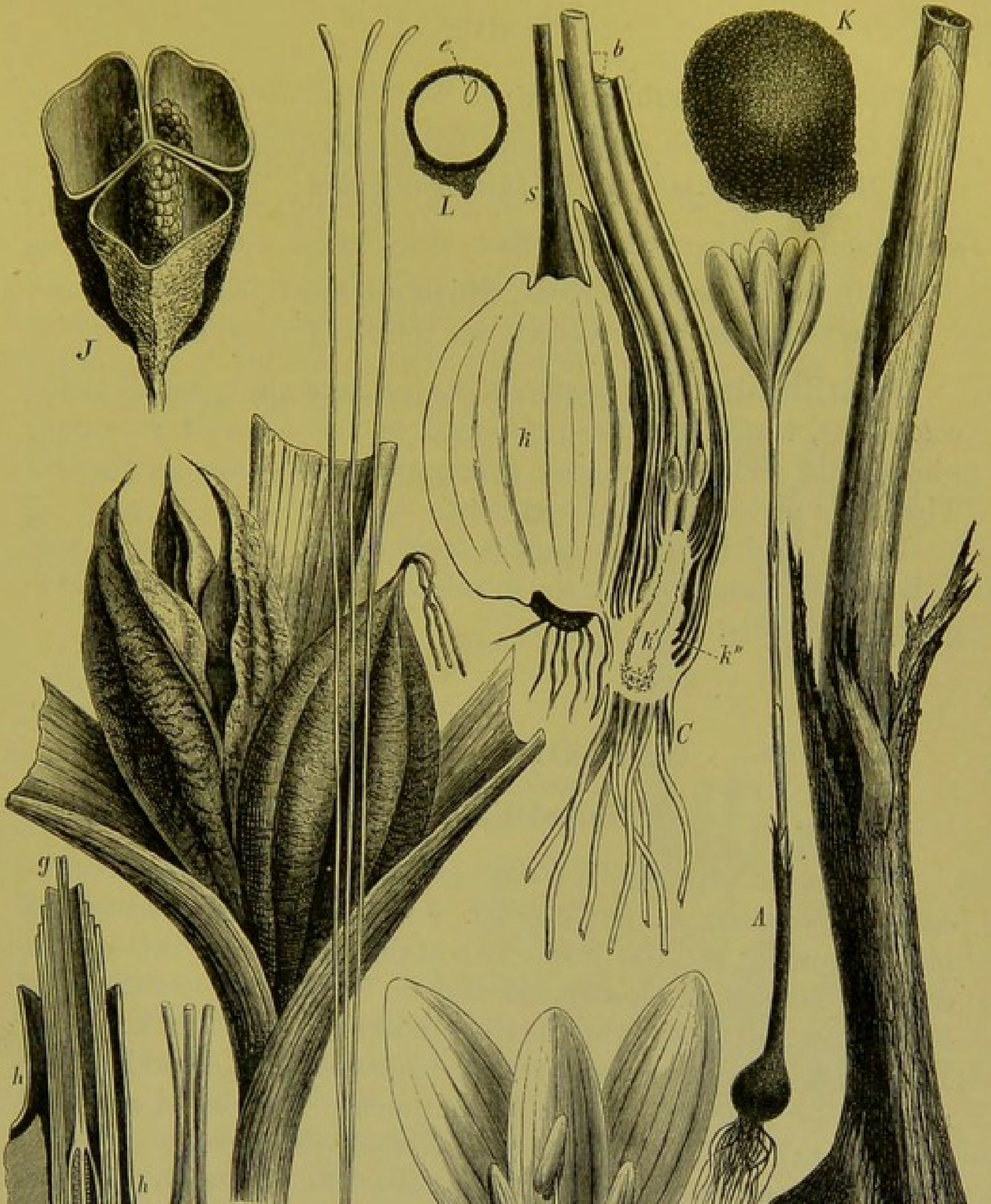


Fig. 76.—*Colchicum autumnale.* *A*, flowering plant, much reduced. *B*, lower part of the same, natural size. *C*, corm, cut vertically: *k*, corm; *k′*, young corm for the next year; *k″*, bud destined to reproduce the plant after *k′* has developed. *D*, portion of the same, showing *h*, the leaves enveloping the corm. *E*, upper part of perianth, halved. *F*, ovary, *o*, with the three styles. *G*, ovary, magnified. *H*, fruit. *J*, the same, cut transversely, showing the seeds. *K*, seed, magnified. *L*, the same, cut to show the embryo. (Luerssen.)

The student should observe

(*a*) The *rough surface* and *hard nature* of the seed.

(*b*) The remains of the *thick funiculus*;

and should compare them with

(i) *Black mustard seeds*, which are much smaller.

(ii) *Henbane seeds*, which are reniform in outline.

Constituents.—All parts of the plant contain an alkaloid, *colchicine*, which has been obtained in the form of an amorphous pale yellow substance possessing weak basic properties. The seeds yield about 0·7 per cent.

Uses.—Colchicum is chiefly used to relieve the pain and inflammation and shorten the duration of acute gout and certain gouty affections.

CEVADILLA SEEDS

(Sabadilla Seeds)

Source &c.—Cevadilla seeds are the ripe seeds of *Schœnocaulon officinale*, A. Gray (N.O. *Liliaceæ*), a tall herbaceous plant growing on the lower mountain slopes near the eastern coast of *Mexico*, in *Guatemala* and in *Venezuela*. At the time of the Spanish conquest the drug was known to the American Indians as a caustic application to wounds; it came into use in Europe much later as a parasiticide. The seeds are now chiefly used as the source of the alkaloid veratrine.

The plant produces a tall raceme of yellowish flowers, succeeded by small three-celled capsular fruits; as the fruit ripens it separates septicidally into three follicles, which dehisce by their ventral sutures. Each follicle contains from one to six seeds. Formerly the dried fruits were imported, but now chiefly the seeds freed from the thin, brown, papery pericarps.

Description.—Cevadilla seeds are long narrow seeds of a glossy dark brown or nearly black colour; in length they average about $\frac{1}{4}$ inch, but they are much narrower. Towards one extremity they taper gradually to an acute point; at the opposite extremity they are more obtuse, and there both hilum and micropyle are situated, though they are not easily seen. From mutual pressure in the fruits there is usually on one side a longitudinal depression with acute edges; for a similar reason the seeds are slightly curved. The surface of the seed is seen under a lens to be finely wrinkled. The minute embryo can be detected by cutting a transverse section near the obtuse end of the seed; it is embedded in a comparatively large dark oily endosperm.

The seeds are inodorous, but have an unpleasant bitter and acrid taste; the powder produces violent sneezing.

The student should observe

(*a*) The *long narrow shape* with *acute angles*.

(*b*) The *acrid taste*.

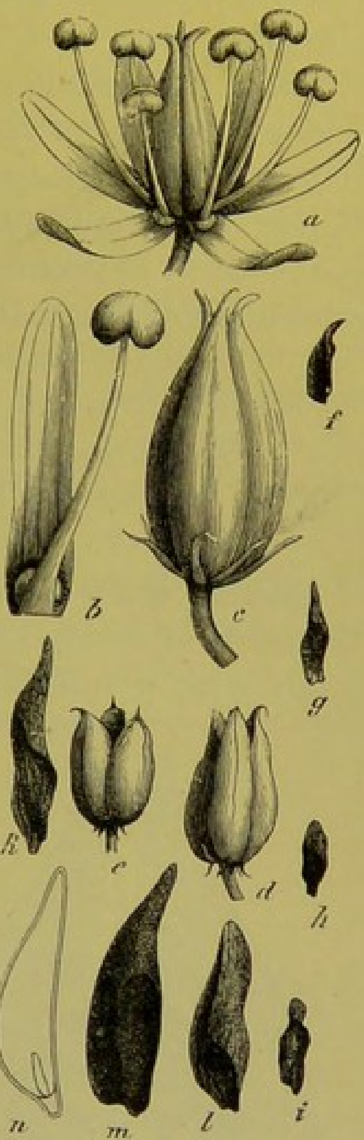


FIG. 77. — Cevadilla seed. *a*, flower, magnified. *b*, stamen, magnified. *c*, fruit, magnified. *d*, *e*, fruit after dehiscence, natural size. *f*, *g*, *h*, *i*, seeds, natural size; *k*, *l*, *m*, enlarged; *n*, cut longitudinally. (Luerssen.)

Constituents. — In 1818 Meissner discovered in cevadilla seed an alkaloid, to which he gave the name of veratrine (from *Veratrum officinale*, Schlechtendahl's name for the plant). His veratrine was undoubtedly a mixture of several alkaloids, of which two only have been carefully examined. For one of these Meissner's name—*veratrine*—has been retained (Schmidt); the other has been termed *veratridine* (Bosetti). These two alkaloids are isomeric; veratrine is crystalline, and present in larger proportion than veratridine, which is amorphous. They constitute together the major part of the mixture of alkaloids officially designated 'veratrine.' [1]

In addition to veratrine and veratridine the presence of

[1] The name veratrine was applied by Merck (1855), Weigelin (1871), and Schmidt and Köppen (1877) to the crystalline alkaloid of cevadilla; Wright and Luff (1879) altered it to cevadine. Wright and Luff named the amorphous alkaloid veratrine; Bosetti (1883) called it veratridine. To avoid confusion Allen (1896) suggests that the name veratrine be discarded, and that the crystalline alkaloid be termed cevadine, the amorphous veratridine.

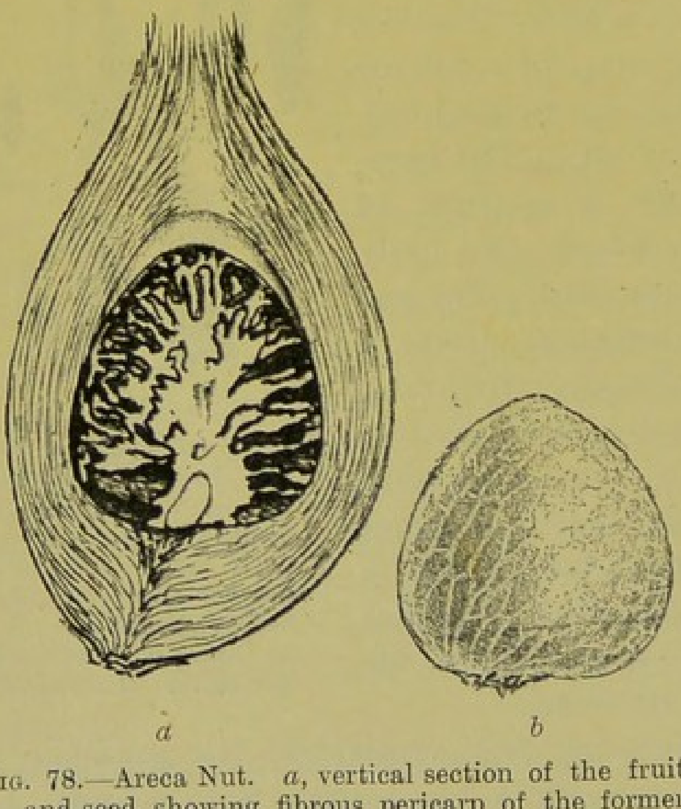
several other alkaloids of minor importance has been reported —viz. sabadilline, sabatrine, sabadine, sabadinine. Keller (1895) reports the seeds to contain about 4·25 per cent. of total alkaloid.

Uses.—Cevadilla seeds (and veratrine) act both internally and externally as a powerful irritant. This primary effect is followed by depression, and, when used externally, loss of sensibility; hence ointment of veratrine is used to relieve neuralgic pains &c. It is employed also as a parasiticide, but is seldom administered internally.

ARECA NUTS

(Semina Arecæ)

Source &c.—Areca nuts, as they are commonly termed, are the seeds of *Areca Catechu*, Linn. (N.O. *Palmeæ*), a handsome palm with a tall slender stem crowned by a number of large elegant leaves. The tree is widely cultivated throughout *India* and the whole of the islands of the *Eastern Archipelago* for its seeds, which are universally employed by the natives as a masticatory.



a *b*

Fig. 78.—Areca Nut. *a*, vertical section of the fruit and seed, showing fibrous pericarp of the former and ruminate albumen of the latter. *b*, entire seed, natural size. (Bentley and Trimen.)

The fruits, which are orange yellow in colour when ripe, and of the size and shape of an egg, are borne in large numbers on a branching axis. The pericarp is fibrous and surrounds a single seed, from which it is easily separated. The use of the seeds as a vermifuge is of quite recent date.

Description.—The areca nut has the shape of a short bluntly rounded cone about 1 inch long and about the same diameter, although frequently it is either a little longer or shorter than it is broad. It has a brownish colour, and the surface is marked with a network of depressed lines, which are usually paler in colour. Frequently portions of a hard, brittle, grey, silvery coat are attached more or less firmly to the seed; these are portions of the inner layer of the pericarp, and do not belong to the seed proper. The latter is hard, but can be cut with a knife, and then exhibits a marbled interior, (*ruminate endosperm*), dark brown lines alternating with opal-white portions. Examination with the lens shows these lines to be slightly fissured. They are folds of the seed-coats, corresponding in position to the fibrovascular bundles that pass into them from the funiculus; they follow the branching of the bundles and produce the reticulate markings on the seed. The outer cells of the seed-coat fill with tannin, to which the brown colour is due, and contain alkaloid (Osenbrug, 1894).

The seed has little odour, but an astringent, slightly bitter taste.

The student should observe

(*a*) The *shape* of the seed.
(*b*) The *ruminate endosperm*.

Constituents.—Areca nuts contain several alkaloids, the principal of which is *arecoline*, a colourless oily base, to which the sialogogue as well as the vermifuge property of the seed is due. Other alkaloids of minor importance are *arecaine*, *arecaidine*, and *guvacine*.

The nuts contain in addition *fat* and *tannin*.

Uses.—The powdered seeds are chiefly used in this country as a vermifuge for dogs.

SECTION V

HERBS AND ENTIRE PLANTS

ACONITE HERB

(Herba Aconiti)

Source &c.—The aconite, monkshood, or wolfsbane, *Aconitum Napellus*, Linn. (N.O. *Ranunculaceæ*), is a perennial herb growing abundantly on the lower mountain slopes of *central Europe*. It is *cultivated in England* as a garden plant as well as for medicinal use, and is found apparently wild in some localities, having probably escaped from cultivation. The drug has only recently been introduced into medicine, but the poisonous properties of aconite have long been known. Both the fresh leaves and flowering tops as well as the dried roots have been used, the latter alone being now official.

The plant should be cut when the flowers are beginning to expand, and the leaves and flowering tops should be separated from the larger stalks; they are used for the preparation of the juice and green extract of aconite.

Description.—The stem, which attains a height of about 4 feet, is upright, smooth, and usually simple, terminating in a leafy raceme of bluish flowers.

The lower leaves are petiolate, radiately veined and deeply palmatisected, the three primary divisions extending very nearly to the petiole; towards the upper part of the plant the petioles become shorter and the lamina less divided. They are of a dark green colour on the upper surface, paler beneath and glabrous, or nearly so.

The flower is zygomorphous; the calyx consists of five blue petaloid sepals (fig. 79, *b*), of which the upper (posterior) is shallow helmet-shaped; of the five petals, two only are easily found as hammer-shaped nectaries concealed within the helmet-shaped upper sepal; the other three are small and inconspicuous (compare fig. 79, *c* and *d*); the stamens are numerous. The fruit consists of from three to five divergent follicles.

The plant has little odour, but produces slowly, when chewed, an unpleasant, acrid, burning taste.

The student should observe

(*a*) The characteristic *shape of the leaf*,
(*b*) The *shallow semicircular hood of the flower*,
(*c*) The characteristic *taste*.

Constituents.—Aconite herb contains certain alkaloidal constituents, but of the exact nature of these and the proportion in

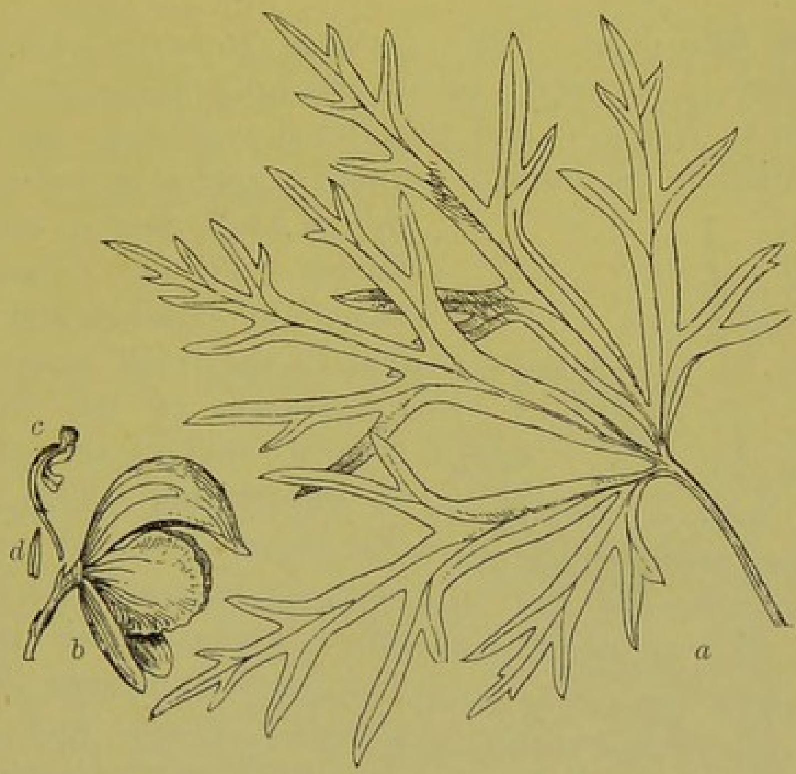


FIG. 79.—Aconite herb. *a*, leaf; *b*, flower; *c*, *d*, petals. Three-fourths natural size. (Holmes.)

which they exist there is no very definite information. Dried leaves of good quality contain about 0·2 per cent. of total alkaloid (Keller), of which a part at least is undoubtedly the highly toxic crystalline alkaloid *aconitine*, but to what extent other alkaloids are associated with it, and what their nature may be, is not at present known. Probably the non-toxic alkaloids picraconitine and aconine, which have been isolated from the root, are also present in the herb (compare 'Aconite Root').

The herb also contains *aconitic acid*, an organic acid widely distributed throughout the vegetable kingdom, and *tannin*.

Uses.—Aconite administered internally produces a steady fall in the body temperature, and is therefore given to alleviate certain febrile conditions; it also relieves the pain of neuralgia, and may be used internally or externally. The tincture prepared from the dry root is much more generally used than the green extract or juice made from the fresh herb.

The very poisonous nature of the herb renders care necessary in tasting it.

BROOM TOPS

(Scoparii Cacumina)

Source &c.—The broom, *Cytisus Scoparius*, Link (N.O. *Leguminosæ*), is a woody shrub, attaining a height of 6 feet, indigenous to *England*, and distributed over temperate Europe. It is essentially a medicine of western origin, as it was employed by the Anglo-Saxons and by the Welsh. The upper parts of the stems are collected, and are official in the fresh state for the preparation of the juice, and dried for making the infusion.

Fig. 80.—Broom, flowering branch. (Maisch.)

Description.—The stem of the broom produces numerous long, slender, wand-like branches which are arranged alternately and directed upwards. They are glabrous, tough, and flexible. The upper part of each branch is dark green in colour, and bears five distinct wings, which, however, are thrown off as the stems increase in size. The leaves are small, alternate, and hairy whilst young; the lower are trifoliate and stalked, but those near the ends of the twigs are reduced to single sessile leaflets. They easily fall off from the stems when dried, and in the dry drug therefore but few leaves are to be found.

The bright yellow, fragrant, papilionaceous flowers are borne on solitary, axillary peduncles, and succeeded by oblong, flattened legumes with hairy margins.

When fresh, the flowering plant has an agreeable odour which, however, disappears on drying. The taste is bitter and unpleasant.

The dried drug consists almost entirely of the dark brownish-green young stems and branches, without leaves, flowers, or fruits.

Constituents.—Broom contains a liquid volatile alkaloid, *sparteine*, which has been obtained in the form of a colourless viscid oil; it forms crystallisable salts, of which the sulphate has been used medicinally. It contains also an indifferent substance, *scoparin*, obtainable in yellow crystals.

Uses.—Broom is largely used as a diuretic in dropsy, an action which is attributed to the scoparin it contains. Sparteine increases the force of the heart, and has been used in cardiac disease in the place of foxglove.

HEMLOCK HERB

(Herba Conii, Folia Conii)

Source &c.—The common or spotted hemlock, *Conium maculatum*, Linn. (N.O. *Umbelliferæ*), is a biennial plant widely spread throughout temperate Europe, and generally distributed over Great Britain. It was in all probability the plant employed by the Greeks in the preparation of poisonous draughts, and was much used in Anglo-Saxon medicine, but latterly has lost much of its reputation owing to the uncertain action of preparations made from it. The herb is cultivated for medicinal use, wild plants being also collected.

Description.—The plant produces, usually in its second year, an erect, cylindrical, glabrous, hollow stem, reaching a height of 6 feet or more, the lower part of which is marked with purplish spots which, however, usually disappear on drying.

The leaves are dark green on the upper, paler on the under surface, quite glabrous, and attached to the stem by amplexicaul petioles. The lower are large and decompound, attaining two feet in length, the upper less divided, the ultimate segments being ovate or lanceolate, and acute, terminating in smooth, colourless, horny points (fig. 81, *a*).

The umbels are about twelve-rayed, and provided with both general and partial involucres, the latter consisting of three short, lanceolate bracts directed outwards.

The fruits are broadly ovate and characterised by the irregular, crenate ridges and grooved endosperm. (Compare 'Hemlock Fruits.')

The plant has a bitterish taste and unpleasant odour, especially when crushed; the addition of solution of potash produces a strong disagreeable odour of mice.

The student should observe

(*a*) The *glabrous, spotted hollow stem*,

(*b*) The *much divided leaves*, which are paler on the under surface, *quite glabrous*, the *ultimate divisions terminating in smooth colourless points*,

(*c*) The *general and partial involucres*,

(*d*) The *crenate ridges* and *grooved endosperm* of the *fruit*.

Constituents.—Hemlock herb contains *coniine* and *conhydrine*. These alkaloids are present in both stem and leaves in largest quantity when the plant is in full flower, the stem containing then 0·064 per cent. and the leaves 0·187 per cent.; the flowers and flower-stalks contain 0·236 per cent. (Farr and

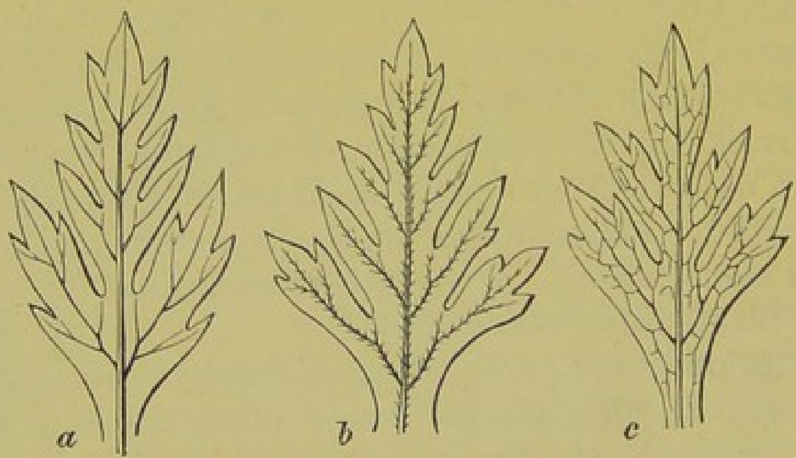


FIG. 81.—Portion of the leaf of *a*, *Conium maculatum*; *b*, *Anthriscus sylvestris*; *c*, *Æthusa Cynapium*. Magnified 2 diam. (Vogl.)

Wright). The herb should therefore be collected as officially directed, when the fruit begins to form, which will be when the plant is in full flower.

Uses.—Fresh hemlock herb is used for the preparation of the green extract and juice. These preparations are administered as sedatives in various spasmodic diseases, in asthma, whooping cough, and spasmodic affections of the larynx.

Adulterations.—Several indigenous umbelliferous plants have been mistaken for hemlock, but the characters detailed above are sufficient to ensure the identification of the latter. The following may be particularly alluded to :

Anthriscus sylvestris, Hoffm., Wild Chervil.—One of the commonest umbelliferous plants; it has, in common with the other less frequent species of the genus, hairy leaves by which it is easily distinguished from hemlock (fig. 81, *b*). The involucels are not directed outwards, and the fruit is elongated.

Æthusa Cynapium, Linn., Fool's Parsley.—The ultimate divisions of the leaves terminate in short brownish points. The under surface is dark green and glossy, and exhibits a more or less distinct network of veinlets (fig. 81, *c*). The umbel has no general involucre, and the bracts of the partial involucre are long and narrow.

COLTSFOOT
(Herba Farfaræ)

Source &c.—The coltsfoot, *Tussilago Farfara*, Linn. (N.O. *Compositæ*), is a small herb with perennial creeping rhizome, abundant in *Great Britain*. The leaves appear much later than the flowering stems, and these two parts of the plant are therefore collected separately and usually sold separately. They have been long used as a domestic remedy for coughs.

Description.—The flowering stems, which appear in the early spring, are simple and hairy, about 6 inches high, and bear numerous small, narrow, alternate reddish bracts. The flower-heads are terminal and solitary and surrounded by reddish involucral bracts ; they possess numerous ray-florets with short, very narrow, bright yellow ligulate corollas, the disc-florets being less numerous and tubular. The receptacle is flat and naked, the fruits cylindrical, tapering towards the base and provided with an abundant pappus of white simple hairs.

The leaves appear much later than the flowers, and arise from separate shoots. They are radical and provided with long stalks ; the lamina is cordate in outline, measuring usually about 4 or 5 inches in breadth. The margin is sinuate-dentate, each tooth terminating in a hard brown point. The upper surface is green, but the under surface is covered with loose, white, felted, woolly hairs.

After the leaves have died down the shoot rests, and produces in the following spring a flowering stem, whilst other shoots develop leaves.

Neither leaves nor flowers have, when dried, any characteristic odour or taste.

The student should observe

(*a*) The *short, very narrow ligulate corolla,*
(*b*) The *cylindrical fruit with pappus,*
(*c*) The *shape and margin of leaves* and *hairy under surface.*

Constituents.—No active constituent is known. The drug contains a little tannin, and Bondurant (1887) found indications of a bitter glucoside which was not isolated.

Uses.—Coltsfoot is used solely as a domestic remedy for coughs.

GRINDELIA

(Herba Grindeliæ)

Source &c.—*Grindelia robusta*, Nuttall, and *G. squarrosa*, Dunal (N.O. *Compositæ*), are perennial herbs indigenous to *North America*. *G. robusta* grows in salt marshes to the west of the Rocky Mountains, *G. squarrosa* in the western plains extending to the Sierra Nevada and south to Texas. The two plants are so closely allied that it is doubtful whether they should not be included in the same species. Before the flowerheads expand they secrete a white, sticky resin ; in May and June the whole plant is resinous, and then the leaves and flowering tops are collected and dried.

Description.—The commercial drug consists largely of the slender upper part of the flowering stem, together with the flowerheads and a few leaves.

The stems, which are frequently as much as 18 inches in length, are rounded, yellow in colour, and smooth. They bear alternate, pale green leaves which, however, are easily broken off, and therefore frequently lie loose in the package.

The leaves are oblong or spathulate in shape, 1½ to 2 inches long, with a serrate margin; they are rigid, brittle, smooth, sessile, and sometimes amplexicaul.

The flowerheads are either depressed-globular in shape and bear appressed involucral bracts (*G. robusta*), or they are nearly conical with squarrose involucral bracts (*G. squarrosa*), giving the flowerhead the appearance of a burr. They are yellowish in colour, hard and resinous, the bracts being lanceolate-acuminate, imbricated and covered with a resinous varnish-like secretion. The florets of the ray have a bright yellow ligulate corolla, which is not usually present in the drug. The fruit is brown and compressed, tapering towards the base, and crowned with a pappus consisting of two or three easily detachable, stiff, thick bristles.

The following are the chief distinctions between the two commercial drugs.

G. robusta is greenish-brown in colour, has ovate, slightly serrate leaves and depressed globular flowerheads with closely appressed bracts.

G. squarrosa is of a straw colour, has lanceolate more deeply serrate leaves and nearly conical flowerheads with squarrose bracts.

The drug has a slight odour and a somewhat balsamic taste. The student should observe

(*a*) The *stalky appearance of the drug*,
(*b*) The *resinous character, especially of the flowerheads*,
(*c*) The *pale green, rigid, brittle leaves*.

Constituents.—The two plants appear to possess similar properties. They contain *two glucosides* possessing great similarity with the glucosides of quillaia bark and senega root, and traces of an alkaloid (Schneegans, 1892). They contain, further, a resin the properties of which have not been investigated.

Uses.—Grindelia has the reputation of being almost a specific for certain forms of asthma. It is not much used in this country.

LOBELIA

(Herba Lobeliæ)

Source &c.—Lobelia or Indian tobacco, *Lobelia inflata* Linn. (N.O. *Campanulaceæ*), an erect annual herb with acrid milky juice (latex), is distributed over the *eastern states of North America,* and cultivated for medicinal use in the states of New York and Massachusetts. The drug was a domestic medicine

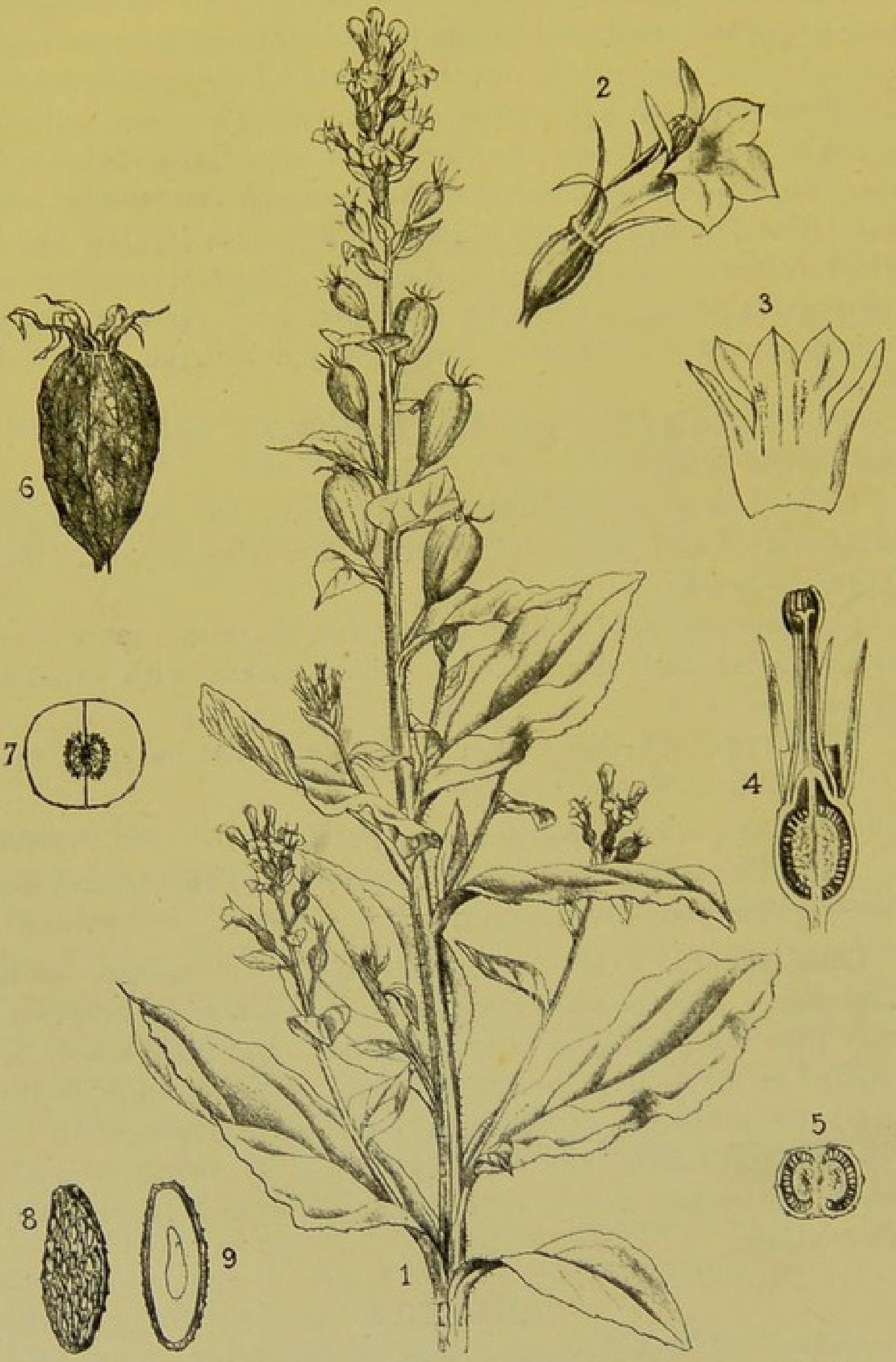


FIG. 82.—*Lobelia inflata.* 1, upper part of a plant; 2, flower; 3, corolla; 4, flower, cut vertically; 5, ovary, cut transversely; 6, ripe fruit; 7, the same, cut transversely; 8, seed; 9, the same cut longitudinally; 1, slightly reduced; 2–7, enlarged; 8, 9, highly magnified. (Bentley and Trimen.)

of the North American Indians, and was introduced into European practice about 1830. The plant is cut as soon as the lower capsules turn brown, and dried; it is sent into commerce either loose or in oblong compressed packets.

Description.—The stem of the plant, which varies in colour from green to yellowish or often purplish, is hairy and winged in the upper part, but quadrangular, channelled, and nearly glabrous below. The leaves are alternate, broadly oval to ovate-lanceolate in outline, and vary in length from 1 to 3 inches. They are sessile or shortly petiolate, and bear, especially on the veins of the under surface, scattered bristly hairs; the margin is irregularly crenate-dentate.

The flowers, which are arranged in a long leafy raceme, have a pale blue bilabiate corolla, a tubular calyx with five long spreading teeth, and an inferior two-celled ovary. The latter develops into an ovoid, inflated, ten-ribbed fruit, about $\frac{1}{4}$ inch or rather more in length, crowned with the remains of the calyx, and containing numerous minute, brown, oval-oblong seeds, which, under the lens, exhibit a beautifully reticulated surface.

In the commercial drug the green hairy and winged or purplish and channelled stems with alternate leaf-scars are easily found. The leaves are mostly in a fragmentary condition, but recognisable by their hairy under surface. The flowers are seldom to be found, but the characteristic inflated fruits containing the very minute seeds are always present.

The stems and leaves contain laticiferous vessels in the bast, a character that can be ascertained by microscopical examination only, but one that may afford valuable aid in identifying doubtful specimens.

The drug has a somewhat irritant odour, and, when chewed, an unpleasant acrid burning taste.

It is said that the plants are sometimes allowed to mature their seeds and are then thrashed, the seeds being sold separately, whilst the herb is pressed into packets. This would account for the frequent absence of the flowers from the drug, and for the presence of numerous capsules with a few ripe seeds.

The student should observe

(*a*) The *hairy winged stem*,
(*b*) The *inflated fruits*,
(*c*) The *minute oblong reticulated seeds*.

Constituents.—That lobelia contains a toxic principle is beyond question, but of the nature of that principle there is some doubt. J. U. and C. J. Lloyd (1887) isolated a white odourless amorphous alkaloid, *lobeline*, which gave easily crystallisable salts with acids, and possessed powerful emetic properties. They also found a neutral crystalline inactive substance, *inflatin*. According to subsequent investigators, however, lobeline is a yellow viscid liquid.

Uses.—Lobelia is used in asthma and bronchitis; in large doses it is an irritant poison, producing vomiting, pain, and purging.

INDIAN PINK

(Herba Spigeliæ)

Source &c.—*Spigelia marilandica*, Linn. (N.O. *Loganiaceæ*), is an erect herb attaining a height of about 2 feet, and widely distributed over the *United States*, especially in the southern and south-western states. It possesses anthelmintic properties that were well known to the Indians, and was introduced into European medicine about 1754. The entire plant is collected in the autumn, tied into bundles, and dried. The rhizome and roots, separated from the aerial parts of the plant, are also found in commerce.

Description.—The stem is smooth and simple, quadrangular in the upper, rounded in the lower part. The leaves are few in number, opposite and sessile; they are ovate-lanceolate in outline, about 3 inches long, acuminate at the apex, and tapering towards the base. The midrib, and the lateral veins, of which there are usually four, are prominent; the latter branch from the midrib near the base at an acute angle, curving round towards the apex. The stem sometimes terminates in a unilateral spike of flowers which, in the fresh state, are of a brilliant red colour, but these are not often found in the drug.

The rhizome is small in size, dark-brown, tortuous, and knotty. It is furnished with numerous slender wiry roots, and bears on the upper side short branches marked with the cup-shaped scars of previous stems.

The drug is odourless, but has a rather acrid taste.

The student should observe

(*a*) The *opposite sessile leaves* with *prominent lateral veins*,
(*b*) The *small tortuous rhizome* with *cup-shaped scars*,
(*c*) The *smooth cylindrical stem*.

Constituents.—The drug is said to contain a liquid volatile alkaloid, *spigeline* (Dudley, 1881), but this statement requires confirmation.

Uses.—Indian pink is often used as a vermifuge. It possesses poisonous properties allied to those of gelsemium, depressing the action of the heart and respiration, and causing loss of muscular power when given in large doses.

CHIRETTA

(Chirata, Herba Chirettæ)

Source &c.—Chiretta, *Swertia Chirata*, Ham. (N.O. *Gentianeæ*), is an erect annual herb growing to a height of about 3 feet, and indigenous to the mountainous districts of northern India. It has long been used by the Hindoos, but was not introduced into European medicine till about 1830. The entire plant is collected when the flowering is well advanced and many fruits formed, and made into bundles about 3 feet long, weighing from 1½ to 2 lbs. each.

Description.—The stem, which reaches a height of 3 feet or more, and attains ¼ inch in thickness, is of a yellowish-brown or purplish-brown colour, glabrous and slightly winged. The lower part is rounded, and exhibits, when cut longitudinally, a narrow wood enclosing a large, continuous, easily separable pith; the upper part of the stem branches freely in a decussate manner, producing in the axils of opposite leaves slender, elongated branches which ramify further and bear numerous fruits and flowers.

The leaves, not many of which are usually found in the drug, are opposite and sessile, ovate or lanceolate in outline, acuminate, entire and glabrous. The fruits are superior, ovoid and pointed; they are formed from two carpels, but are one-celled and contain numerous minute reticulated seeds. There are not many flowers present in the drug.

The tapering root, from which the stem springs, attains about 4 inches in length and $\frac{1}{2}$ inch in thickness at the crown, and is frequently oblique.

The drug has no marked odour, but all parts have an extremely bitter taste.

The student should observe

(*a*) The *purplish-brown colour of the stem,*
(*b*) The *large continuous pith,*
(*c*) The *intensely bitter taste,*
(*d*) The *opposite leaves,*
(*e*) The *bicarpellary, unilocular fruits.*

The first three characters will suffice to distinguish the genuine drug from other species of *Swertia*, which sometimes are mixed with it or substituted for it, as well as from other substitutions that have been occasionally noticed. The last two are characteristic of the natural order Gentianeæ and are also useful in identifying the drug.

Constituents.—Chiretta contains two intensely bitter principles, *ophelic acid* and *chiratin*, both amorphous or indistinctly crystalline yellow substances.

Adulterations.—The name chiretta being applied in India to a number of bitter plants, it is not surprising that other more or less similar bitter drugs are occasionally mixed with or substituted for the official chiretta. Sometimes, too, plants that resemble true chiretta in appearance but are much less bitter, make their appearance under the name of chiretta. Amongst the substitutions and adulterations may be mentioned *Swertia angustifolia*, Buch.-Ham.; *S. alata*, Royle; *S. trichotoma*, Wall., &c.; *Andrographis paniculata*, Nees; the root of *Rubia cordifolia*, Linn., &c. The large continuous pith, dark colour, and intensely bitter taste are sufficient to distinguish *S. chirata* from other species of the same genus; the opposite leaves and bicarpellary, unilocular fruits, from plants belonging to natural orders not possessing these characters.

Uses.—This drug, which has bitter and tonic properties, is highly esteemed in India, and much used as a tonic. In this country it is now but seldom prescribed, probably on account of the very disagreeable nature of its bitterness.

BITTER-SWEET

(Stipites Dulcamaræ)

Source &c.—The bitter-sweet or woody nightshade, *Solanum Dulcamara*, Linn. (N.O. *Solanaceæ*), is a perennial shrubby plant with long climbing or straggling stems, common in *England* in hedges and thickets. It produces small purplish-blue flowers and red berries. During the middle ages it was much used as a medicine; now it is seldom employed.

The young stems are green and hairy, but as they grow older the hairs fall off, and they become quite smooth. The stems are gathered when about two or three years old, cut into short pieces, and dried.

Description.—Bitter-sweet stems occur in commerce in short pieces about $\frac{1}{4}$ inch in diameter, of a light greenish or brownish-yellow colour, bearing occasional alternate scars. They are nearly cylindrical, quite glabrous, and more or less longitudinally furrowed and wrinkled. The yellow, glossy, corky layer can easily be scraped off, and the green primary cortex disclosed. The wood is yellowish, and exhibits, in older pieces, distinct annual rings. The stems are usually hollow in the centre, the remains of the pith being attached to the inner surface of the ring of wood.

The drug has no marked odour; the taste is at first bitter, but afterwards sweetish.

The student should observe

(*a*) The *alternate scars*,
(*b*) The *glabrous, glossy surface* and *hollow centre*,
(*c*) The *bitter-sweet taste*.

Constituents.—Bitter-sweet contains an amorphous glucoside, *dulcamarin*, to which the characteristic bitter-sweet taste is due.

Whether the drug contains the alkaloid solanine or not, appears to be at present doubtful; it has been obtained in white bitter needles from the berries of the black solanum (*Solanum nigrum*, Linn.), from the berries and young shoots of the potato (*S. tuberosum*, Linn.) and other members of the same natural order.

WHITE HOREHOUND

(Herba Marrubii)

Source &c.—White horehound, *Marrubium vulgare*, Linn. (N.O. *Labiatæ*), is an erect herbaceous plant with perennial root, widely distributed over *Europe*, but not very common in England. It is, however, collected in various parts of the country for medicinal use, and is also imported from the south of France. The Romans esteemed horehound as one of the most valuable drugs, but at present it is used only as a domestic remedy, and that not to any great extent. The plant is cut when in flower, and dried.

Description.—White horehound grows to a height of about 18 inches, and possesses a quadrangular, branching stem densely clothed with white woolly hairs. The leaves are about 1 inch long, opposite and petiolate; the lower rounded-ovate, the upper ovate-acuminate, with dentate or dentate-crenate margin. They are much wrinkled, and both the upper and under surfaces, but especially the latter, are covered with white felted hairs.

The flowers are arranged in dense verticillasters in the axils of the upper leaves. The hairy calyx is provided with ten recurved, hooked teeth; the whitish bilabiate corolla is characterised by its small, erect, cleft upper lip.

The drug has an agreeable though not powerful odour, and a somewhat aromatic but very bitter taste.

The student should observe

(*a*) The *dense felted hairs* on the stem and leaves,
(*b*) The *ten hooked teeth of the calyx*.

Constituents.—White horehound contains a crystalline bitter principle, *marrubiin*, that deserves closer investigation than it has received, a little *volatile oil*, and *tannin*.

Substitutes.—Other species of *Marrubium* have occasionally been substituted for *M. vulgare*, but the latter may be distinguished by the ten hooked teeth. Black horehound (*Ballota nigra*, Linn.) is a very different plant; it is not covered with white felted hairs, and has a disagreeable odour.

Uses.—Horehound is used as a domestic remedy for coughs and pulmonary complaints generally.

INDIAN HEMP

(Cannabis Indica)

Source.—The drug known as Indian hemp, or Cannabis indica, is derived from *Cannabis sativa*, Linn. (N.O. *Urticaceæ*), cultivated in *tropical districts of India*.

The plant is an annual diœcious herb, indigenous to central and western Asia, but largely cultivated in temperate countries for its strong fibres (hemp) and its oily seed (hempseed), and in tropical countries also for the resinous secretion which it there produces. This secretion possesses very valuable and powerful medicinal properties, but is not produced by the plant when grown in temperate climates; on the other hand, the fibre of the plant under the latter condition is stronger than that of the tropical plant.

The hemp plant grown in India differs, however, in certain particulars from that grown in Europe, and the plant was formerly considered a distinct species and named *Cannabis indica*, but this opinion is now abandoned.

The cultivation of hemp for its seed and fibre dates from very remote periods. It was used as an intoxicant by the Persians and Arabians in the eleventh and twelfth centuries, and probably much earlier, but was not introduced into European medicine till comparatively recently (1838). For medicinal use it is grown in the districts of Bogra and Rajshahi, to the north of Calcutta, and westward thence through Central India to Gujerat. Very good qualities of the drug are produced in Madras, but the European market is chiefly supplied with inferior grades from Sholapur (Hooper).

The pistillate plants, by which alone the resin is secreted in any quantity, are pruned to produce flowering branches. The tops of these flowering branches are collected, allowed to wilt, and then pressed, by treading them under the feet, into more or less compact masses. This forms the drug known as 'ganjah' or (on the London market) 'guaza.' The larger leaves are collected separately; when dried they are known as 'bhang.'

During the manipulations to which the plant is subjected in preparing the drug a certain quantity of the resin is separated; it is collected, and forms the drug known as 'charas' (churrus).

Charas is also prepared by rubbing ganjah between the hands, or by men in leathern garments brushing against the growing plants; in any case separating part of the active adhesive resin; hence the official description limits the drug to that from which the resin has not been removed.

All these forms of the drug are largely used in India for producing an agreeable form of intoxication. Ganjah and charas are smoked; bhang is used to prepare a drink or sweetmeat.

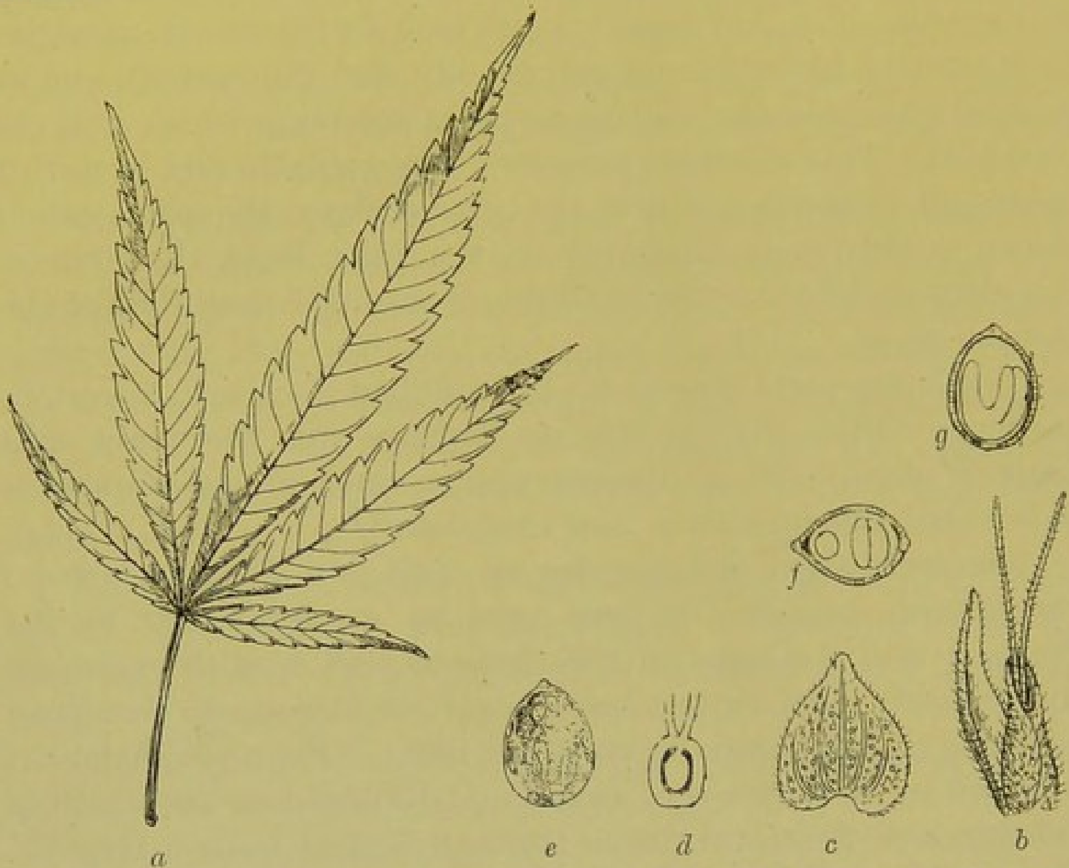


Fig. 83.—Indian Hemp. *a*, young leaf. *b*, pistillate flower enclosed by a bract and supported by a stipule. *c*, bract, showing glands. *d*, ovary, cut longitudinally. *e* fruit (hemp-seed). *f* and *g*, fruit in transverse and longitudinal section (figures after Holmes).

Description.—In English commerce the drug usually occurs in flattened, compressed, rough masses of dull dusky green colour, harsh and resinous to the touch. Sometimes the tops are only 2 or 3 inches in length, but more frequently 6 to 12 inches, the former being preferred. They consist of a straight stem with ascending branches, longitudinally furrowed, and bearing numerous small curved appressed hairs and occasional glands. The hairs are characterised not only by their shape, but by being enlarged at the base and containing cystoliths.

The leaves on the drug (that is, the upper leaves of the plant) are alternate; the lower are digitate, and consist of three or five linear-lanceolate leaflets with distantly serrated margins; the upper are simple. The upper part of the stem and branches bear numerous flowers or fruits.

The pistillate flowers are small and consist of a single ovary, surrounded by a perianth and supported by an ovate bract, beyond which two long brown stigmas protrude. The fruit is ovoid, slightly reticulated, and contains a single oily seed.

Both bracts and leaves (especially the upper ones) bear numerous hairs and stalked glands, the latter secreting a quantity of viscid adhesive resin.

The drug has a powerful odour, but is almost devoid of taste.

The student should observe

(*a*) The *rough dusky-green masses* in which the drug occurs,
(*b*) The *curved appressed hairs*,
(*c*) The *linear-lanceolate leaflets*.

It is advisable to free the drug from resin by macerating it in spirit, and then to soak it in water, when the leaves can easily be separated and the flowers dissected.

Constituents.—Numerous attempts have been made to isolate the active constituent of Indian hemp; it is not possible here to do more than allude to the chief later ones.

In 1881 Siebold and Bradbury isolated a thick yellowish oily liquid, which they termed cannabinine, and their results were confirmed by Warden and Waddell (1884). Kobert (1894) separated a dark red syrupy mass possessing intoxicating properties, and quite recently (1896) Wood Spivey and Easterfield obtained from charas, by distillation under reduced pressure, certain inactive terpenes and a viscous resin, *cannabinol*, which, when warmed, melts to an oily liquid. Cannabinol, when taken internally, induces delirium and sleep, and, as far as is at present known, is the intoxicating constituent of Indian hemp.

In addition to this principle, Matthew Hay (1883) obtained colourless crystals of an alkaloid, tetano-cannabine, which, in physiological action, resembled strychnine.

Uses.—Cannabis indica was formerly used as a hypnotic and anodyne, but is uncertain in its action. It is administered in mania and hysteria as an anodyne and antispasmodic.

EUPHORBIA PILULIFERA

Source &c.—*Euphorbia pilulifera*, Linn. (N.O. *Euphorbiaceæ*), is an annual herb indigenous to the hotter parts of *India* and occurring in *all tropical countries*. It has been used in India as a domestic remedy for ringworm, coughs, and other complaints. Quite recently it has been much recommended for asthma, bronchitis, emphysema, &c.

The whole of the aerial part of the plant is collected whilst flowering and fruiting, and dried. It is exported chiefly from India.

Description.—The stem is slender, erect or ascending, attaining a height of from 1 to 2 feet, cylindrical, and hispidly hairy. The leaves are opposite, oblong-lanceolate in outline, from $\frac{3}{4}$ to $1\frac{1}{2}$ inch long, and have a dentate or serrulate margin. They are dark green in colour, frequently blotched with red, and both upper and lower surfaces are hairy. The flowers are very minute, and crowded in dense axillary or terminal cymes which are seldom as much as $\frac{1}{2}$ inch in diameter. The fruit is a minute, yellow, three-celled capsule, about $\frac{1}{24}$ inch in diameter, each of the three carpels being distinctly keeled.

The most conspicuous part of the drug is frequently the slender rounded stems; the leaves are often much broken, but the fruits, which are very characteristic, can usually be found by examining the inflorescence with a lens. The drug is odourless, but has a bitter taste.

The student should observe

(*a*) The *slender cylindrical hairy stems*,

(*b*) The *minute three-celled fruits*, each carpel distinctly keeled;

and should compare the drug with

(i) *Indian pink*, which has larger leaves with prominent lateral veins and entire margins,

(ii) *Grindelia*, which has stouter yellowish stems bearing alternate leaf-scars,

(iii) *Chiretta* (smaller pieces), which branches freely, and bears much larger ovoid fruits with numerous seeds.

Constituents.—It appears doubtful whether the drug really possesses the efficacy with which it is credited. Investigations have failed to isolate any particular constituent.

Uses.—It has been recommended for asthma, bronchitis, hay fever, whooping cough, and other affections of the respiratory organs, but has never come into general use.

SAVIN TOPS

(Cacumina Sabinæ)

Source &c.—The savin, *Juniperus Sabina*, Linn. (N.O. *Coniferæ*), is a small evergreen shrub indigenous to the mountains of *southern Europe*, especially the southern Austrian and Swiss Alps, and frequently cultivated in Britain. It was probably introduced by the Romans, to whom the drug was well known.

The young shoots are collected in the spring from plants grown in this country; they are used fresh for the preparation of the ointment and for the distillation of the volatile oil, or dried for making the tincture. They are, however, no longer official.

A B

Fig. 84.—Savin. A, natural size; B, magnified. (Moeller.)

Description.—The young twigs of the savin are densely covered with minute, thick, imbricated, opposite leaves, which are appressed and frequently adnate to the stem for a considerable portion of their length; they are sessile, rhomboidal in shape, and bluntly pointed. On the dorsal surface of each leaf a large oval depression is visible, corresponding to a large gland in the mesophyll of the leaf. Occasionally small drooping baccate fruits may be found.

The lower leaves (and sometimes all) are more distant, linear and subulate, and, instead of being closely appressed to the stem, are more or less spreading.

The drug has a strong, characteristic odour and a bitter, acrid, unpleasant taste.

The student should observe

(*a*) The *rhomboidal, appressed, bluntly pointed leaves,*
(*b*) The *oil-glands on their dorsal surfaces,*
(*c*) The *very characteristic odour.*

Constituents.—The principal constituent of savin is the *volatile oil*, of which it yields from 2 to 4 per cent. *Tannin* and *resin* are constituents of secondary importance.

Uses.—Oil of savin is a powerful irritant, and is used externally to promote discharge from blisters; internally it acts as an emmenagogue, and is often used to procure abortion, frequently with fatal effect.

IRISH MOSS

(Carrageen)

Source &c.—Irish moss, *Chondrus crispus*, Stackh. (Class, Algæ; Subclass, Rhodophyceæ; Order, *Gigartinaceæ*), is not a moss, but a seaweed widely distributed on the northern shores of the *Atlantic Ocean*. It is collected for medicinal use on the north-western coast of *Ireland*, and the coast of Massachusetts in the United States. The plant, which is exceedingly variable in colour, in the amount of furcation, and in the width of the segments, grows just below low-water mark and is collected by raking. When fresh it varies in colour from green to dark purplish brown, but is bleached by exposing it to the sun and watering it, the colouring matter, which is soluble in water, being partly washed out and partly destroyed by the treatment. It is said to be bleached also by means of potassium permanganate, the excess of which is decolourised by sodium hyposulphite, a procedure that has the disadvantage of rendering the drug liable to develop an odour of sulphurous acid (Schack, 1886). When finally dried the plant acquires a cartilaginous consistency.

Description.—The drug, which consists of the entire plant, is usually yellowish-white in colour, translucent, and cartilaginous or horny. The thallus is rounded near its attachment to the stones upon which it has grown, but becomes flattened in its upper part, repeatedly branching dichotomously, the branches being sometimes narrow, sometimes broadly wedge-shaped, and then assuming a fanlike appearance. It has a slight odour of seaweed and a mucilaginous saline taste. A decoction

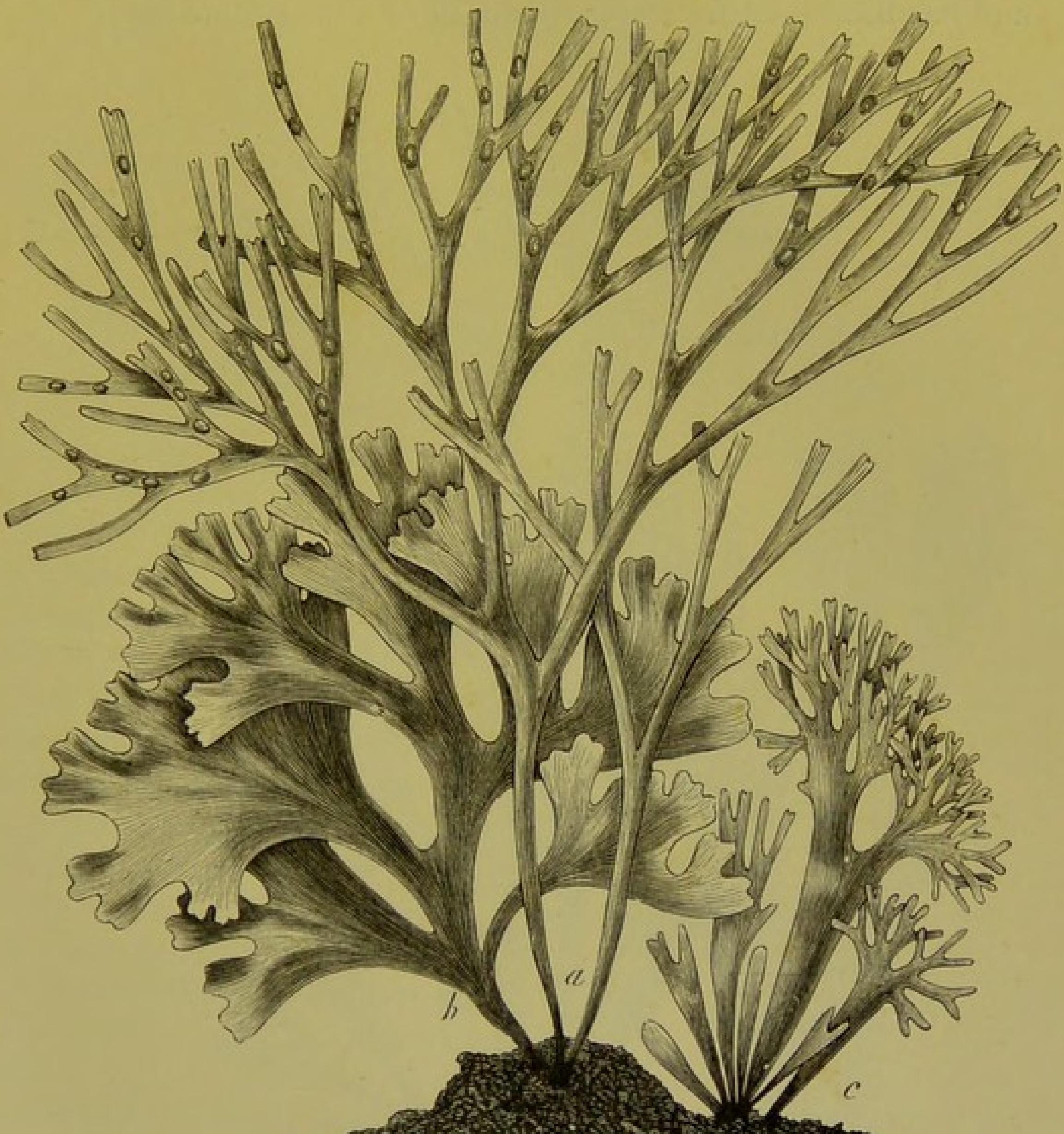


FIG. 85.—Irish Moss (*Chondrus crispus*). Three different forms of the plant, *a*, *b*, *c*; *a*, with fruit, natural size. (Luerssen.)

made with 20 times its weight of water solidifies to a jelly on cooling.

Constituents.—The principal constituent of Irish moss is a gelatinous principle, *carrageenin*, of which Stanford obtained (1884) 63·7 per cent. The drug yields about 15 per cent. of ash, in which a little iodine can be detected, and about 7 per cent. of proteids.

Uses.—Irish moss possesses demulcent properties. It has been given in pulmonary complaints and for chronic diarrhœa, and has been used for the preparation of a nutritious jelly.

Fig. 86.—*Gigartina mamillosa*. *a*, fruiting plant, natural size. (Luerssen.)

Varieties &c.—*Gigartina mamillosa*, Jutg., which is occasionally found mixed with Irish moss, may be distinguished by its stalked sporocarps, as may also *Gigartina pistillata*, Lamour., but the latter is a rare British seaweed and its presence would indicate that the drug had probably been collected in France; the sporocarps of *Chondrus crispus* are immersed in the thallus, the surface of which is slightly raised over them.

BLADDERWRACK

(Fucus vesiculosus)

Source &c.—Bladderwrack, *Fucus vesiculosus* (Class, Algæ; Subclass, Phæophyceæ; Order, *Fucaceæ*), is a seaweed widely distributed on the shores of the Atlantic Ocean, and one of the commonest seaweeds on the coast of *Great Britain*. For medicinal use, the entire living plant should be gathered from the rocks to which it attaches itself, and dried. That which is thrown up by the sea on the shore should be rejected, as by contact with the sea water it is liable to lose some of its constituents, which easily diffuse out from those cells the protoplasm of which has lost its vitality.

Description.—Bladderwrack, when fresh, is of a dark olive-brown colour, changing, as the weed dries, to nearly black. The thallus of the plant is thin and flattened, about $\frac{3}{4}$ inch in width, attaining upwards of 3 feet in length, though it is usually rather shorter. It has an entire margin, and branches dichotomously, bearing at intervals bladder-like swellings (air-vesicles) arranged mostly in pairs; some of the branches terminate in club-like

FIG. 87.—Bladderwrack. Fruiting branch. Natural size. (Maisch.)

enlargements, in which the organs of reproduction are situated. When slightly moist it is cartilaginous, but when quite dry,

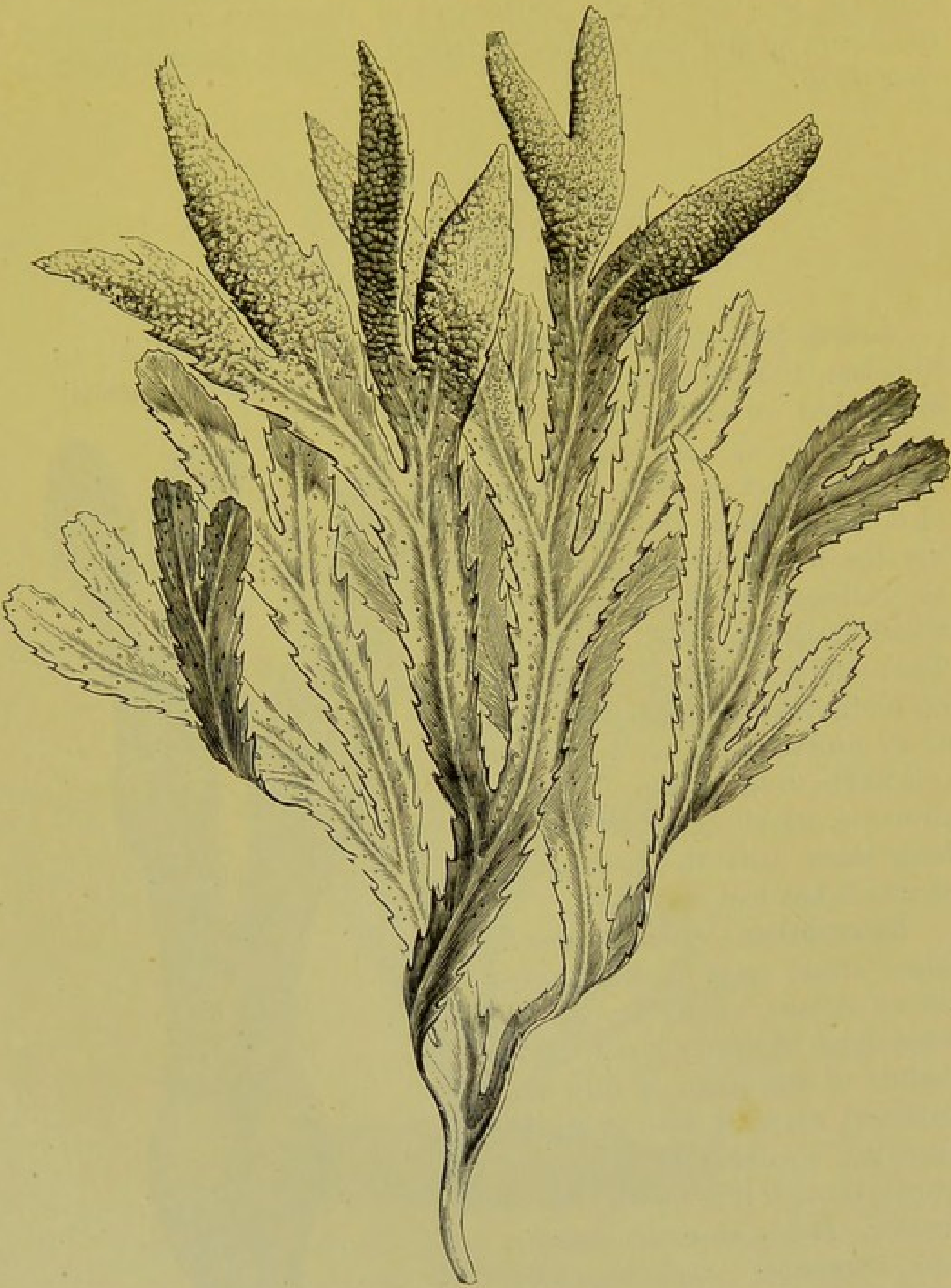


FIG. 88.—*Fucus serratus*. (Planchon and Collin.)

hard and brittle. It has a peculiar seaweedy odour and a disagreeable, mawkish, mucilaginous and saline taste.

The student should observe

(*a*) The *entire margin,*
(*b*) The *vesicles usually in pairs.*

Constituents.—Bladderwrack yields to alkaline solutions a gummy or gelatine-like substance that has been found in other seaweeds, and termed *algin.*

It also contains mannite and a small proportion of *iodine.* The latter appears to exist in the form of an organic compound (Eschle, 1897), similar in its nature to the iodine compound found in thyroid glands. This is probably the most important constituent of the drug. Odourous oil.

The dry plant yields about 0·0113 per cent. of iodine (v. Itallie, 1889), and 1·6 to 3·0 per cent. of ash, in which chlorides and bromides are present in addition to iodides.

Uses.—Preparations of bladderwrack have been used medicinally to reduce obesity.

Varieties &c.—*Fucus serratus,* Linn. (fig. 88), also a common seaweed occurring with *F. vesiculosus* on our rocky shores, has a serrated margin and no air-vesicles, whilst *F. nodosus,* Linn., has the vesicles usually single, not in pairs. The constituents of these seaweeds are probably similar to those of *F. vesiculosus.*

ICELAND MOSS

(Cetraria)

Source &c.—Iceland moss, *Cetraria islandica,* Acharius (Class, Fungi; Subclass, Ascomycetes; Order, *Discomycetes*), is a foliaceous lichen indigenous to Great Britain and widely distributed over the northern hemisphere. It is collected chiefly in the *German, Swiss,* and *Austrian Alps* and in Scandinavia, growing usually amidst moss and grass on the lower mountain slopes.

Description.—The lichen consists of a very thin, erect, leafy thallus, branching fanlike into curled or flattened papery lobes about ¼ inch broad, fringed with minute projections. It is remarkably harsh and springy to the touch, tough when slightly moist, but brittle when quite dry. The upper surface is usually of a brownish or greenish-brown colour; the undersurface greyish and marked with numerous small, white, depressed spots. The apothecia are circular, of a dark reddish-brown colour, and about $\frac{1}{4}$ inch in diameter; they are not often to be found on the plant. The drug is almost odourless, and has, when chewed, a mucilaginous bitter taste. A decoction (1 to 20) gelatinises on cooling.

The student should remember that this drug, although commonly called a moss, is not a moss but a lichen. He should also be careful not to confuse *Iceland* moss with *Irish* moss (see before).

FIG. 89.—Iceland Moss (*Cetraria islandica*). Natural size. (Luerssen.)

Constituents.—Iceland moss consists principally of a carbohydrate, *lichenin*, which though only slightly soluble in cold water dissolves in hot water, the solution gelatinising when cooled. It differs from cellulose in the ease with which it is converted into sugar, in which respect it is allied to starch.

Lichenin is accompanied by *iso-lichenin* (dextro-lichenin), which is soluble in water and behaves as a soluble modification of starch.

In addition to these two substances which constitute the bulk of the drug, Iceland moss contains a crystalline bitter substance, *cetrarin*, which is almost insoluble in water, but dissolves in the presence of an alkali with which it can combine to form a soluble salt. *Lichenostearic acid*, which is also present, is a tasteless crystalline substance, insoluble in water but soluble in ether.

Uses.—The properties of Iceland moss are those of a bitter tonic and nutritive, but it is now seldom employed.

ERGOT

Source.—Ergot is the sclerotium of *Claviceps purpurea*, Tulasne, originating in the ovary of *Secale cereale*, Linn. (N.O. *Gramineæ*).

In the spring or early summer the spores of *Claviceps purpurea* are carried by the wind on to the flowers of various graminaceous plants, in the case under consideration on to those of the rye. Here they germinate and produce colourless hyphæ, which envelop, with the exception of the apex, the very young ovary, and penetrate the outer part of the pericarp, covering it with a soft white felted mass, which gradually takes the place of the ovary, and is known as the *sphacelia*. During this period a saccharine secretion, 'honeydew,' is produced by the hyphæ, and at the same time numbers of conidia are formed, thus contributing to the further dissemination of the fungus by means of the insects attracted to the honeydew. After the felted mass has reached its full development, the sclerotium is gradually produced at

Fig. 90.—Ear of Rye bearing two fully developed ergots. Natural size. (Luerssen.)

its base by the hyphæ forming a dense compact mass instead of a loose felt. The sclerotium grows and finally projects from the ear of rye, which has by this time ripened, bearing on its apex the remains of the felt.

In this compact form the fungus is able to resist the damp and cold of the autumn and winter. In the spring it produces small stalklike projections (stromata, fig. 91, B) each of which is terminated by a globular head in which numberless spores (ascospores) are developed, and these, carried by the wind on to the flowers of the rye, complete the cycle (compare Green's 'Manual of Botany,' vol. ii. p. 86).

Ergot is collected chiefly in Spain, Russia, Germany, and Austria. It is sometimes picked grain by grain by hand, or

Fig. 91.—A, Ergot of Rye. (Planchon and Collin.)
B, Ergot of Rye germinating. (Luerssen.)

more usually separated from the grain after it has been threshed by a machine specially designed for that purpose. Its exclusion from the grain is, in countries in which rye-bread forms the staple food of the people (as in Russia), a matter of the utmost importance, as the continued consumption of bread containing ergot has led to widespread disease (ergotism).

Description.—The grains of ergot are usually about ½ to 1½ inch in length, and of a very dark violet or nearly black colour. They are slender and curved, tapering towards both ends, to one of which a small whitish appendage (remains of the sphacelia) is often attached, and in section rounded or obscurely triangular. They are longitudinally furrowed, especially on the concave side, and often bear as well numerous small transverse fissures. Ergot breaks easily with a very short fracture, and is whitish or pinkish white within, but does not exhibit any definite structure when examined with a lens. It has a characteristic disagreeable odour and an unpleasant mawkish taste.

Constituents.—Few drugs have been so often investigated with such varying results as ergot.

Most important amongst its constituents is the crystalline alkaloid, *ergotinine* (also called cornutine), of which it contains ergoto
from 0·1 to 0·26 per cent. This is probably the only alkaloid in ergot, the cornutine of Kobert being partially changed ergotinine (Keller, Tanret). In addition to this alkaloid ergot contains two organic acids—viz. *ergotinic acid*, which is soluble in water but insoluble in alcohol, and produces paralysis of the spinal cord; and *sphacelinic acid*, insoluble in water, soluble in hot alcohol, producing contraction of the blood-vessels, and consequently gangrene. Neither of these acids has been isolated in a state of purity.

Ergotonin & ergotoxine.

These three principles, of which one only has been obtained in a pure and crystalline form, represent the active constituents of ergot as far as we are acquainted with them.

Ergot contains in addition a large quantity (about 33 per cent.) of *fixed oil*, together with proteids, such alkaloids as choline and lecithine, and a number of other less important constituents.

Spanish and Russian are the chief commercial varieties of ergot, although others (German, Austrian, Swiss, Swedish) are known. Spanish is generally larger and of handsomer appearance, but contains less ergotinine than the Russian, viz. 0·205 per cent. against 0·245; the latter is therefore to be preferred.

Varieties.—Ergot can also be obtained from wheat and numerous other plants belonging to the natural order *Gramineæ*. They are usually smaller and slenderer than the ergot of rye.

Uses.—Ergot is chiefly used to control hæmorrhage, and to excite or increase uterine contraction.

SECTION VI

WOODS

GUAIACUM WOOD

(Lignum Guaiaci, Lignum Vitæ)

Source &c.—The lignum vitæ or guaiacum wood of commerce is derived from *Guaiacum officinale*, Linn., and *G. sanctum*, Linn. (N.O. *Zygophylleæ*), both evergreen trees, the former a native of the *West Indian Islands* and the north coast of South America, the latter indigenous to *southern Florida* and the *Bahamas*. Both occur in Cuba and Hayti, whence the wood is largely exported. The Spaniards became acquainted with it when they conquered San Domingo ; the drug was soon brought to Europe, where it acquired an immense reputation in the sixteenth century as a cure for syphilis and certain other diseases, the resin extracted from the trunk being introduced subsequently.

The trees are felled, the bark stripped off, and the wood exported in the shape of logs, often of considerable size and weight.

Description.—The trunks, which are commonly 6 or 8 inches in diameter, are either smooth externally or exhibit shallow furrows. They are exceedingly hard, heavy and compact, and consist of a dark heartwood, some 5 or 6 inches in diameter, surrounded by a narrow yellowish ring of sapwood.

In the heartwood, which alone is official, brown zones may be distinguished, alternating with darker olive-green or nearly black ones ; these are not annual rings though they resemble such, but are produced by variations in the resin secreted in the wood.

The medullary rays, which can be seen under a lens, are narrow, straight, and closely approximated; the vessels are distinct, usually single, and arranged in concentric zones.

The wood splits very irregularly, owing to the oblique and varying course taken by the wood fibres. Both these and the vessels—in fact, all the elements of the heartwood—are filled with a dark resin, which is sometimes also found in cavities in the trunk. This resin assumes under the influence of oxidising agents a deep blue colour, a reaction which can be utilised in identifying the wood, for a tincture prepared from it will acquire a deep blue colour on the addition of a dilute solution of ferric chloride.

The wood exhales, when warmed, a faint aromatic odour, recalling benzoin, and has, when chewed, an acrid taste. Its toughness and hardness render it valuable for many technical purposes, and it is chiefly used in making blocks, pulleys, &c. The chips or turnings, in which state it is usually employed in pharmacy, should consist of the dark-coloured heartwood alone, but they are frequently mixed with the lighter, pale yellow sapwood. The latter contains but very little (about 3 per cent.) of resin, which is not identical with the resin of the heartwood. The latter is so heavy as to sink in water.

The student should observe

(*a*) The *pale colour of the sapwood*,
(*b*) The *dark greenish-brown heartwood*,
(*c*) The *distribution of the vessels* in the latter.

Constituents.—The heartwood of guaiacum contains between 20 and 25 per cent. of *resin*, which has been found to consist of guaiaretic acid, guaiaconic acid, and guaiacic acid. Guaiaconic acid is the constituent that is coloured blue by oxidising agents. (Compare 'Guaiacum Resin.')

Uses.—Guaiacum has a local stimulant action which is sometimes useful in sore throat. In the form of ammoniated tincture the resin is used in chronic gout and rheumatism, whilst the wood is an ingredient in the compound decoction of sarsaparilla, which is used as an alterative in syphilis. In the latter case the resin, which is insoluble in water, is not extracted from the wood, and the drug does not in all probability contribute to any medicinal action that the decoction may possess.

QUASSIA WOOD

(Quassiæ Lignum)

Source &c.—The official quassia wood is derived from *Picræna excelsa*, Lindl. (N.O. *Simarubeæ*), a tree reaching a height of 50 or 60 feet, and common on the plains and lower mountains of *Jamaica*.

Quassia wood was introduced into medicine about the middle of the eighteenth century, but was then obtained from *Quassia amara*, Linn., a smaller tree than *Picræna excelsa*, and indigenous to the north of South America, whence its usual, distinctive name of Surinam quassia. The wood of *P. excelsa* was found to possess the same properties, and has been substituted for it in England, but Surinam quassia remains official on the Continent.

The trunks and larger branches with the bark attached are exported in logs and billets several feet in length, and varying from 2 to 8 inches or more in diameter.

Description.—The logs of Jamaica quassia wood are commonly covered with a thin, dark grey or nearly black bark, which is more or less readily separable. The wood is pale yellow in colour, light, rather dense, and easily split. When the smoothed transverse section is moistened and examined with a lens numerous narrow medullary rays can be seen traversing somewhat irregular concentric rings. The latter are not annual rings, but are produced by the distribution, in more or less concentric zones, of bands of parenchyma (false annual rings). The vessels are usually in groups of two or three, and frequently extend from one medullary ray to the next.

Not unfrequently dark grey patches are visible in the wood; they are caused by a fungus, the dark hyphæ of which penetrate the wood through the cells of the medullary rays and wood parenchyma.

The wood has no odour, but the taste is purely and intensely bitter. It is usually employed in pharmacy in the form of chips or turnings.

The student should observe

(*a*) The *pale colour* and *intensely bitter taste* of the drug,
(*b*) The *distribution of the vessels*.

Constituents. — According to Massute (1890), Jamaica quassia wood contains two closely allied crystalline bitter principles, *α picrasmin* and *β picrasmin*, which are to be regarded as the active constituents; it contains, further, a minute quantity of a yellow crystalline substance which exhibits in acidified alcohol a magnificent blue fluorescence.

The wood contains no tannin.

Uses.—Quassia is used as a pure bitter tonic.

Substitutes.—Surinam quassia is usually in smaller billets than Jamaica quassia; it is best distinguished by its microscopical characters, the medullary rays being usually one cell wide, whereas in Jamaica quassia they are two or three cells wide; the wood parenchyma is free from crystals of calcium oxalate, which are conspicuous in Jamaica quassia. The width of the medullary rays and the presence of calcium oxalate are therefore specified in the Pharmacopœia in order to exclude Surinam quassia; for although the physiological action is presumably the same, it is desirable for the sake of uniformity to use one variety of the wood only. The bitter principles contained in Surinam quassia are distinct from those of Jamaica quassia, and have been called 'quassiins' (Massute, 1890).

LOGWOOD

(Lignum Hæmatoxyli)

Source &c.—The logwood tree, *Hæmatoxylon campechianum*, Linn. (N.O. *Leguminosæ*), is a tree of moderate size, indigenous to *Central America*, but *naturalised in the West Indian Islands*. The use of the wood as a dye was probably known to the Mexicans, for its introduction into Europe followed closely on the conquest of Mexico by Cortes; it was introduced in 1746 into the London Pharmacopœia as a mild astringent, but is now not much used medicinally.

The wood is exported in the form of billets and logs from which both bark and sapwood have been separated; the heartwood alone contains the colouring and astringent principles.

Description.—The logwood of commerce consists simply of the heartwood of the tree, and is imported in logs and billets, often of considerable weight. Externally these are of a dull dark orange or purplish red colour, internally they are reddish brown ; they are hard and heavy, but easily split. The transverse section exhibits under the lens very narrow and closely approximated medullary rays and narrow concentric dark zones alternating with paler ones, a difference due to the colouring matter secreted in the former.

The odour of the chips is faint but pleasant, recalling that of violets; the taste is sweetish and astringent. When chewed the wood tinges the saliva violet. It imparts a similar colour to dilute aqueous solutions of caustic alkalies.

Logwood is cut by suitable machinery into chips or turnings of a reddish-brown colour, and these are usually subjected to a process of fermentation. They are well moistened, heaped together, and exposed to the air for a period of from four to six weeks, the heaps being frequently turned over; they are then dried. By this process the chips darken in colour and exhibit in patches a dark beetle-green lustre. The unfermented chips are alone official.

The student should observe

(*a*) The *reddish-brown colour* of the chips,
(*b*) The *violet colour they produce in contact with alkaline solutions.*

Constituents.—The principal constituent of unfermented logwood is *hæmatoxylin*, of which it contains about 10 per cent. This, when pure, is colourless and crystalline, but in the presence of alkalies it is easily oxidised to hæmatein, which forms dark scaly crystals with a green lustre, soluble in alkaline solutions with production of a blue or reddish colour. During the fermentation to which the chips are subjected the colourless hæmatoxylin is partially converted into hæmatein, and to the presence of this substance the beetle-green lustre that characterises the fermented chips is due.

Logwood contains, further, *tannin*, *resin*, and a *trace of volatile oil.* The sweetish taste is produced by the hæmatoxylin, the astringency by the tannin.

Uses.—Logwood is largely used as a dye and in the manufacture of inks. Much of it is converted for these purposes into an aqueous extract containing about 50 per cent. of hæmatoxylin and from 10 to 30 per cent. of hæmatein. Medicinally, it is employed occasionally as a mild astringent.

RED SANDERS WOOD

(Red Sandal Wood, Lignum Pterocarpi)

Source &c.—Red sanders wood is the heartwood of *Pterocarpus santalinus*, Linn. f. (N.O. *Leguminosæ*), a small tree indigenous to *southern India* and the Philippine Islands; it is cultivated in southern India, whence the drug is obtained. During the middle ages it was classed as a spice and used for culinary purposes, and at one time it was supposed to possess medicinal properties; it is now employed solely as a colouring agent. Why this inodorous red wood should bear the same name as the pale fragrant yellow sandal wood is uncertain.

The tree is now regularly cultivated in districts situated to the west and north-west of Madras. The felling of the trees is controlled by the inspectors of forests, and the revenue yielded by them is considerable. The dark red heartwood alone is exported.

Description.—Red sanders wood is imported in billets and logs of varying length, but usually not very thick, deprived of both the rugged bark and the pale sapwood. It is of a deep blood-red colour both internally and externally, the transverse section exhibiting alternating darker and lighter zones. The medullary rays are just visible under the lens; the vessels are large, mostly isolated, and connected by fine, bright red lines (wood parenchyma). The wood is very hard, but can be easily split. It is inodorous, has but a very slight astringent taste, and when chewed does not colour the saliva red.

The red resinous colouring matter is produced in the form of droplets in all the elements of the heartwood (wood fibres, wood parenchyma, and vessels). It is readily soluble in alcohol, but only very sparingly in water, and in this respect it differs essentially from logwood, which freely yields its colouring matter to water.

In pharmacy the wood is usually employed in the form of small, hard, splintery raspings of a dull purplish-red colour.

The student should observe

(*a*) The *dull purplish-red colour*,
(*b*) The *hardness*,
(*c*) The *slight solubility of the colouring matter in water*.

Constituents.—Red sanders wood contains a red crystalline substance, *santalin* (or santalic acid), which is insoluble in water, but yields a red solution with alcohol, and violet with caustic alkalies. *Santal* (Weidel, 1869), *pterocarpin* and *homopterocarpin* (Cazeneuve and Hugouneng, 1887, 1890) are colourless crystalline substances also contained in red sanders wood.

Uses.—Red sanders wood is used solely as a colouring agent, and even in this respect it has only a limited application, as the colouring matter requires alcohol to dissolve it, and is precipitated when the alcoholic solution is diluted with water.

SANDAL WOOD

(Yellow Sandal Wood)

Source.—The yellow sandal-wood tree, *Santalum album*, Linn. (N.O. *Santalaceæ*), is a small tree distributed over India and the Malay Archipelago. It is found especially in *southern India*, from Mysore to Madras, and is regularly cultivated there for the sake of its wood, which has long been used in India in religious ceremonies. It was known in Europe in the eleventh century, and has been used medicinally since the middle of the fifteenth century.

The yellow sandal-wood tree is a Government monopoly in Mysore, whence nearly all the sandal wood of commerce is obtained. The tree is plentiful, but must be grown slowly in arid situations upon poor and stony soil to yield the largest proportion of oil. The tree is uprooted and roughly deprived of its bark and part of the sapwood. It is then taken to certain depôts (of which there are nine in Mysore) where the trunks are sawn into lengths of about 3 feet and trimmed, and the roots are freed from bark. The logs are sent either direct to London or by native craft to Bombay, whence they are exported to London. A certain amount of the wood is distilled in Mysore, and the oil obtained is sold by auction.

Description.—Sandal-wood logs are about 3 feet in length and up to 6 or 8 inches in diameter, consisting of the heartwood only of the tree. The wood is yellowish or pale reddish in colour, hard, heavy and dense, but easily split. The transverse section shows alternating lighter and darker zones ; the medullary rays, which are very fine and close together, are visible under a lens ; the vessels are mostly solitary, being only occasionally arranged in small radial groups.

The wood has a slightly bitter taste, but strong, very fragrant odour.

In the yellow sandal wood the formation of heartwood is due to the production of a volatile oil, not, as in the case of guaiacum or red sandal wood, of a resin, or, as in the case of logwood, of a mixture of resin, tannin, and colouring matter. The volatile oil is found in all the elements of the wood ; it is not secreted by or contained in any particular cells or glands.

The student should observe

(*a*) The *pale colour*,
(*b*) The *characteristic odour and taste*,
(*c*) The *vessels usually single.*

Constituents.—The only important constituent of the wood is the *volatile oil*, of which it yields from 2 to 5 per cent.

Uses.—The wood is used as a source of the volatile oil, and technically for the manufacture of various articles. Sandal-wood oil is a stimulant and disinfectant of the whole genito-urinary tract.

Varieties.—The wood of other trees is occasionally imported under the name of sandal wood. The chief of these are Australian sandal wood (from *Fusanus spicatus*, R. Br., N.O. *Santalaceæ*) and Venezuelan or West Indian sandal wood (*Amyris balsamifera*, Linn., N.O. *Burseraceæ*). They may both be distinguished by the vessels being arranged in *radially elongated groups* (Petersen, 1886).

SECTION VII

BARKS

BARBERRY BARK

(Cortex Berberidis)

Source &c.—The common barberry, *Berberis vulgaris*, Linn. (N.O. *Berberideæ*), is a shrub commonly about 6 feet high, with three-lobed thorns at the bases of the tufts of leaves. It occurs scattered over Great Britain, and is distributed over the greater part of Europe and temperate Asia. The yellow flowers, which are arranged in elegant drooping racemes, are succeeded by oblong scarlet fruits.

The stem bark is collected by shaving, and dried.

Description.—Barberry bark occurs in small, thin, nearly flat [1] pieces not often exceeding 2 inches in length or ½ inch in breadth, dark in colour, with a decided yellow or yellowish-grey tinge.

The outer layer (cork) [2] is dark yellowish-grey in colour, and is marked with shallow, longitudinal furrows or deeper

[1] Barks are said to be in *flat* pieces when they are quite flat; in *curved* pieces when they present a curved but not deeply concave transverse section; in *recurved* pieces when the concave surface is the outer portion of the bark; in *channelled* pieces when the transverse section is deeply concave. Should it be so deeply concave that the edges nearly or quite overlap, a *quill* is produced, and should both edges be inrolled a *double quill* is formed. Single or double quills packed inside one another form *compound* quills.

[2] The restriction by botanists of the common English terms, bark and cortex, to portions only of the bark and cortex has rendered an intelligible description of the structure of barks exceedingly difficult. I have used the term *bark* in its ordinary English signification—that is, to denote all the tissues of the stem and root exterior to the cambium—whilst I have restricted the term *cortex* to that portion of the bark extending from the epidermis, cork or phelloderm, as the case may be, up to and including the endodermis. Cortex corresponds, therefore, to the 'middle bark' of many pharmacognosists. I have employed the term *bast*

fissures, becoming ultimately scaly; it frequently bears the minute black apothecia of small inconspicuous lichens. The inner surface is dark yellowish-brown, longitudinally striated and fibrous, and occasionally has fragments of yellow wood adhering to it.

The bark breaks with a fracture that is short in the outer portion (cork and cortex), but fibrous and strongly laminated in the inner (bast).

The transverse section exhibits under the lens a narrow cork and a dark brown bast traversed by paler, yellow medullary rays. The bast rays contain narrow, tangentially elongated bundles of bast fibres, which easily separate from the bast parenchyma into strands and produce the laminated appearance and fracture.

The bark has a bitter taste, and colours the saliva yellow when chewed.

The student should observe

(*a*) The *yellow colour* both of the bark and the wood that is sometimes attached to it,
(*b*) The *minute lichens* (the presence of which proves it to be stem bark),
(*c*) The *strongly laminated bast*.

Constituents.—Barberry bark contains several alkaloids, of which *berberine* is the most important. Berberine, which can be obtained in yellow crystals, is found in a number of plants belonging not only to this but to other natural orders, as, for example, in *Hydrastis canadensis* (Ranunculaceæ), *Jateorhiza Columba* (Menispermaceæ), &c.

Oxyacanthine and *berbamine* are colourless alkaloids that have been obtained from the bark of barberry root, and doubtless exist also in that of the stem. Contains Tannin.

Uses.—Barberry bark is sometimes employed as a remedy for fevers, and as a tonic.

to denote the tissue extending from the endodermis to the cambium, corresponding therefore to the 'inner bark.' For the tissue to which botanists restrict the term bark I have retained the old name '*outer bark*,' as it forms the outer portion of those barks in which it is formed.

I have endeavoured to give further precision to the descriptions by inserting in brackets the usual botanical term when I have thought desirable.

The student should study the anatomy of the bark in his text-book of botany before passing to this section of the work.

CANELLA BARK

(Wild Cinnamon Bark, Cortex Canellæ)

Source &c.—Canella bark is obtained from *Canella alba*, Murray (N.O. *Canellaceæ*), a small tree distributed over the *West Indian Islands* and found also in Florida. With this tree the Spaniards became acquainted when they discovered America, and thinking, from its aromatic bark, that it was a kind of cinnamon, which was known to them as a valuable Asiatic spice, they brought it to Europe, where it received the name of white cinnamon or 'canella alba.' It is now used by the negroes as a condiment.

Fig. 92.—Canella bark. Natural size.

The bark of the tree is covered with a thick layer of ash-grey cork; by gentle beating, this layer of cork is detached, and the remainder of the bark, which has been at the same time loosened, can then be stripped off and dried. It is exported chiefly from the Bahamas.

Description.—Canella bark occurs in commerce in channelled pieces and single quills of very varying size, evidently obtained from small trunks and from large and small branches. The quills vary in diameter from $\frac{1}{4}$ inch to 1 inch or more; channelled pieces may be as much as 2 inches broad and $\frac{1}{4}$ inch thick. Much of the bark shows evidence, in the shape of irregular longitudinal fractures, of the beating to which it has been subjected. The outer surface is of a bright pale reddish or yellowish-buff colour, very hard and granular, and usually marked at somewhat distant intervals with circular crateriform scars or with whitish spots, as well as with numerous shallow transverse or longitudinal depressions. The inner surface is paler, and finely striated longitudinally.

The bark breaks with a very short granular fracture. The smoothed transverse section exhibits under the lens a narrow, irregular, translucent, brown outer layer (phelloderm of sclerenchymatous cells), a paler cortex in which numerous brown oil-cells can be seen, and, in the bast, white wavy medullary rays.

The odour is agreeably spicy, recalling cinnamon ; the taste pungent and bitter.

The student should observe

(*a*) The *hard buff outer surface* with its characteristic *scars or spots*,

(*b*) The *oil-cells* and *medullary rays*,

(*c*) The characteristic *odour and taste*.

Constituents.—Canella bark contains about 1 per cent. of tains *volatile oil* which has a pungent aromatic taste. The bitter principle has not yet been isolated, and it is doubtful whether enol the pungency is due entirely to the volatile oil. The bark contains no tannin—a negative character by which it may be distinguished from that of *Cinnamodendron corticosum*.

Uses.—It was formerly used as an aromatic and stimulant, but is now almost obsolete.

CINNAMODENDRON BARK

(False Winter's Bark)

Source &c.—Cinnamodendron bark, or, as it is sometimes called, false Winter's bark, is derived from *Cinnamodendron corticosum*, Miers (N.O. *Canellaceæ*), a small tree indigenous to *Jamaica*.

True Winter's bark (the bark of *Drimys Winteri*, Forst., N.O. *Magnoliaceæ*) was first brought to Europe in 1579 by Captain Winter, who became acquainted with it during the detention of his ship in the Straits of Magellan. No doubt his attention was directed to the bark by its very pungent peppery taste. True Winter's bark was, however, difficult to procure, and for a long time cinnamodendron bark, which resembles true Winter's bark in its pungent taste, was substituted for it, whence its name of 'false' Winter's bark. The importation of cinnamodendron bark has also ceased, and other barks (such as canella bark and the bark of a species of *Croton*) have been sold in its stead. The peppery taste of both true and false Winter's barks disappears if the barks are kept, and is therefore frequently not perceptible in museum specimens.

Description.—Cinnamodendron bark occurs in channelled pieces or single quills, frequently bearing a close resemblance to canella bark. The outer surface is usually of a dingy brownish-grey colour, hard, and marked with circular rusty-brown spots and occasional shallow transverse depressions, being, but for the latter, nearly smooth. The inner surface is reddish brown and longitudinally striated.

The bark breaks with a short fracture, and the transverse section exhibits a structure resembling that of canella bark. The external layer is a dark phelloderm; the cortex is commonly reddish or dark reddish-brown and marked with still darker oil-cells; the medullary rays are pale in colour and wavy.

The odour of the bark is characteristic, distinctly recalling coriander; the taste also resembles that of coriander, but is in addition rather bitter, and in fresh bark extremely pungent.

The student should observe

(*a*) The *dark colour,*
(*b*) The *rusty-brown spots,*
(*c*) The *coriander-like odour and taste,*

and should compare the bark with canella bark, with which it has been confused.

Constituents.—Of the constituents of cinnamodendron bark we know little. Neither the *pungent principle* nor the *volatile oil* has been examined. The drug contains *tannin*, by which, as well as by the physical characters, it may be distinguished from canella bark. A cooled decoction is coloured deep red by a solution of iodine, a reaction which distinguishes it from true Winter's bark.

Cinnamodendron bark, canella bark, and true Winter's bark are further easily distinguished by their structure.

Uses.—Cinnamodendron bark has been substituted for true Winter's bark, a remedy now obsolete in Europe, but much used in Brazil for diarrhœa and gastric debility.

CUSPARIA BARK

(Angostura Bark, Cortex Cuspariæ)

Source &c.—Cusparia bark is obtained from *Cusparia febrifuga*, DC. (N.O. *Rutaceæ*), a tree indigenous to the mountains of *Venezuela*, and there abundant. It was introduced into

European medicine about the end of the last century, being brought from Angostura (on the Orinoco) to Trinidad, whence its name 'Angostura bark.' At present it is not much used in medicine.

Description.—Cusparia bark occurs in somewhat thin curved or channelled pieces or single quills, usually about 3 or 4 inches

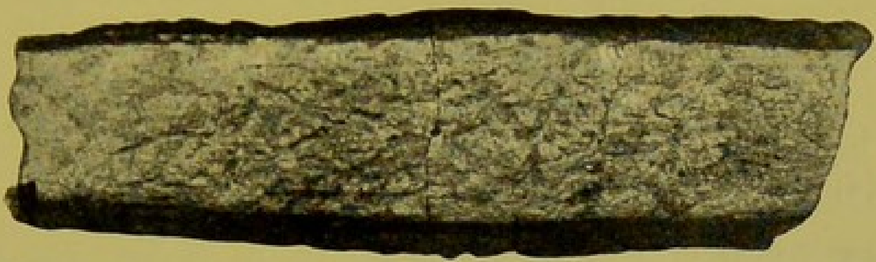


Fig. 93.—Cusparia bark, showing buff spongy cork and obliquely cut edges. Natural size.

long and $\frac{1}{16}$ to $\frac{1}{8}$ inch thick, but sometimes much longer, one of the longitudinal margins being frequently obliquely cut, indicating that the bark is not easily stripped from the tree. The outer layer (cork) is sometimes buff-coloured, friable, and easily removed by the finger-nail, sometimes dark grey, thin and firmly adherent, a difference due to the alternate production of layers of thin and thick walled cork cells.

Below the cork is a hard, dark brown middle layer (cortex), whilst the inner surface of the bark (bast) is of a cinnamon or chocolate brown colour and finely striated. This portion frequently exhibits a laminated structure and bears numerous minute short white lines longitudinally arranged, which are usually easily visible under a lens, especially after the inner surface has been smoothed with a knife. They are caused by axially elongated cells filled with acicular crystals of calcium oxalate. Similar white masses of calcium oxalate may be seen on the smoothed radial and transverse sections.

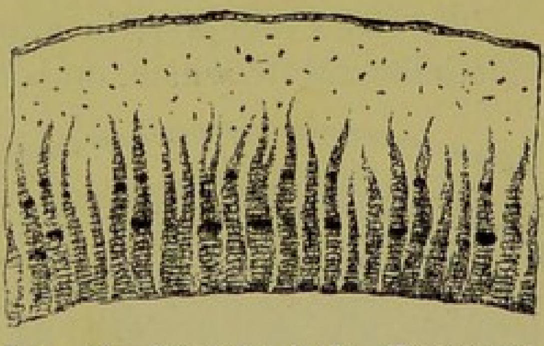


Fig. 94.—Cusparia bark. Transverse section, showing oil-cells and groups of bast-fibres. Magnified. (Planchon and Collin.)

The bark breaks with a short resinous fracture, the transverse section exhibiting a whitish cork, a yellowish-brown cortex, and, in the bast, yellowish oblique or wavy medullary rays alternating with darker bast-rays. Throughout both cortex and bast numerous cells filled with white crystals of calcium oxalate, as well as minute dark ones filled with oil, may be distinguished under the lens.

The bark has an unpleasant musty odour and a bitter taste. The student should observe

(*a*) The *cork, which is often spongy,*
(*b*) The *laminated inner portion,*
(*c*) The *calcium oxalate,*
(*d*) The *characteristic odour.*

Constituents.—A number of interesting bodies have been isolated by Beckurts and Nehring (1891) from cusparia bark. Several alkaloids are present, of which four, amounting together to about 2·4 per cent., have been obtained in crystals and closely examined, whilst other amorphous alkaloids await further investigation.

Of the crystalline alkaloids the two most important are *galipine* and *cusparine, galipidine* and *cusparidine* being present in smaller quantity.

Although these alkaloids are bitter, the bitterness of the bark is due principally to a crystalline bitter principle, *angosturin,* which contains no nitrogen and is therefore not alkaloidal; it is soluble both in water and alcohol.

The bark contains in addition a substance apparently of glucosidal nature which, on boiling with diluted sulphuric acid, yields a fluorescent substance. The characteristic odour is due to about 1·5 per cent. of *volatile oil.*

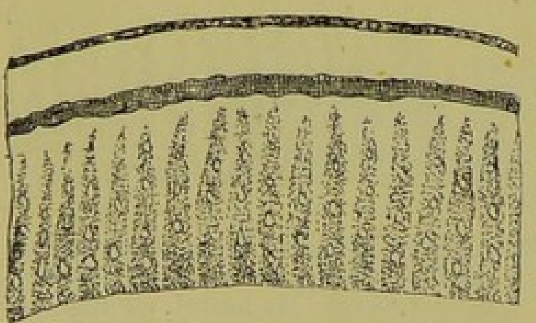


FIG. 95.—Nux Vomica bark. Transverse section, showing band of sclerenchymatous cells. Magnified. (Planchon and Collin.)

Uses.—Cusparia belongs to the group of aromatic bitters. It formerly had a high reputation as a febrifuge and tonic, being preferred to cinchona bark on account of its freedom from astringency.

Substitutes.—The accidental substitution in Hamburg in 1804 of the bark of *Strychnos nux-vomica,* Linn., for cusparia bark led to several cases of poisoning. Such a substitution or admixture is not likely to occur again, and would moreover be easily detected, as the barks do not bear much resemblance to one another. Nux vomica bark is harder and thicker; it occurs in small, often recurved pieces, with dark greyish, yellowish, or rusty-red cork, usually bearing numerous greyish warts. The dark transverse section exhibits under the lens a distinct paler line of sclerenchymatous cells separating the cortex from the bast. This line of sclerenchymatous cells is never found in cusparia bark, which seldom contains any sclerenchymatous tissue other than small isolated groups of bast fibres. This latter character suffices to distinguish cusparia bark from copalchi bark (*Croton niveus*, Jacq.), Brazilian angostura bark (*Esenbeckia febrifuga*, A. Juss.), and others, the separate enumeration of which would be beyond the scope of the present volume.

SIMARUBA BARK

Source &c.—Simaruba bark is obtained from two species of Simaruba, viz. *Simaruba amara*, Aublet, and *S. glauca*, DC. (N.O. *Simarubeæ*), both of them tall trees with long horizontal roots, the former a native of *Guiana* and *northern Brazil*, the latter of the *West Indian Islands and Florida*. It was brought from Guiana to Paris in 1713 as the bark of a tree called by the natives simaruba and used by them with great success in dysentery. In Europe it soon gained renown, and was imported in considerable quantity.

The bark is stripped from the root, probably after a preliminary beating to loosen it, freed from the outer layer (cork) and dried. Possibly the bark from the stem is also collected.

FIG. 96. — Simaruba bark. Transverse section, magnified. (Berg.)

Description.—Simaruba bark is imported in long fibrous strips, sometimes as much as 3 feet in length, several inches wide, and between $\frac{1}{8}$ and $\frac{1}{4}$ inch thick. These pieces are more or less fissured and rent longitudinally, probably the result of beating. Externally they are of a buff or yellowish-brown colour, and rough as though they had been deprived of the outer cork layer by rasping. They are frequently marked with brownish raised corky warts or the depressions left after their removal.

The inner surface is yellowish, longitudinally striated, and fibrous. In fact the whole bark is characterised by its extremely fibrous nature, as it may be bent double without completely breaking.

The transverse section exhibits numerous, fine, yellow medullary rays traversing the bark from the inner almost or quite to the outer margin, and showing therefore that the drug consists almost entirely of bast tissue, the cork and part or all of the cortex having been removed.

The drug has no odour, but a very bitter taste.

The student should observe

(*a*) The *extremely fibrous* nature of the bark,
(*b*) Its *yellowish colour* and *bitter* taste,
(*c*) The characters of the *transverse section*.

ed Oil. cn. ine bitter stance

Constituents.—Simaruba bark contains xtalline bitter principle, probably identical with either the picrasmins of Jamaica quassia, or the quassiins of Surinam quassia. The drug requires re-investigation.

Uses.—Simaruba bark was formerly used for dysentery; it is now seldom employed in European medicine.

EUONYMUS BARK

(Cortex Euonymi)

Source &c.—Euonymus bark is the dried root-bark of the wahoo tree, *Euonymus atropurpureus*, Jacquin (N.O. *Celastrineæ*), a tall erect shrub with small dark purple flowers succeeded by crimson fruits; it is common in the *eastern United States*, extending westward to Wisconsin and southward to Florida. The root-bark is alone official, but the stem-bark also is collected.

Description.—Euonymus root-bark occurs in small, more or less irregular quilled or curved pieces, not usually exceeding 3 inches in length or ½ inch in width. The outer layer is a soft, spongy, finely fissured cork, easily removed with the finger-nail; it is of a light ash-grey colour marked with darker lines or patches (due to adhering particles of earth) and occasional small transverse scars. The inner surface is of a pale tawny yellow or buff colour and nearly smooth; occasionally a thin shaving of pale yellow, dense wood adheres to it, indicating that the bark is separated with difficulty from the root.

It breaks with a very short fracture, and if the two pieces be separated very gently from one another delicate mucilaginous threads will be seen connecting them; these threads are the elas-

Fig. 97.—Euonymus root-bark. Natural size.

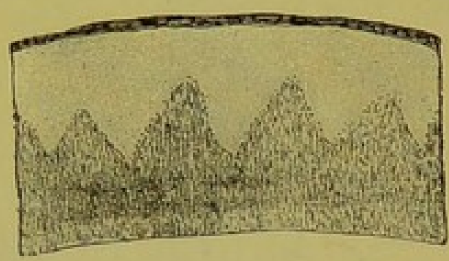


Fig. 98. — Euonymus root-bark. Transverse section, magnified. (Planchon and Collin.)

tic, mucilaginous contents of certain of the cells of the bast. The section, which is of a greyish-white colour, exhibits, when moistened, a narrow whitish cork, a pale cortex and darker bast.

The bark has a faint but characteristic odour, and a disagreeable and persistent, bitter, acrid taste.

The student should observe

(*a*) The *spongy grey cork*,

(*b*) The characteristic *silky threads from the fractured surface*.

(*c*) The *bitter taste*.

Constituents.—Very little that is definite is known of the chemical constituents of euonymus bark. A nearly colourless, amorphous, intensely bitter principle, *euonymin*, has been isolated (Wenzell, 1862), as well as a *crystalline glucoside* (Meyer, 1883, Romm, 1885), resembling digitalis in its action, to which the same name has been given; the latter constituent is said not to be contained in commercial euonymin. Both of these substances must be carefully distinguished from commercial euonymin, which is a powdered extract, and from the crude mixture of substances precipitated by water from a concentrated alcoholic tincture, which is also known as euonymin.

Uses.—Euonymin (the powdered extract) is an hepatic stimulant, direct cholagogue, and mild cathartic. It is used in constipation and in hepatic derangements.

Stem-bark.—The stem-bark, which, although not official, is a commercial article, occurs in long thin narrow strips; it has a dark greenish-grey cork, green cortical portion, and fibrous bast; it is therefore easily distinguished from the root-bark.

ALDER BUCKTHORN BARK

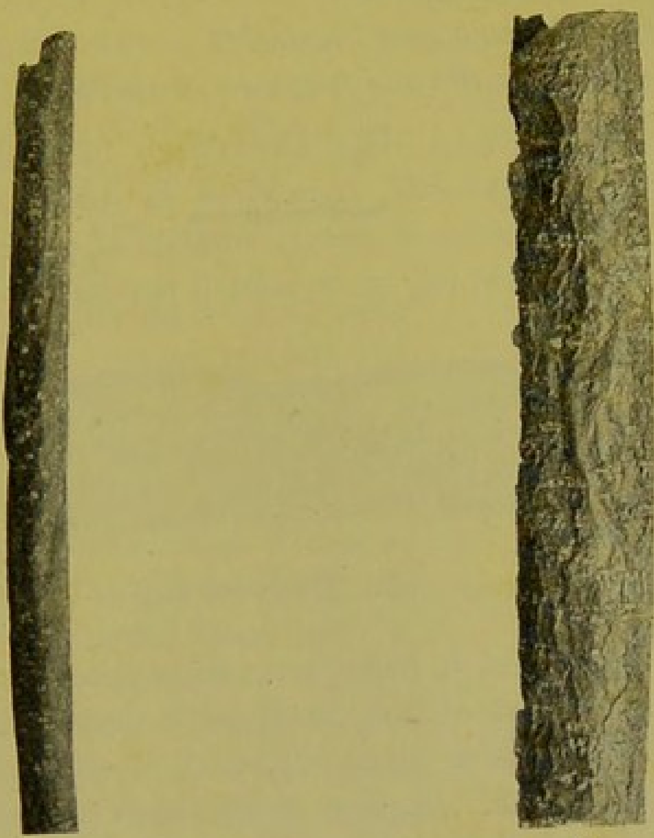
(Cortex Rhamni Frangulæ)

Source &c.—The alder buckthorn, *Rhamnus Frangula*, Linn. (N.O. *Rhamneæ*), is a shrub indigenous to and not uncommon in *England*, and distributed generally over *Europe*. It is distinguished from the common buckthorn (*R. cathartica*, Linn.), the only other indigenous species, by its entire leaves, hermaphrodite flowers with five stamens, and the absence of thorns.

The medicinal value of the bark appears to have been known in the middle ages, but forgotten until recent years when its use was again advocated. Even now it appears to meet with little favour.

The bark is stripped from the stem and branches, the wood of which is valued for making charcoal. When fresh it has an unpleasant odour and taste, and acts as an emetic, properties which are all lost when the bark is dried and kept; alder buckthorn bark should not therefore be employed medicinally until it has been kept for at least a year.

Description.—The dried bark as found in commerce varies very much in size according to the size of the stem or branch from which it has been collected. It occurs in single or double quills which may be as much as $1\frac{1}{2}$ inch in diameter or as little as $\frac{1}{4}$ inch; commonly they are several inches in length. Young bark is usually extremely thin, almost papery in texture, with a smooth, glossy, dark-purplish exterior marked with small circular or transversely elongated whitish lenticels. The cork frequently exfoliates, or at least easily separates, disclosing a yellowish-brown cortex; but if the outer layers of cells alone be removed by scraping, the inner part of the cork is of a dark



A B

Fig. 99.—Alder Buckthorn bark. A, young, B, older bark. Natural size.

crimson colour. The inner surface is dark cinnamon-brown in colour and nearly smooth, exhibiting under the lens fine longitudinal striations.

The fracture is short in the outer, but rather fibrous in the inner part, groups of bast fibres projecting a short distance beyond the fractured surface.

The transverse section shows under the lens a narrow dark purple cork and yellowish-brown cortex and bast.

Older bark is commonly much rougher. It has usually a dull dark purple colour, and is marked with transversely elongated lenticels and shallow longitudinal fissures, the cork exhibiting less disposition to exfoliate. The transverse section shows a similar purple cork; the bast is thicker and allows of very fine medullary rays being distinguished.

The bark has no odour and a taste that is scarcely bitter. As previously observed, it should not be used medicinally until at least a year after its collection.

The student should observe

(*a*) The *dark purple cork*, showing, when scraped, a *deep crimson colour*,

(*b*) The *light-coloured lenticels*,

(*c*) The *shortly fibrous fracture* of the bast.

Constituents.—From alder buckthorn bark that has been kept as directed, a glucoside, *frangulin*, is obtainable in yellow crystals. This substance is slowly volatile at ordinary temperatures, and stains white paper, in which the bark has been kept,

2120- thin.

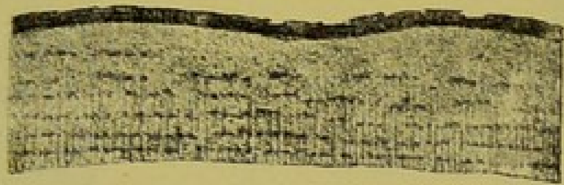


FIG. 100.—Alder Buckthorn bark. Transverse section, magnified. (Berg.)

yellow; it is not found in fresh bark, and appears to be produced from some constituent of the fresh bark that is at present unknown. Frangulin is a glucoside, and yields by hydrolysis a sugar (rhamnose) and *emodin* (sometimes called frangulinic acid), which is also found in the free state in the bark. *Frangulic acid* (pseudo-frangulin, Aweng, 1897), another constituent of the bark, has not yet been obtained pure; it resembles the cathartic acid of senna, and like that substance is laxative. The aperient action of alder buckthorn bark is probably due to the combined effect of the frangulin, emodin, frangulic acid, and possibly other unknown constituents. The emetic action of the fresh bark has been attributed to a ferment which is destroyed by heat (Aweng, 1897), but this statement requires confirmation.

Uses.—Alder buckthorn bark has been used as an agreeable laxative, preferable to cascara sagrada on account of its more agreeable taste.

CASCARA SAGRADA

(Cortex Rhamni Purshiani, Sacred Bark)

Source &c.—Cascara sagrada, as this drug is commonly called, is the bark of *Rhamnus Purshianus*, DC. (N.O. *Rhamneæ*), a shrub or small tree abundant in north California and very abundant in the states of *Washington* and *Oregon*. The bark of *R. californicus*, Eschsch., was known to the Spanish settlers in California as cascara sagrada, a name which has since been applied to the bark of the closely allied *R. Purshianus*. The latter has been much used as a laxative since 1883.

The bark is collected in the spring and early summer, as soon after the rains as possible. At that season it is easily peeled from the wood, and when dried curls into quills. If left till later in the year it adheres so firmly to the wood that it has to be cut off, and then brings shavings of wood with it.

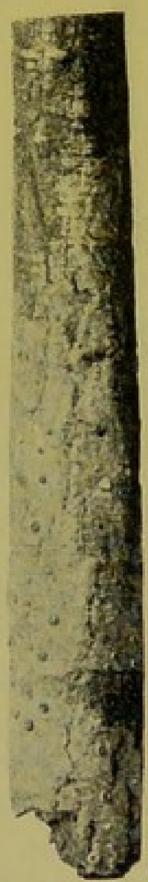


Fig. 101.—Cascara Sagrada bark. Natural size.

Description. — Cascara sagrada occurs in straight, stiff, single quills or in channelled pieces. The quills vary from $\frac{1}{4}$ to 1 inch or more in diameter, whilst the channelled or sometimes flattish pieces may be as much as 4 inches wide; commonly the drug is seen in pieces about 4 or 6 inches long, $\frac{3}{4}$ inch across, and from $\frac{1}{16}$ to $\frac{3}{16}$ inch thick, the thinnest being most esteemed.

The outer layer is a smooth, dark purplish-brown cork marked with transversely elongated whitish lenticels. The bark, however, is usually more or less completely covered with silvery grey patches of lichens which conceal the purple cork and the lenticels and give to the drug its pervading greyish-white colour, but they can easily be removed by scraping, disclosing the purplish cork. The inner surface is of a dark, or even very dark, reddish-brown colour and longitudinally striated, with faint transverse corrugations.

The fracture is short; that of the bast being shortly fibrous. The smoothed transverse section exhibits under the lens a narrow purplish cork, a yellowish-grey cortex in which darker translucent points (groups of sclerenchymatous cells) can be distinguished, and a brownish-yellow bast in which wavy, somewhat distant medullary rays may sometimes be discerned.

The bark has a characteristic though not strong odour, and a persistent, nauseously bitter taste.

Like alder buckthorn bark, this drug should be kept for at least a year before it is used medicinally; the action is then milder and less emetic. It also shares with alder buckthorn bark the property of imparting a yellow colour to the paper in which it is kept.

The student should observe

(*a*) The *purplish cork* and the *grey lichens* covering it,
(*b*) The *groups of sclerenchymatous cells* in the cortex,
(*c*) The *characteristic odour and taste.*

Constituents.—Our knowledge of the constituents of cascara bark is very deficient. *Emodin* has been isolated from it in orange-yellow crystals, and *frangulin*, which yields emodin by hydrolysis, is probably also present. Several *resins* have been separated, to one of which the bitter taste is said to be due.

Dohme and Engelhardt (1898) ~~claim to~~ have isolated a purgative glucoside, *purshianin*, in dark brown-red crystals melting at 237° C. By hydrolysis purshianin yields emodin and a sugar. ~~These results await confirmation~~.

Uses.—Cascara sagrada is tonic and stomachic in small doses, aperient in large doses, and cathartic if freely given. It is said to be more active and more certain than alder buckthorn.

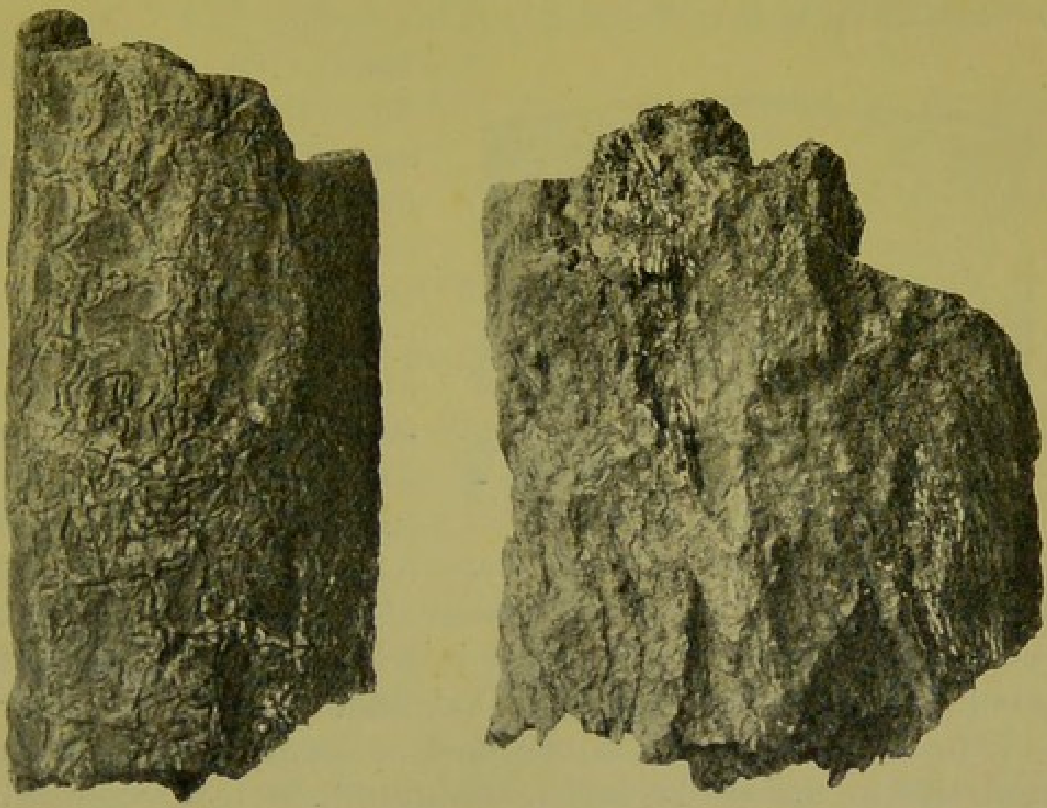
Substitutes.—The bark of *R. californicus*, Eschsch., has been substituted for that of *R. Purshianus*. The shrub occurs sparingly in north California, but abundantly in the south and east of the state, as well as in Arizona, New Mexico, and Texas. The bark is said to be distinguished by its dull grey, slightly reddish cork, its fewer lenticels and uniform coat of lichens; the inner surface is said to be paler, and the medullary rays commonly 3 to 4 cells wide, those of *R. Purshianus* being only 2 to 3 cells wide.[1] The two plants are, however, so closely allied that some botanists refer them to the same species.

N.O.

SASSY BARK

(Red Water Bark, Cortex Erythrophlei)

Source &c.—Sassy bark is derived from *Erythrophleum guineense*, G. Don (N.O. *Leguminosæ*), a large tree indigenous to the *west coast of Africa* (Upper Guinea and Senegambia). Possibly other species than *E. guineense* yield the sassy bark of



A B

Fig. 102.—Sassy bark. A, portion of bark of medium thickness, showing fissured surface; B, portion of very thick bark showing rugged surface, with depressions produced by exfoliation of the outer portion.

commerce, as certain differences have been observed in the alkaloid obtained from the bark imported at different times.

It has poisonous, emetic, and purgative properties, and is used by the west African negroes as an ordeal poison to distin-

[1] I have not been able to verify these differences in the specimens of bark I have examined.

guish the guilty from the innocent. An alkaloid prepared from it was recommended in 1875–77 as a substitute for digitalis.

The bark is collected from the trunk as well as from the larger and smaller branches.

Description.—Sassy bark varies exceedingly in size and thickness with the age of the stem or branch from which it has been collected. Most common are hard heavy curved or flat pieces about 3 or 4 inches long, 2 or 3 inches wide, and about $\frac{1}{4}$ or $\frac{3}{8}$ inch thick; but small quills, not $\frac{1}{2}$ inch in diameter, may sometimes be found.

In pieces of medium thickness (about $\frac{1}{4}$ inch) the outer layer (cork) is usually of a dull grey colour, but sometimes it is so dark as to be nearly black; it is interrupted by reddish warts or circular spots that eventually fuse together into longitudinal bands. Older and therefore thicker barks are rugged, and have a more uniform reddish-brown colour. They often exhibit conchoidal depressions of considerable size ($\frac{1}{2}$ to 1 inch long), the whole surface, elevations as well as depressions, being ruggedly ridged. In these barks most of the primary cortex has been exfoliated by the formation of cork. Very young bark is comparatively smooth and dark in colour; it bears occasional small reddish warts and exhibits longitudinal reddish bands.

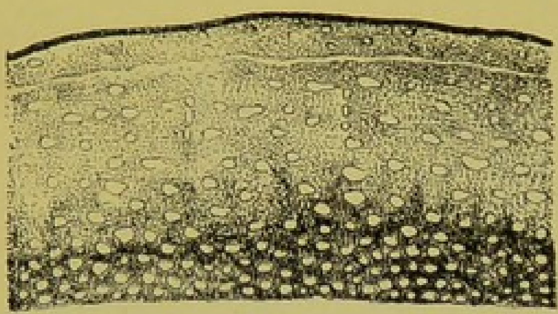


Fig. 103.—Sassy bark. Transverse section, magnified, showing the distribution of sclerenchymatous tissue. (Planchon and Collin.)

The inner surface exhibits shallow longitudinal striations or elevations, and is of a dark reddish-brown or, more commonly, dull black colour.

The bark is extremely hard, and breaks with a very short granular fracture. The transverse section examined under the lens is most characteristic. The cork appears as a narrow brownish line; the cortex is narrow and darker in colour, and separated from the bast by a pale complete or interrupted line of sclerenchymatous cells. The bast, which constitutes the major part of the larger and thicker pieces, exhibits numerous large closely approximated groups of sclerenchymatous cells embedded in reddish-brown (parenchymatous) tissue. The structure of this portion of the bark is discernible with the naked eye, and is identical in both young and old bark. The bark has no odour, and only a slightly bitter and astringent taste.

The student should observe

(*a*) The *reddish-brown warts* (*or outer surface*) and the *nearly black inner surface*,
(*b*) The *hard granular fracture*,
(*c*) The *sclerenchymatous cells* in the bast.

Constituents.—Sassy bark contains an alkaloid, *erythrophleine*, possessing an action similar to that of foxglove.

Erythrophleine has not yet been obtained in a crystalline form, nor has it been sufficiently investigated.

The hydrochloride has been recommended for medicinal use, but is not now much employed.

Uses.—Erythrophleine has been found useful in certain forms of heart disease.

WILD CHERRY BARK

(Virginian Prune Bark, Cortex Pruni Virginianæ)

Source &c.—The bark that is commonly known as 'wild cherry bark,' and officially in the British Pharmacopœia as Virginian prune bark, is obtained from *Prunus serotina*, Ehrh. (N.O. *Rosaceæ*), the black cherry, a tree widely distributed over *North America*, especially throughout the northern and central States. The wood is highly valued for cabinet work, whilst the bark is employed medicinally, having come into extensive use in America during the latter part of the eighteenth century.

The bark of the trunk is of a blackish-brown colour and rough; that of the twigs and smaller branches is smooth or even glossy, dark reddish-brown in colour, and bears numerous whitish lenticels. For medicinal use, bark from the smaller branches is collected in the autumn, at which time experiments have proved it to be most active; that from the trunk has been shown to be inferior to that from the branches (Stevens, 1896).

Description.—Wild cherry bark varies considerably in appearance. It occurs usually in flattened, curved, or recurved pieces, not quills, as much as 5 inches long and 2 inches broad; generally they are smaller and average about $\frac{1}{12}$ inch in thickness. Young bark is frequently covered with a thin, smooth, often glossy, reddish-brown cork, much interrupted by whitish lenticels which are strongly tangentially elongated. It can easily be peeled off in thin, membranous, tangential strips, disclosing a smooth greenish-brown cortex. Much of the commercial drug has been deprived of its cork, and then the smooth greenish-brown cortex, bearing scars corresponding to the lenticels, constitutes the outer layer. Sometimes even this has been removed, and the exposed part is then the outer layer of bast, which has a rough or rasped appearance and is of a uniform dark cinnamon-brown colour; examined under the lens such bark exhibits pale longitudinal strands (sclerenchymatous cells) alternating with darker parenchymatous tissue (medullary rays).

FIG. 104.—Virginian Prune bark, showing transverse lenticels and papery cork peeling off. Natural size.

The inner surface of the bark is of a cinnamon-brown colour and is finely longitudinally striated or rough, with reticulately anastomosing pale strands (bast fibres), the interstices of which are only partially filled with the brown (parenchymatous) tissue of the medullary rays.

The fracture is short and granular; the fractured surface has a reddish-grey colour, and usually exhibits numerous tortuous, pale red medullary rays alternating with bast rays containing much sclerenchymatous tissue, and projecting therefore beyond the medullary rays, owing to their contracting less when drying.

The bark has a slight odour of bitter almonds, which becomes much more apparent when it is moistened; the taste is astringent, aromatic and bitter, resembling that of bitter almonds.

The student should observe

(*a*) The *reddish-brown cork with numerous lenticels,*

(*b*) The *irregularly reticulated or fissured inner surface,*

(*c*) The *granular fracture,*

(*d*) The *taste of bitter almonds* when chewed.

Constituents.—Wild cherry bark yields, when moistened with water, hydrocyanic acid and benzaldehyde. This reaction led Procter (1838) to assume the presence of amygdalin, which was hydrolysed by the action of a ferment, possibly emulsin, giving rise to hydrocyanic acid, benzaldehyde, and dextrose. Power and Weimar (1887) were unable to isolate amygdalin, but found an *amorphous substance* closely allied to laurocerasin; the *ferment* by which it was hydrolysed was apparently not identical with emulsin. To this principle, hydrolysed by the action of a particular ferment, is due the development of benzaldehyde and hydrocyanic acid (compare the constituents of bitter almonds and of cherry laurel leaves).

Experiments have shown that thin green bark collected in the autumn from trees of moderate size yields most hydrocyanic acid (0·12 to 0·16 per cent.); the bark of the root is said to be more active than that from the stem or branches (Stevens, 1896).

The bark contains also *tannin* and a crystalline *bitter fluorescent glucoside*, to which the bitter taste of the drug is to be ascribed.

Uses.—The bark has mild tonic and sedative properties; it is frequently given for coughs and chest complaints.

Resu

QUILLAIA BARK

(Panama Wood, Soap Bark, Cortex Quillajæ)

Source.—Quillaia bark, or, as it is often called, soap bark, is obtained from *Quillaja saponaria*, Molina (N.O. *Rosaceæ*), a large tree indigenous to Chili and Peru. The bark, which is called 'cullay' by the natives and has apparently been long used by them for washing silk and wool, was known to Europeans in the early part of the eighteenth century, but was not regularly imported until about 1857, when it was sent to France under the name of 'Bois de Panama,' the name indicating the route by which it was sent. It is evidently stripped from the trees in large pieces, freed from the outer dark-coloured portion (bark), and dried. The tree has been introduced into India, where it yields a bark identical with the commercial drug.

Description.—Soap bark comes into commerce in large flat pieces measuring some 3 feet in length by 4 or 6 inches in breadth; it is usually about $\frac{1}{4}$ inch thick, and evidently the produce of trunks of considerable size.

The outer surface is usually of a pale brownish- or yellowish-white colour, longitudinally striated and streaked with reddish brown where the outer portion (bark) has been imperfectly removed. Sometimes, from insufficient trimming, the bark is of a uniform dark dull red colour and bears patches of the outer bark still adhering to it. The inner surface is smooth and white or yellowish-white.

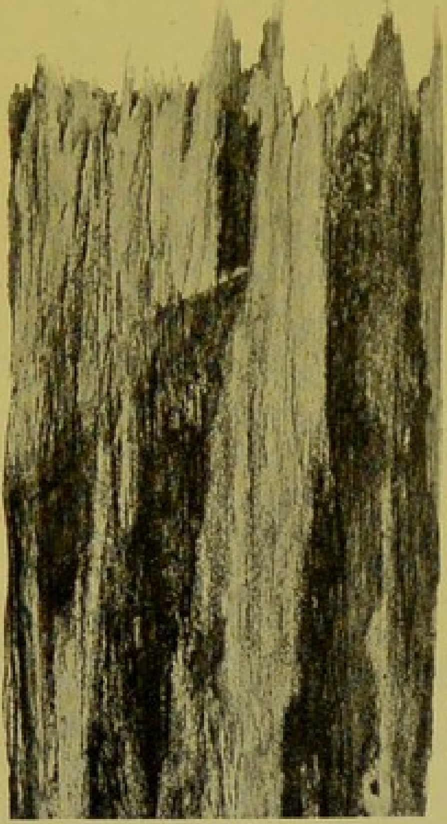


Fig. 105.—Quillaia bark, showing splintery fracture. Natural size.

The bark breaks with a splintery fracture, and the fractured surface exhibits a disposition to separate into thin plates or laminæ. Here and there, especially on the freshly fractured laminated surfaces, but also on the smooth inner surface of the bark, minute, glittering, prismatic crystals (calcium oxalate) can be seen with the naked eye, or better with a lens; sometimes these are present in considerable numbers.

The smoothed transverse section is seen under a lens to be traversed by parallel tangential and radial lines, which give it a chequered appearance; the tangential lines are tangentially arranged bands of bast parenchyma, the radial are medullary rays, the darker portions between being groups of bast fibres.

The bark is almost odourless, but small portions dislodged when it is handled or broken are extremely irritating to the nostrils and fauces and give rise to prolonged fits of sneezing; the taste is acrid and unpleasant.

The student should observe

(a) The *splintery, laminated fracture,*
(b) The *glittering crystals of calcium oxalate,*
(c) The *very smooth inner surface,*
(d) The *appearance of the transverse section*;

and should compare this bark with

(i.) *Elm bark*, which is fibrous and has a roughish, not smooth, inner surface,

(ii.) *Slippery elm bark*, which has a decided odour of fœnugreek and is very fibrous.

Constituents.—The principal constituents of quillaia bark are two amorphous, toxic glucosides, *quillajic acid* and *sapotoxin.* quilla The former is soluble in alcohol, the latter insoluble. Both communicate to water the property of frothing, and both are poisonous, but to sapotoxin alone the acrid taste and sternutatory effect are due (Kobert, 1887).

Commercial saponin, which is usually obtained from quillaia bark, is a mixture of quillajic acid, sapotoxin, a carbohydrate, and frequently also an inert modification of quillajic acid produced during the preparation of the substance. This inert modification appears to differ from quillajic acid principally in its want of toxicity, and to this body—which, when pure, is tasteless, inactive, and not sternutatory—the name saponin should, according to Kobert, be restricted. It is, however, frequently applied to impure substances from different sources, having in common the acrid taste and the power of communicating to water the property of frothing.

Sapotoxin, quillajic acid, and pure saponin all yield by hydrolysis the same bodies, and hence stand in close relation to one another (Kobert).

Uses.—Quillaia bark has been recommended as a stimulant and expectorant, but has not met with much favour. A tincture is largely used as a means of emulsifying tars &c.

WITCH-HAZEL BARK

(Cortex Hamamelidis)

Source &c.—The witch hazel, *Hamamelis virginiana*, Linn. (N.O. *Hamamelideæ*), is a common shrub in the United States and Canada. It attains a height of about 10 feet, and resembles the common hazel both in its leaves and its fruit, which is edible. The bark should be collected in the spring.

Description.—Witch-hazel bark occurs in thin channelled pieces of a characteristic pale reddish-pink colour, occasionally as much as 6 or 8 inches long and 1 inch wide, but usually much smaller. They are sometimes covered with an ash-grey smooth cork which in older pieces becomes darker in colour, fissured, and scaly. Frequently the cork has been removed and the cortex forms the outer layer, which is then pale reddish-brown in colour and nearly smooth, exhibiting under the lens slight transverse striations

Fig. 106.—Witch-hazel bark, showing scaly cork. Natural size.

The inner surface is pale reddish-pink in colour and finely striated longitudinally; small portions of white wood, which is seen in transverse section to be dense and traversed by numerous fine medullary rays, are frequently found adhering to it.

The outer portion of the bark (cork and cortex) breaks with a short fracture, but the inner portion (bast) is coarsely fibrous and disposed to separate into laminæ, due to its containing numerous tangentially elongated groups of bast fibres. The smoothed transverse section exhibits under the lens a dark narrow cortex and a pale tangential line (sclerenchymatous cells) separating this from the bast. In many of the pieces the cork and much of the cortex have been removed, and the ring of sclerenchymatous cells may then form the outer layer.

The bark has no odour, and an astringent, slightly bitter taste.

The student should observe

(*a*) The *pinkish colour*,
(*b*) The *pale grey but not glossy cork*,
(*c*) The *line of sclerenchymatous cells*;

and should compare this bark with

(i) *Oak bark*, which has a glossy, silvery cork and usually a brownish colour,
(ii) *Willow bark*, which has a dull greenish-brown cork, is usually longitudinally striated on the outer surface, and does not exhibit a line of sclerenchymatous cells.

Constituents.—The bark contains about 6 per cent. of *tannin*, part of which, hamamelitannin, is crystalline and part amorphous; gallic acid is also present (Grüttner, 1898).

Uses.—It is astringent and hæmostatic, and is useful in hæmorrhages from the nose, lungs, rectum, or uterus.

POMEGRANATE BARK

(Cortex Granati)

Source &c.—The pomegranate tree, *Punica Granatum*, Linn. (N.O. *Lythrarieæ*), is a shrub or small tree indigenous to north-western India, but cultivated generally in the warmer parts of the temperate regions, especially in the *countries bordering on the Mediterranean.* More than one variety is known, but that producing crimson flowers is the commonest. Gran-acea

The vermifuge action of the pomegranate was well known to the ancients, who employed the juice of the fruit mixed with wine, as well as the small roots and a decoction of the root-bark. The drug appears to have been subsequently forgotten, but at the beginning of the present century its use among the Hindoos attracted the attention of English physicians, and it began to be successfully employed. The bark of the root is said to be the most efficacious, especially when administered in the fresh state, but analyses have shown that the stem-bark is only inferior in the proportion of alkaloid it contains (Ewers, 1899). As it is impossible to procure the root-bark alone in commerce, the official description has been framed so as to include that of the stem.

FIG. 107.—Pomegranate root-bark. Transverse section, magnified. (Berg.)

Description.—Pomegranate bark occurs in irregular, curved or channelled pieces, varying usually from 2 to 4 inches in length and from ½ to 1 inch in width; it seldom forms quills.

The root-bark has a rough outer surface of an earthy yellow colour with darker patches and is marked with conchoidal depressions, due to exfoliation of the outer portion. The inner surface is smooth and yellow in colour, with irregular, darker, brown blotches.

It breaks with a very short fracture, the fractured surface being nearly white and exhibiting under the lens numerous fine tangential and still finer radial lines.

The stem-bark differs from the root-bark in being smoother. It exhibits no conchoidal depressions, the formation of cork being less abundant, but it presents occasional, shallow, longitudinal furrows and bands of pale cork. Very frequently the minute apothecia of lichens can be detected on it; these are not to be found on the root-bark. The latter, too, is usually in more irregular, curved, flattish or even recurved fragments, whilst the stem-bark is in straighter, channelled pieces and sometimes in quills.

The bark of both stem and root is odourless, but has an astringent, slightly bitter taste.

The student should observe

(*a*) The *short fracture* and *pale interior*,
(*b*) The *yellow colour of the inner surface with brown patches*,
(*c*) The comparatively *smooth surface of the stem-bark* and the frequent *presence of lichens*,
(*d*) The *rough surface, conchoidal depressions*, and *absence of lichens* characteristic of *root-bark*.

Constituents.—The principal constituents of pomegranate bark are the alkaloids it contains. Four of these have been isolated (Tanret, 1878–1880); three, viz. *pelletierine*, *methylpelletierine*, and *isopelletierine*, are liquid, whilst one, *pseudopelletierine*, is crystalline. To these alkaloids the vermifuge
nrite. properties of the bark are due. They exist to the extent of about 0·5 per cent. in the stem-bark and 0·6 to 0·7 in the root-bark (Ewers, 1899). The average of commercial bark, which is principally stem, is only 0·35 per cent., the proportion of alkaloid gradually diminishing as the bark is kept.

A white-flowered variety in Java yielded 1·48 per cent. of alkaloid in the root-bark, and the suggestion has been made to cultivate this variety in tropical countries and export either the dried root-bark or an extract prepared from it.

Pomegranate bark contains, in addition to the alkaloids,
Lrico. tannic acid.

Uses.—Pomegranate bark has an anthelmintic and slightly irritant action, but is somewhat astringent unless taken freely.

It is used in the treatment of tapeworm, which is expelled (not actually killed) by the decoction, or by the sulphate of pelletierine.

CINCHONA BARK

Source &c.—The genus Cinchona embraces, according to Baillon, about twenty species, all of which are indigenous to *South America* and restricted in that country to the *chain of the Andes extending from western Venezuela, through New Granada, Ecuador, and Peru, to Bolivia.* On the spurs of this mountain range, at an elevation of about 5,000 to 7,000 feet, where the climate is warm and moist, the cinchona trees occur usually singly, not forming forests and seldom groups. They are evergreen shrubs or trees, frequently of handsome appearance and considerable size, attaining upwards of 100 feet in height.

The natives of Peru and Bolivia appear to have been only imperfectly acquainted with the febrifuge properties of the bark of these trees; at least they seldom employed it. In 1638 the Spaniards learnt the use of the drug when the Countess Chinchon, wife of the Viceroy of Peru, was cured of fever by its means. The bark soon found its way into Spain, probably by the aid of the Jesuits, who were frequently instrumental in introducing new drugs into Europe; it was known as Countess bark, Jesuit's bark, or Peruvian bark, and early in the eighteenth century the trade in it at Loxa in Ecuador had assumed considerable proportions.

Just about this time (1736) the expedition sent by the Paris Academy of Sciences to measure a degree of the earth's surface at the equator, which was accompanied by the botanist Jussieu, found trees, hitherto unknown, that yielded valuable cinchona bark. The botany of these trees was subsequently specially investigated by Mutis (1760), Ruiz and Pavon (1778-1788), Weddell (1845-1848), and others.

The method that was adopted of collecting the bark—viz. by felling the tree and stripping the bark from it—very soon aroused fears that the trees would eventually be exterminated. Attempts were made by the Jesuits to induce the bark collectors to plant young trees to replace those that they destroyed, and suggestions and attempts to cultivate the trees were not wanting. These eventually culminated in Markham's expedition to Peru and Bolivia (1859), which was successful in introducing *Cinchona succirubra*, *C. officinalis*, and other species into British India, the cultivations being commenced at positions in the Himalayas and Neilgherries that had already been recommended by Royle.

A few years previously the German botanist Hasskarl was commissioned by the Dutch on a similar expedition, and succeeded in bringing plants and seeds to Java.

From small beginnings the cultivation of cinchona trees in British India, Ceylon, and Java has rapidly assumed such enormous dimensions that the world is practically independent of South America for its supply of quinine. Part only of the plantations belong to either the English or Dutch Government, the bulk are conducted as private enterprises, and the cultivation of cinchona trees is being pushed forward in many other countries besides the two referred to, as, for instance, in Jamaica, Bolivia, tropical Africa, &c.

The chief species of cinchonas that yield commercially valuable barks are

1. *Cinchona Calisaya*, Wedd., southern Peru and Bolivia.
2. *C. Ledgeriana*, Moens, southern Peru and Bolivia.
3. *C. officinalis*, Linn., Ecuador and Peru.
4. *C. succirubra*, Pav., Ecuador.

The first three of these species—viz. *C. Calisaya*, *C. Ledgeriana*, and *C. officinalis*—yield barks rich in quinine, and it is to the cultivation of these three species, especially *C. Ledgeriana*, that attention is now being directed. *C. succirubra* has been largely grown in India, but is now being replaced by other more valuable species. *C. lancifolia*, Mutis, and certain other species yield barks that are poor in quinine; they are therefore not cultivated, but nevertheless these barks are imported from South America and used to some extent as sources of the cinchona alkaloids.

Collection.—The following methods have been adopted in collecting cinchona bark:

1. *Felling.*—In South America the bark is collected, usually in the rainy season, by felling the tree, stripping the bark from it, and drying it either in the sun or over a gentle fire in huts. Large thick pieces from the trunk and large branches are pressed under weights, and often freed from the dead outer portions (bark), and occur therefore in commerce in the form

of thick, flat, heavy pieces (*flat bark*); the bark from the smaller branches curls as it dries into quills (*quilled bark*). Hence the bark from the same tree may occur in two forms differing very considerably in appearance. Cultivated trees are not allowed to attain the age or size of the South American forest trees, and yield therefore no flat bark.

2. *Mossing* and *Renewing*.—MacIvor found in 1863 that, if the bark were removed in longitudinal strips and the trunk were afterwards protected by covering it with moss, the cambium rapidly replaced the bark that had been removed by a fresh growth, and this fresh growth proved to be richer in alkaloid than the natural bark of the tree. This method of collecting the bark was largely adopted in India, and is practised as follows: When the trees have reached a sufficient age longitudinal incisions are made and alternate strips of bark about 1½–2 in. wide are removed, leaving the intervening strips untouched. The bark thus collected, which has not been subjected to any artificial treatment, is known as 'natural bark.' The trunk is then covered with moss, paper, straw, or other protecting material, and left to replace the bark that has been stripped off. After a sufficient time has elapsed the covering is removed, and the strips that were left on the first occasion are now collected; these have spent part of their life under a protecting covering of moss, and are called 'mossed' bark.

The tree is now again covered, and having been deprived by the first two strippings of all its original bark, yields, when visited for the third time, bark that has been entirely developed under the covering of moss to replace that which had been removed; this is 'renewed' bark.

The process is an interesting one, and has been successfully used, but the labour and consequently the expense it involves are considerable.

3. *Shaving*.—By this modification of renewing, only a portion of the bark is removed by shaving; the remainder is left on as a protection to the tree, which therefore does not require any covering of moss.

Both these methods are being abandoned in favour of the following:

4. *Uprooting*.—The tree is allowed to grow until it has attained the age at which it yields the maximum proportion of alkaloid. It is then uprooted and the bark stripped from the

root as well as from the stem. By this means the valuable root-bark is secured, and the land can then be planted with a different variety of cinchona.

5. *Coppicing.*—The tree is cut down to form stools, from which adventitious shoots arise. These shoots yield handsome quills of bark, and the method is specially suited for the production of the quilled bark sold to the pharmacist.

The bark is usually collected in the rainy season, when it separates easily from the stem; the colour of the inner surface of the fresh bark is always pale, but by the action of the air a change in the tannin rapidly takes place, and the bark assumes a brown or red colour. The drying is usually effected in the sun, or frequently by artificial heat in a specially constructed drying machine. For exportation, the bark is usually pressed by hydraulic pressure into firm bales (as in Ceylon) or stamped into sacks (as in Java), or, in the case of fine quills for druggists' use, carefully packed in cases.

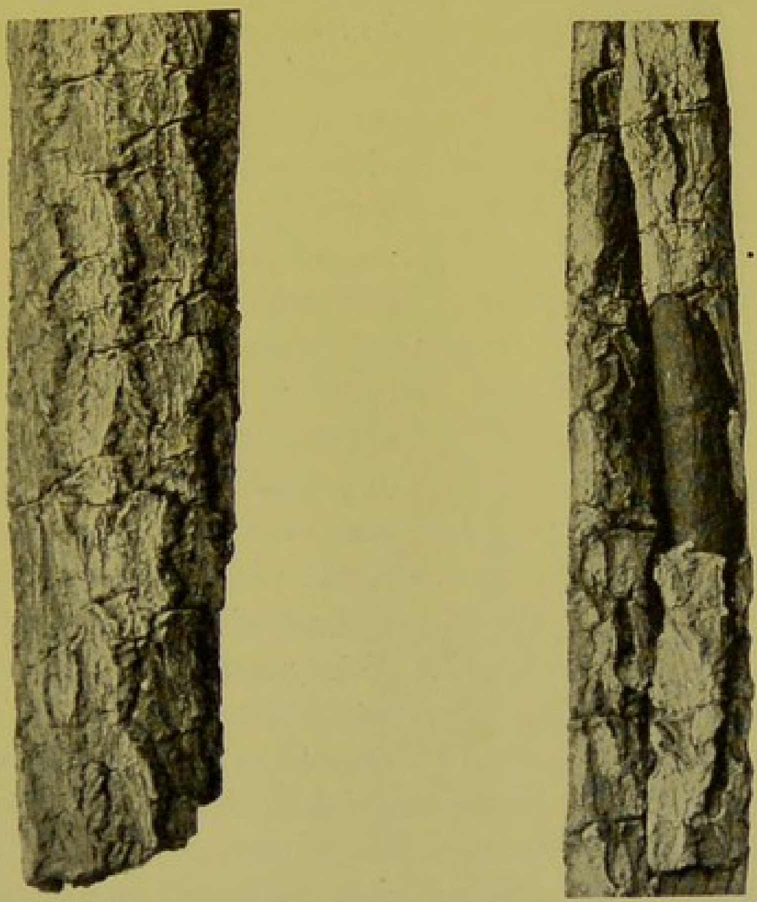
Description.—The commercial varieties of cinchona bark yielded by the following species of *cinchona* may be briefly described.

1. *C. Calisaya.*—The bark yielded by this species is sometimes called 'yellow' bark, but as this term is also applied to all cinchona barks exhibiting a distinctly yellowish-brown colour it is better to specify this variety of yellow bark as calisaya bark.

Calisaya Bark was formerly imported in two distinct varieties, viz. (a) *flat* and (b) *quill calisaya*, but the former is now seldom seen.

(a) *Flat calisaya* was formerly imported in thick, flattish, heavy pieces 6 or 8 inches or more in length, from 2 to 4 inches in width, and varying frequently from $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness. The inner surface was tawny yellowish-brown in colour and showed a close fibrous structure, the undulating course of the fibres often communicating a wavy appearance to the bark. The outer surface was darker and marked with broad, shallow, longitudinal depressions (digital furrows). These were caused by the formation in the bark of concave lines of cork, by which shallow curved pieces of the bark had been cut off. This outer bark was commonly removed from the drug before exportation.

(b) *Quill Calisaya.*—This, which at present is the variety of calisaya bark commonly seen, is principally obtained from plantations of *C. Calisaya* in Bolivia, and is the produce therefore of cultivated trees. It occurs in quills varying usually from $\frac{1}{2}$ to 1 inch in diameter and 1 foot or more in length, fine specimens attaining 2 feet in length and 2 or 3 inches in diameter. The outer surface is of a dull dark grey or dull brownish colour marked with lighter, whitish patches. The outer layer is rugged, and exhibits shallow, rather broad longitudinal fissures that are frequently of a brownish colour, and hence, even if



A B

Fig. 108.—Calisaya bark. A, showing the longitudinal fissures and transverse cracks, natural size; B, showing in addition exfoliating cork, natural size.

not deep, are easily seen. Transverse cracks mark the bark at distances of $\frac{1}{4}$ to $\frac{1}{2}$ inch. This layer shows in many pieces a decided disposition to exfoliate in flakes, the inner portion, which is of a dull yellowish-brown colour, bearing impressions corresponding to the cracks of the cork.

The bark breaks with a shortly fibrous fracture, the smoothed section exhibiting a narrow dark brown outer layer (cork) and brown inner portion.

The taste is distinctly bitter and astringent, the former quality predominating.

2. *C. Ledgeriana.*—This species, which is considered by some botanists to be a variety of *C. Calisaya*, yields a bark that very closely resembles quill calisaya in general appearance and is remarkable for its richness in quinine. On this account the tree is being largely cultivated in Java in preference to other species.

FIG. 109.—Pale bark (*C. officinalis*), showing very numerous longitudinal and transverse cracks. Large specimen, natural size.

Commercial ledger bark occurs usually in single, sometimes in double, quills about the same size as quill calisaya. The colour internally is a dull tawny brown, often with a reddish tinge; externally the quills mostly exhibit large light grey or whitish patches of lichen.

They are marked with longitudinal furrows and transverse cracks, which, however, are usually more numerous and less conspicuous than in quill calisaya. Some pieces bear distinct longitudinal ridges and scattered reddish warts that recall typical red bark (see below), but from this bark they are easily distinguished by their colour and by their taste, which is bitter but not markedly astringent. Sometimes the cork shows a distinct disposition to exfoliate as it does in quill calisaya, but in this feature the bark varies considerably.

As already observed, ledger bark bears a close resemblance to quill calisaya; it is best distinguished by its more numerous and less conspicuous longitudinal fissures and transverse cracks.

3. *C. officinalis.*—The bark of this species, commercially known as *pale cinchona bark*, is obtained chiefly from India, although it is sometimes imported from South America. It occurs in quills only, and these are much narrower than those of quill calisaya, seldom exceeding ½ inch in diameter, the bark itself

being usually less than $\frac{1}{16}$ inch thick. They are frequently inrolled on both margins, so as to form double quills. The outer surface is of a dull brown colour, and often has foliaceous lichens adhering to it. Typical pieces are marked with numerous transverse cracks often less than $\frac{1}{4}$ inch apart, in addition to which there are numerous less prominent longitudinal cracks, all of which, but especially the transverse, tend to impart to the bark a roughness to the touch that is characteristic. The colour of the inner surface is usually yellowish brown, and the taste resembles that of calisaya bark in being bitter as well as astringent.

4. *C. succirubra.*—This species yields a drug that is characterised by a more or less distinct reddish colour, and is therefore usually known as 'red bark;' it occurs in two forms, viz. 'flat' and 'quill.' The former is imported from South America, but the latter is obtained from cultivated trees, chiefly Indian.

(a) *Flat red bark* occurs in flattish pieces, often of considerable size, and attaining $\frac{3}{4}$ inch in thickness, though usually thinner; in these respects it resembles flat calisaya, but it differs from that bark essentially in having the outer bark attached; the latter is rugged, of a dusky, ferruginous-red colour, and marked with longitudinal ridges of cork as well as brighter red warts. The inner surface has also a distinctly red colour, and does not exhibit the wavy-fibrous structure characteristic of flat calisaya.

The bark has a bitter and markedly astringent taste.

(b) *Quill Red Bark.*—The only official cinchona bark is that obtained from the stem and branches of cultivated plants of *C. succirubra.* This variety of cinchona bark is imported chiefly from India, but other countries also occasionally send red cinchona bark to the market, which would be equally official provided that it corresponded to the description and test.

The quills of red cinchona vary in size, but are often about 1 inch in diameter. The outer surface is of a dull brownish-grey or reddish-brown colour, and often bears numerous greyish lichens attached to it. It is always more or less strongly wrinkled longitudinally, and marked with warts which are sometimes small and numerous or sometimes larger and scattered; in the latter case they are usually either reddish in colour or exhibit a reddish colour when broken. Some varieties of the bark bear small transverse cracks and reddish warts, the longitudinal wrinkles being less pronounced. In thickness the bark varies from $\frac{1}{8}$ to $\frac{3}{16}$ inch. The colour of the inner surface is in typical specimens reddish brown, but when this outer reddish brown is cut away the inner is yellowish brown and resembles that of pale bark. The colour is due to a change in the tannin of the bark, by which a reddish phlobaphene is produced. When removed from the tree the inner surface is white, but the tannin changes so rapidly that within thirty seconds a perceptible colour is developed (Tschirch). The bark has a distinctly

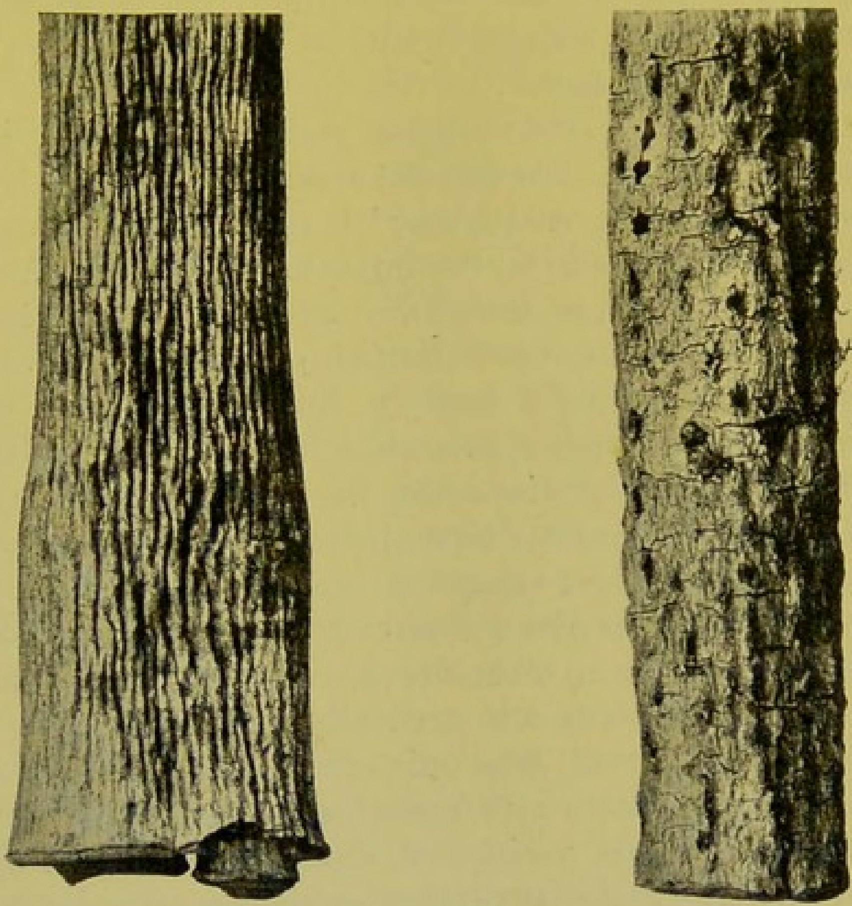

A B

FIG. 110.—Red Cinchona bark, showing longitudinal wrinkles (A), reddish warts and small transverse cracks (B). Slightly reduced.

astringent and bitter taste. The Pharmacopœia requires that it shall yield between 5 and 6 per cent. of total alkaloid, of which not less than half should consist of quinine and cinchonidine.

Branch bark may generally be distinguished from trunk bark by being thinner, by bearing more numerous wrinkles and small warts, and by being more strongly inrolled.

Renewed bark may be recognised by its more uniform brownish-red colour and few but well-developed ridges and warts.

All these varieties of red bark are characterised by their taste, which is more markedly astringent than that of pale or yellow bark.

5. *C. lancifolia.*—The cinchona barks yielded by *C. lancifolia* (Columbian, Carthagena barks) occur both in single quills and in flattish pieces; they are usually more or less spongy in texture and reddish brown in colour. They are characterised and easily distinguished by the presence of smaller or larger patches of silvery cork which are to be found on almost every piece. The bark has an astringent bitterish taste.

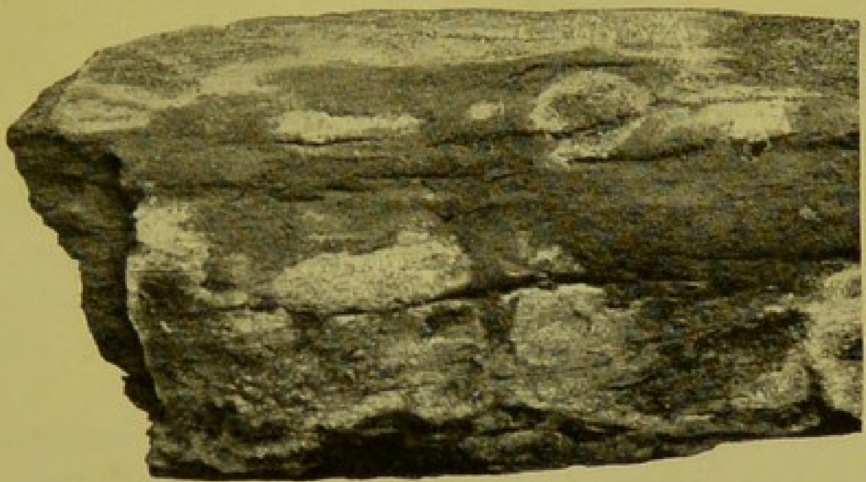


FIG. 111.—Bark of *Cinchona lancifolia*, showing patches of silvery cork. Natural size.

The student should carefully compare the principal varieties of cinchona bark and note the following prominent characters:

1. Quilled barks:
   - (*a*) *C. succirubra*; longitudinal wrinkles and reddish warts; a more or less spongy bark.
   - (*b*) *C. Calisaya*; longitudinal furrows, transverse cracks, cork often exfoliating; a firm hard bark.
   - (*c*) *C. officinalis*; very numerous small transverse and longitudinal cracks; quills usually very small and rough to the touch; a firm bark.
   - (*d*) *C. lancifolia*; more or less uniformly smooth surface with patches of silvery-grey cork.
2. Flat barks:
   - (*a*) *C. succirubra*; ferruginous red colour, reddish warts, and raised ridges; usually in thick pieces.
   - (*b*) *C. lancifolia*; exhibits the characteristic silvery cork.

Constituents.—The chief constituents of cinchona barks are the alkaloids they contain, of which a number have been isolated. Some of these are well-defined crystalline substances, and doubtless exist preformed in the bark (possibly combined with quinic or cinchotannic acid); some, on the other hand, have been obtained only in an amorphous condition; and of others, again, it is questionable whether they are not produced from other pre-existing alkaloids during the process of isolation.

The principal alkaloids in cinchona are *quinine, cinchonidine, cinchonine*, and *quinidine*; next in importance are hydroquinine, hydrocinchonidine, quinamine, and homocinchonidine.

In addition to the alkaloids, many cinchona barks also contain a very bitter amorphous glucoside, *quinovin*; a crystalline organic acid, *quinic* or *kinic acid*, also found in coffee, in the whortleberry (*Vaccinium Myrtillus*, Linn.), and other plants; a particular tannin, *cinchotannic acid*, which by oxidation rapidly yields a dark-coloured phlobaphene, *cinchona red*; starch, calcium oxalate, &c.

The total amount of alkaloid present is subject to great variation. Succirubra quills of good quality contain on the average about 6·5 per cent., Ledger bark from 6·0 to 7·0, and calisaya quills the same, whilst pale bark yields from 5·0 to 6·0 per cent. Root-bark is the richest, and stem-bark is better than branch-bark. The relative value of a bark is, however, determined by the proportion of quinine it contains.

Quinine was first isolated by Pelletier and Caventou in 1820, after Gomez in 1811 had produced from cinchona a crystalline combination of quinine and cinchonine. It occurs in the largest proportion in Ledger bark, the highest recorded yield being 14·5 per cent. This, however, is quite exceptional, the quinine in commercial Ledger bark averaging from 3·0 to 5·0 per cent. Bolivian cultivated calisaya contains from 3·0 to 4·0, and cultivated *C. officinalis* about 3·0 per cent.

Cinchonine is found in small quantity in most of the cinchona barks, especially in *C. lancifolia* and some specimens of *C. succirubra*; this alkaloïd is frequently found more abundantly in the root-bark than in the stem-bark.

Quinidine, discovered by Henry and Delondre in 1833, seldom exceeds 0·5 per cent. in any bark; it occurs chiefly in certain varieties of *C. Calisaya*.

Cinchonidine, isolated in 1847 by Winckler, is found more generally distributed and in much larger proportion than quinidine. The cultivated *C. succirubra*, which is at present largely exported from India, contains as a rule more cinchonidine than quinine, from 3 to 4 per cent. being frequently present.

All these alkaloids exist, according to de Vrij, combined with cinchotannic acid in the parenchymatous tissue of the bark.

Uses.—The cinchona barks are far too bulky for use as antiperiodics and antipyretics if quinine can be obtained. They are therefore given only as bitter stomachics and tonics. The amount of tannin contained in them indicates that they may be used when an astringent effect also is desired.

CINNAMON BARK

(Cortex Cinnamomi)

Source &c.—The cinnamon tree, *Cinnamomum zeylanicum*, Breyn (N.O. *Laurineæ*), is a small evergreen tree indigenous to *Ceylon* and cultivated there for the sake of its aromatic bark.

Cinnamon bark appears to have been collected from wild plants and exported towards the end of the thirteenth century. After the occupation of the island by the Portuguese in 1536, the exportation became more regular. In 1770 the cultivation of the tree was successfully carried out by the Dutch, who, as in other cases, made strenuous efforts to retain the cinnamon trade in their own hands, controlling the supply and the price. Soon afterwards the English obtained possession of the island, and the trade in cinnamon was diverted from Amsterdam to London.

Cinnamon is now almost entirely obtained from cultivated plants. These are cut down to form stools, from which adventitious shoots arise. When these are from 4 to 6 feet long and about a year and a half or two years old, they are cut down during the rainy season. The shoots are trimmed from the leaves &c., ringed at the nodes with a brass or copper knife (to avoid the discoloration that steel would cause), and the bark removed in strips, which are allowed to remain exposed in heaps for about twenty-four hours. Each strip is then stretched upon a stick and the epidermis and cortex scraped off, great care being taken that neither too much nor too little is removed. They are then packed inside one another so as to form sticks, which are dried, cut to a definite length, sorted, and made into bundles. The trimmings are either exported as such (cinnamon chips), or are used in the island for the distillation of the volatile oil. The leaves and petioles also yield an oil, which, however, is less valuable than that from the bark.

Description.—Cinnamon occurs in long slender flexible sticks about 40 inches in length and $\frac{1}{4}$ inch in width, each consisting of numerous (about forty) channelled pieces or single quills, not more than a few inches in length, skilfully packed into one another, the largest on the outside, so as to form a long stick of compound double quills; such a stick may easily be separated into its component parts after it has been soaked in water.

Each of the pieces of bark of which the stick is composed is of papery thickness and of a dull pale brown colour. The outer surface is marked with paler, glossy, undulating, longitudinal lines (bundles of bast fibres), and shows here and there scars or holes, indicating the insertion of leaves or lateral shoots, but does not bear even a small trace of epidermis or cork. The inner surface is rather darker than the outer, and finely striated longitudinally.

The fracture is short and rather splintery; the transverse section shows an outer pale layer (sclerenchymatous cells) and an inner dark layer (bast). Having been deprived, by scraping, of the epidermis (or cork, if any has formed) and the cortex, the drug consists entirely of the bast, and this statement corresponds with the appearance of the bark.

Cinnamon has a fragrant odour and a warm, sweet, aromatic taste.

The student should observe

(a) The *uniform colour* and *absence of cork*,
(b) The *narrow wavy longitudinal lines*,
(c) The *odour and taste*.

Constituents.—The principal constituent of cinnamon bark is the *volatile oil*, of which it yields 0·5 to 1·0 per cent.; the bark contains also *tannin* and *mucilage*. Inferior qualities are generally more mucilaginous and contain a volatile oil of inferior fragrance.

Uses.—Cinnamon is used chiefly as a flavouring agent in astringent powders and tinctures. It has aromatic and mildly astringent properties.

Substitutes.—The cinnamon tree has been cultivated in other countries, but has never yielded a bark equal in aroma to Ceylon cinnamon. This fact has been attributed to the disposition the tree exhibits to pass into numerous varieties according to the conditions of climate and cultivation. From plantations in southern India cinnamon of good quality has been obtained, whilst that exported from Brazil, the West Indies, and Java, is distinctly inferior.

CASSIA BARK

(Cassia Lignea, Chinese Cassia)

Source &c.—Cassia bark is obtained from *Cinnamomum Cassia*, Blume (N.O. *Laurineæ*), a medium-sized tree, probably a native of *Cochin China*, but cultivated now in the south-eastern provinces of the Chinese Empire (Kwang-si and Kwang-tung). This tree yields the bark known in English commerce as cassia bark or Chinese cassia lignea. Other species of *Cinnamomum* growing in the country between these provinces of China and north-eastern India yield barks to which the name of Cassia vera (or sometimes also Cassia lignea) is given ; they are exported from Calcutta and Saigon.

The bark is collected entirely from cultivated trees. When about six years old the branches are cut and all the small twigs and leaves are stripped off ; two longitudinal slits are then made, and three or four transverse incisions are cut round the circumference through the bark at intervals of about 16 inches. The bark is then removed in pieces about 16 inches long and half the circumference of the branch. These are next laid with the concave surface downwards and a small plane passed over them, by which the cork and part of the cortex are more or less completely removed. The bark is then tied up into bundles for exportation.

Description.—Cassia bark is imported in bundles about 12 or 15 inches long and weighing about a pound. The pieces of which the bundle is composed vary from 2 or 3 to 15 inches in length and average about $\frac{1}{2}$ or $\frac{3}{4}$ inch in width and $\frac{1}{8}$ or $\frac{3}{16}$ inch in thickness. They are either channelled pieces or single (but not double) quills, of a dark earthy-brown colour and smooth, but with patches of the thin greyish cork still adhering to the outer surface, indicating a want of care in trimming them.

The fracture is short, the section of the thicker pieces showing a faint white line (sclerenchymatous cells) sometimes near the centre, sometimes near the outer margin and parallel to it. In odour and taste cassia bark resembles cinnamon, but it is less delicate in aroma and more mucilaginous and astringent.

Cassia bark occurs in much larger and thicker pieces than cinnamon, seldom in double quills, and never packed into sticks. It is darker in colour, and frequently exhibits patches of cork on the outer surface.

The student should observe

(*a*) The *thickness of the bark* and its *dark colour*,

(*b*) The *patches of cork*.

Constituents.—The constituents of cassia bark are the same as those of cinnamon. It yields from 1 to 2 per cent. of *volatile oil*, resembling but not identical with that of cinnamon.

More starch + mucilage.

NO

BEBEERU BARK

(Bibiru Bark, Greenheart Bark)

Source.—The greenheart tree, *Nectandra Rodiæi*, Hook. (N.O. *Laurineæ*), is a large forest tree growing abundantly on the hills in *British Guiana*. Its tall straight stem yields a hard and resistent wood that is highly valued for shipbuilding; the bark was recommended early in the present century as a substitute for cinchona bark, and the alkaloid obtained from it in 1835 by Rodie as a substitute for quinine. It aroused some interest at first, but now neither the bark nor the alkaloid obtained from it is much used, nor does either of them appear to be valued in Guiana.

Description.—Bebeeru bark occurs in flat heavy pieces, frequently 4 or 5 inches long, 2 or 3 inches wide, and $\frac{1}{8}$ to $\frac{3}{8}$ inch thick. It is of a more or less uniform greyish-brown colour, and frequently marked on the outer surface with broad shallow depressions left by the exfoliation of the outer portions by formation of bands of cork; these exfoliating portions are occasionally but not often found adhering to the bark. The outer layer is usually a very thin greyish-brown, often warty cork, which can easily be scraped off, disclosing a darker brown inner portion. The inner surface is walnut-brown in colour, bears shallow, rather broad longitudinal depressions, and is coarsely longitudinally striated by strands of sclerenchymatous tissue, which under the lens can be seen slightly projecting beyond the remaining parenchymatous tissue.

FIG. 112.—Greenheart bark, showing short fracture. Natural size.

The bark is extremely hard, and breaks with a short granular fracture. The transverse section, smoothed and moistened, exhibits under the lens a very narrow pale grey cork; the remainder of the bark is completely traversed by closely approximated, yellowish, wavy medullary rays, showing that in the majority of cases the drug consists (with the exception of the cork that covers it) of bast tissue. Between the medullary rays numerous minute groups of (sclerenchymatous) cells can be distinguished, arranged in radial lines.

The bark has no odour, but a bitter taste.

The student should observe

(*a*) The *flat heavy pieces*,
(*b*) The *thin grey cork*,
(*c*) The *structure of the transverse section*;

and should compare this bark with

(i) *Sassy bark*, which is seldom flat, is nearly black on the inner surface, and exhibits in transverse section large conspicuous groups of sclerenchymatous cells.

(ii) *Coto bark*, which has a reddish-brown colour, is usually much thicker, and has a characteristic odour and taste.

(iii) *Elm bark*, which is much paler in colour and fibrous.

Constituents.—Bebeeru bark contains several alkaloids, two of which, *beberine* and *nectandrine*, have been isolated. Pure beberine is colourless and forms colourless salts. It was formerly considered to be identical with a similar alkaloid (buxine) occurring in the box, and with a third alkaloid (pelosine) present in Pareira brava. Recent investigations, although not conclusive, indicate certain differences that throw doubt upon the identity of these three alkaloids. The commercial sulphate of beberine in dark brown scales, which was official in the British Pharmacopœia of 1885, is not a pure sulphate of the alkaloid. It contains about 30 per cent. of beberine associated with nectandrine and other alkaloids as well as with much colouring matter.

Uses.—Bebeeru bark is a bitter stomachic and tonic ; the alkaloid is, to a small extent, antipyretic, but these effects being insignificant, its use in fever and ague has now been abandoned.

COTO BARK

(True Coto and Paracoto Bark)

Source &c.—The botanical source of coto bark is at present unknown ; all that can with certainty be said is that the bark is derived from a large tree and obtained from *Bolivia*. Guided by the anatomical structure of the bark, Vogl refers it to the natural order *Laurineæ*, whilst Moeller, on similar grounds, ascribes it to *Monimiaceæ*. The bark was first sent to Europe about 1873 from the neighbourhood of the Mapiri river in Bolivia, the home of *Cinchona Calisaya*, under the name of Coto cinchona. It was employed there in the form of powder or alcoholic tincture for diarrhœa and for neuralgia, and rapidly gained a reputation in Europe as an astringent. Owing, however, partly to the difficulty of obtaining the genuine bark, it fell into disuse, and is now seldom prescribed.

This, the true coto bark, was in commerce but a very short time. In 1876 it was replaced by a very similar bark, also imported from Bolivia. This later bark was found on examination to yield constituents resembling but not identical with those of true coto; one of these was called 'paracotoin,' and the bark that yielded it 'paracoto bark.'

Paracoto bark, as it is properly termed, is at present the only commercial variety of coto; it is commonly sold as coto bark, and to it the following description refers.

Description.—Paracoto bark occurs in flat or curved pieces commonly up to 12 inches long, 3 or 4 inches wide, and ⅜ to ⅝ inch thick. They are hard, heavy, and of a cinnamon-brown colour; some of the pieces bear on their outer surfaces patches of a thin whitish, others a brownish cork; they are frequently nearly smooth, or bear transverse wrinkles, or are irregularly chequered by longitudinal fissures and transverse cracks. The inner surface is brown and distinctly and coarsely striated, this being due to projecting strands of sclerenchymatous tissue.

Fig. 113.—Paracoto bark, showing a fissured cork and splintery-fibrous fracture. Natural size.

The bark breaks with a fibrously splintery fracture, coarse stiff strands of sclerenchymatous tissue projecting from the fractured surface. The inner part easily separates into coarse longitudinal strips, on the surface of which, especially after they have been exposed to the air for some time, glistening prismatic crystals can be observed even with the naked eye.

The section is very characteristic. The outer layer, a thin brownish cork, encloses a narrow brown cortex separated by a distinct paler line (of sclerenchymatous cells) from the very thick bast which in older barks constitutes nine-tenths of the drug. This bast contains an abundance of sclerenchymatous tissue arranged in rounded or tangentially elongated groups. The section resembles that of sassy bark, but the groups of sclerenchymatous cells are much smaller and the colour is reddish brown.

The drug has a very characteristic odour and a pungent taste. The student should observe

(*a*) The *brownish cork* and *brown striated inner surface*,
(*b*) The *characteristic transverse section*, and
(*c*) The *distinctive odour* ;

and should compare this bark with

(i) *Sassy bark*, which has a nearly black inner surface, darker outer surface, and fewer and larger groups of sclerenchymatous cells ;
(ii) *Bebeeru bark*, which is smoother and exhibits distinct medullary rays, but very inconspicuous masses of sclerenchyma.
(iii) *Flat red cinchona bark*, which is characterised by its rusty red colour, reddish warts, and bitter astringent taste.

Constituents.—Paracoto bark contains several crystalline constituents, the chief of which, *paracotoin*, occurs in yellow scales, giving with nitric acid a yellow (not red) colour. Other constituents are *leucotin*, *oxyleucotin*, and *hydrocotoin*. The bark contains also a little *volatile oil*, *resin*, and *tannin*.

Uses.—The drug has been employed with success for diarrhœa, but is not much used now.

Varieties.—True coto bark closely resembles paracoto ; it is said to be distinguished by its odour, which recalls cinnamon, that of paracoto recalling nutmeg, and by its taste which is more pungent. The most definite distinctive characters lie in the constituents. True coto contains *cotoin* and *dicotoin*, the former yielding a red (not yellow) colour with nitric acid. This difference is in fact the only really definite means of distinguishing the two barks.

MEZEREON BARK

(Cortex Mezerei)

Source &c.—Mezereon bark may, according to the British Pharmacopœia, be obtained from either of the following species of *Daphne* (N.O. *Thymelæaceæ*) :

1. *Daphne Mezereum*, Linn., *Mezereon*, a small shrub attaining 3 feet in height, growing in moist woods in *hilly parts of Europe*, and found also in the southern counties of *England*. It bears in early spring, before the leaves appear, purple, sweet-scented flowers on the preceding year's shoots. The bark is collected chiefly in Thuringia.

2. *Daphne Laureola*, Linn., *Spurge Laurel*, a small *indigenous* evergreen shrub, not uncommon in woods; it bears inconspicuous green odourless flowers in the axils of the leaves, which are crowded towards the summit of the stem. The bark is seldom collected.

3. *Daphne Gnidium*, Linn., a small shrub with numerous straight slender branches and small white flowers; it is a native of the south of France and the north coast of Africa, and is found generally on the shores of the Mediterranean. It is largely collected in *Algeria* and the *south of France*, and has been long known and used as an irritant.

The bark of all these plants is collected in the winter or early spring, when it separates readily from both stem and root in long flexible strips. These are dried, and either sold loose or made into small bundles or flat disc-like rolls. They all possess acrid properties, and the description in the British Pharmacopœia is framed so as to admit both stem-bark and root-bark of all three species of *Daphne*.

Description.—The bark of *Daphne Mezereum* sometimes occurs in quills of varying length, but more usually in long, thin, more or less flattened fibrous strips that are remarkable for their extreme toughness and flexibility; they can easily be torn lengthwise, but it is almost impossible to break them.

The outer surface (cork) is of a yellowish or olive-brown colour, very thin, and transversely wrinkled, that of the stem-bark being marked with scattered rounded scars of leaves and buds, and often bearing the minute black apothecia of small lichens. It easily separates in papery fragments from the cortex, which is either green (stem-bark) or yellowish (root-bark) in colour. The inner portion of the bark (bast) has a pale yellowish or nearly white and silky inner surface; it is extremely tough and fibrous from the presence of numerous strands of tough bast fibres.

The dry bark has little or no odour, but a persistent burning acrid taste. So marked is the acrid nature of the bark that, moistened and applied to the skin, it produces inflammation and even vesication.

Spurge laurel bark is very similar to the foregoing; it may be distinguished by the purplish-grey colour of the cork and by elongated, pointed-oval leaf- and bud-scars which are crowded at intervals.

The bark of *D. Gnidium* has a dark purplish-brown cork; the leaf-scars resemble those of *D. Mezereum*.

The student should observe

(*a*) The *thin, easily separable cork*,
(*b*) The *silky inner surface*,
(*c*) The *extreme toughness and flexibility*.

Constituents.—Mezereon bark contains a greenish-brown amorphous resin, *mezerein*, possessing extremely acrid and sternutatory properties. It easily changes into an acid bitter resin, mezereic acid, which is present in the ethereal and alcoholic extracts of the bark. A crystalline bitter glucoside, *daphnin*, has also been isolated, as well as a fixed oil and a substance resembling euphorbone, neither of which is acrid.

Uses.—Mezereon is a powerful local irritant, like mustard, capable of producing vesication. Internally it is stimulant, and in large doses an irritant poison; it is, however, seldom administered internally, and although frequently employed in the south of France as an irritant, finds but little use in this country.

CASCARILLA BARK

(Cascarilla, Cortex Cascarillæ)

Source &c.—Cascarilla bark is obtained from *Croton Eleuteria*, J. J. Bennett (N.O. *Euphorbiaceæ*), a shrub or small tree indigenous to the Bahama Islands, the name cascarilla having its origin probably in the resemblance this bark bears to small quilled cinchona bark, which was formerly called cascarilla (the diminutive of the Spanish *cáscara*, bark). It is evidently the bark of twigs, branches, and possibly small stems.

Description.—Cascarilla bark is usually imported in single quills or channelled pieces, commonly varying from 2 to 4 inches in length and from $\frac{1}{6}$ to $\frac{1}{2}$ inch in width, rarely exceeding the latter limit. The outer layer of the bark is a white or greyish-white cork which owes its characteristic chalky appearance to the presence in the cells of numerous crystals of calcium oxalate. It is longitudinally wrinkled, and often at more distant intervals both longitudinally and transversely furrowed, thus assuming a chequered appearance. It frequently bears the minute black apothecia of a small lichen, and easily exfoliates, disclosing a brown or dark grey inner layer (cortex) marked with furrows corresponding to those in the cork. On some portions of the bark the white cork is so thin that the brown cortex shows through and imparts to the outer surface a brown or dark grey colour.

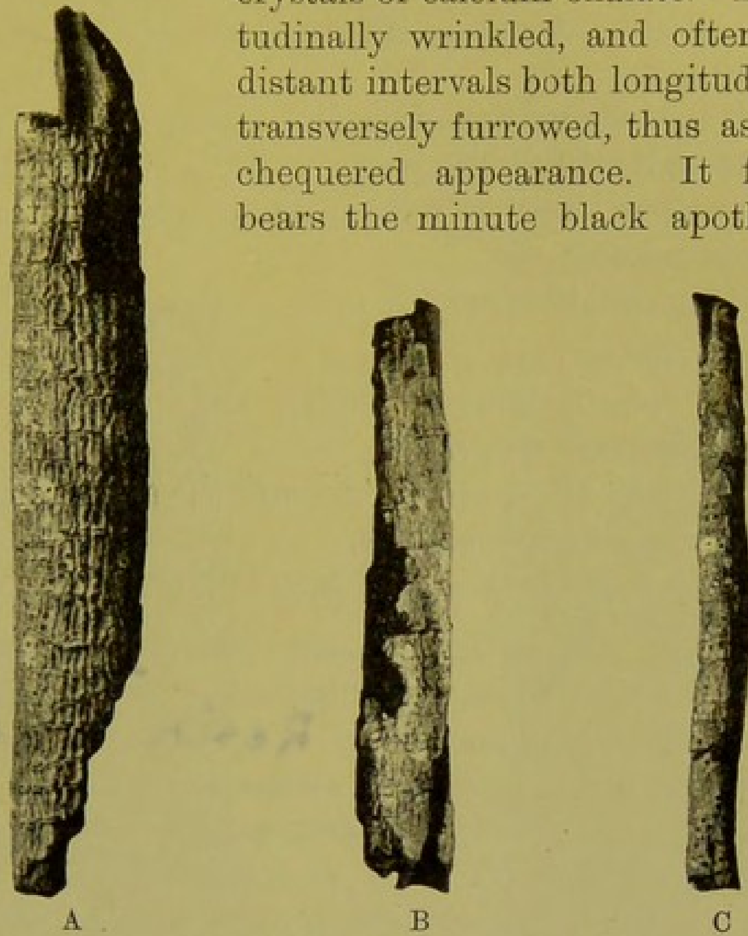


Fig. 114.—Cascarilla bark. A, large; B, medium; C, small. All natural size.

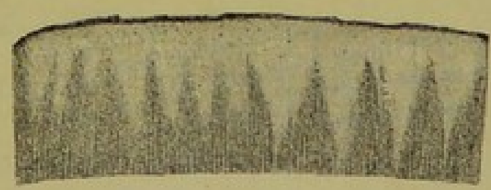


Fig. 115.—Cascarilla bark. Transverse section, magnified. (Berg.)

The inner surface of the bark is dark in colour and longitudinally striated. The fracture is short and resinous. The section exhibits under the lens a pale cork layer and a dark brown cortex and bast, the latter being traversed by numerous very fine whitish medullary rays. Examined under the microscope, the section is found to be free from groups of sclerenchymatous cells, a character that definitely distinguishes the bark from certain substitutes (see below) and one much to be preferred, as differences in structure usually are, to distinctions based upon slight differences in external appearance, in taste or in odour.

The bark has a pleasant aromatic odour and an aromatic but rather disagreeably bitter taste. When burned it exhales an agreeable odour, whence its use as an addition to fumigating mixtures, tobacco, &c.

The student should observe

(*a*) The *chalky cork*,
(*b*) The *longitudinal wrinkles* and *longitudinal and transverse fissures*,
(*c*) The *short resinous fracture* and the appearance of the *section* under the lens,
(*d*) The *aromatic odour* and *bitter taste*.

Constituents.—Cascarilla contains about 3 per cent. of *volatile oil* and a crystalline bitter principle, *cascarillin*, which is neither alkaloidal nor glucosidal. Resin & tannin.

Uses.—Cascarilla is used as an aromatic, bitter stomachic.

Substitutes.—The barks of other species of croton (*Croton niveus*, Jacq., *C. lucidus* (?), Linn., *C. Malambo*, Karst, &c.) have occasionally appeared in commerce mixed with or substituted for cascarilla; the genuine is best distinguished by its anatomical characters, especially the absence of sclerenchymatous cells, which are found in groups in the above three species; the bitter taste and aromatic odour are also characteristic.

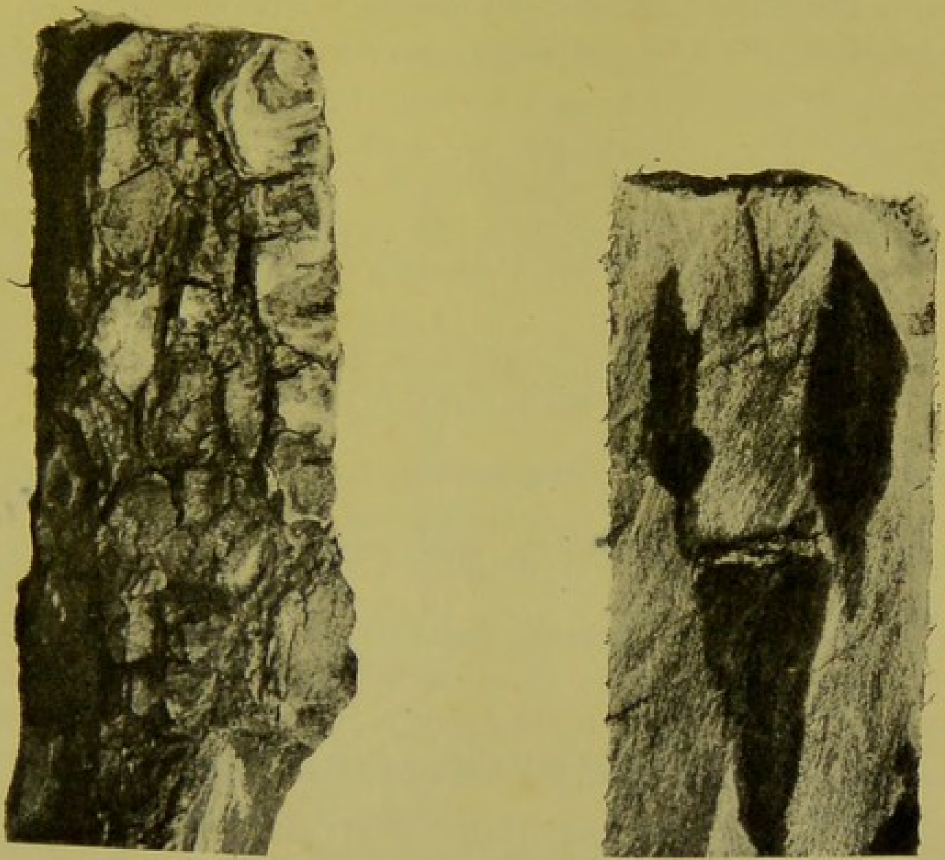
ELM BARK

(Cortex Ulmi)

Source &c.—The common elm, *Ulmus campestris*, Linn. (N.O. *Urticaceæ*), is a large handsome tree attaining a height of 100 feet or more, and found in *England*, especially in the southern counties, although doubtfully a native. It extends also over central and southern Europe. The Greeks and Romans were well acquainted with the properties of elm bark, and it continued to be used during the early and middle ages. It has now fallen into disuse, its place having been taken by other drugs possessing similar astringent qualities in a higher degree.

The bark should be stripped from the trunk and branches in the spring, when it can easily be separated, and freed from its dark rough outer portion (bark); the remaining whitish inner part (bast) forms, when dried, the elm bark of commerce.

Description.—The elm bark of commerce consists, as observed, of the dried bast of the tree. It occurs usually in



A B

FIG. 116.—Elm bark. A, with outer layers attached; B, commercial bark. Natural size.

rather thick flattened pieces about 4 or 5 inches long, 1 or 2 inches wide, and nearly $\frac{1}{4}$ inch thick. The outer surface is yellowish or pale rusty-brown in colour, often discoloured and frequently marked with dark brown patches of the outer portion (bark) that have been left adhering to it and bearing evidence of the instrument that has been used in scraping it. The inner surface is longitudinally striated or nearly smooth. It is tough, but breaks with a rather short, not very fibrous fracture. The smoothed transverse section exhibits under the lens numerous dark, usually oblique medullary rays that completely traverse the bark, thus proving it to be bast. Crossing the medullary rays at right angles are numerous rows of tangentially elongated whitish masses (groups of bast fibres).

The bark is inodorous, but has a slightly astringent, mucilaginous taste.

The student should observe

(*a*) The *flattened pieces*,
(*b*) The rather *fibrous, but not splintery fracture*,
(*c*) The (usually) *striated, not perfectly smooth, inner surface*;

and should compare the bark with

(i) *Quillaia bark*, which has a perfectly smooth inner surface, splintery, laminated fracture, and acrid taste;
(ii) *Slippery elm bark*, which is thinner, very fibrous, and has an odour resembling fœnugreek.

Constituents.—Elm bark contains as principal constituent a little *tannin*; *mucilage* and *starch* are also present. 20%

Uses.—It was formerly employed as an astringent, but is now seldom used.

SLIPPERY ELM BARK

(Cortex Ulmi Fulvæ)

Source &c.—The slippery elm, *Ulmus fulva*, Michaux (N.O. *Urticaceæ*), is a small tree indigenous to the central and northern of the *United States*. The bark is collected in the spring from the trunk and large branches, deprived of its outer dead portions, and dried; the tree is thereby destroyed, and as the wood has no commercial value no effort is made to replace it. Large quantities of the bark are collected in the lower peninsula of Michigan.

Description.—Like the preceding drug the slippery elm bark of commerce consists entirely of the bast of the tree. It is commonly imported in large flat strips 2 or 3 feet long and several inches wide, but only $\frac{1}{8}$ inch or less in thickness. The outer surface is reddish-yellow in colour, with patches of the reddish-brown outer portion (bark), and is distinctly striated longitudinally; the inner surface is tawny yellow and also longitudinally striated.

It is extremely tough and fibrous; narrow pieces can be bent double without completely breaking. The section, examined under the lens, is seen to be completely traversed by medullary rays (showing it to be bast), between which small tangential bands (bast fibres and bast parenchyma) are arranged, giving the section a chequered appearance. If the transverse section is moistened and allowed to remain for a minute or two and again examined, numerous cells full of transparent swollen mucilage can be detected. No trace of the cortex can be found, but portions of the dark outer layer (bark) are frequently present.

The bark has a strong odour resembling fœnugreek, and a very mucilaginous taste.

The student should observe

(*a*) The *striated inner* and *outer surface*,
(*b*) The *fibrous fracture*,
(*c*) The *odour of fœnugreek* and the *mucilaginous taste*;

and should compare the bark with elm bark and quillaia bark.

Constituents.—The principal constituent is *mucilage*, which appears to swell but not dissolve in water; it is contained in large mucilage cells in the bast, and is present in such proportion that 10 grains of the powdered bark will convert a fluid ounce of water into a thick jelly.

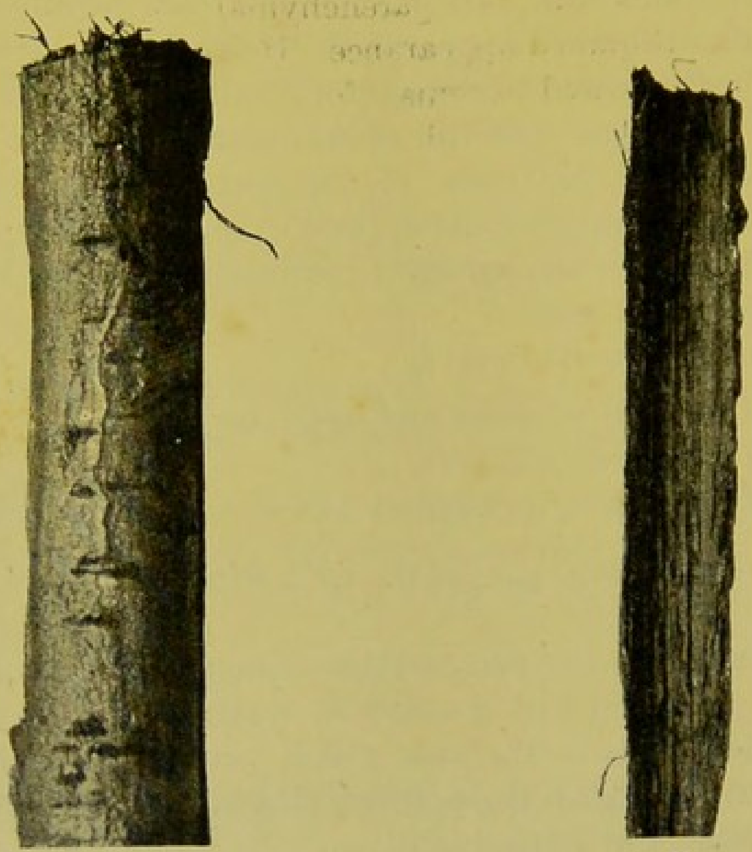
Uses.—The bark has demulcent and emollient properties. It is chiefly used as an external application in the form of a poultice.

OAK BARK

(Cortex Quercus)

Source &c.—The British oak, *Quercus robur*, Linn. (N.O. *Cupuliferæ*), is widely diffused over *Europe* and largely cultivated for its wood and especially for its bark, which from the large proportion of tannin it contains is valued highly for tanning. Although the astringent properties of the bark have long been known, and although it has been used from time immemorial in preparing leather, it never appears to have been much used in medicine.

In the collection of oak bark the trees are usually felled when they have reached an age of twelve to thirty-five years, and in the early spring when the buds are opening. Longitudinal incisions are made through the bark, which can then be removed in strips, and after drying is ready for the market.



A B

Fig. 117.—Oak bark. A, outer surface, showing the smooth, glossy cork and transverse lenticels. B, inner surface. Natural size.

Young bark is preferable to old, because as the trees increase in age the outer portions are cut off by the production of layers of cork in the bast (formation of bark), and the tannin in the portions thus cut off undergoes certain changes. Bark from older stems is also collected and freed from its dead outer portions, but such bark is not so valuable for tanning or fit for medicinal use.

From the stools that are formed when the trees are felled adventitious shoots arise, and these, when they have attained a sufficient age, are cut and peeled.

While the bark is young (up to about twenty years old) it possesses a smooth, glossy, silvery cork; such bark is to be preferred and should alone be used medicinally.

Description.—Oak bark usually occurs in channelled pieces several inches in length and about an inch or rather more in breadth. The outer layer is a thin, smooth, shining, silvery-grey, firmly adherent cork, which in young barks is marked with darker transverse lenticels and in older barks is frequently longitudinally fissured and bears darker spots and patches; beneath the cork is a reddish-brown cortex. The inner surface is strongly striated longitudinally and fibrous, and varies in colour from yellowish to reddish-brown.

The bark breaks with a short fracture in the outer part (cork and cortex), but is coarsely fibrous in the inner part (bast). Under a lens the section exhibits a thin cork, a narrow yellowish cortex, occupying about one-fourth of the total width, separated by a pale line (sclerenchymatous cells) from the reddish-brown bast, which is chequered by tangentially arranged groups of bast fibres. Touched with dilute solution of ferric chloride the section assumes a black colour.

The bark has a scarcely perceptible odour, but a strongly astringent taste.

The student should observe

(*a*) The *glossy silvery cork*,
(*b*) The *line of sclerenchymatous cells*,
(*c*) The *striated fibrous inner surface*;

and should compare the bark with

(i) *Willow bark*, which usually possesses a dull greenish-brown cork, paler inner surface, and no line of sclerenchymatous cells;
(ii) *Witch-hazel bark*, which has a dull grey cork and pinkish colour.

Constituents.—The principal constituent of oak bark is the tannin, *quercitannic acid*, of which it contains from 10 to 16 per cent. Quercitannic acid is distinct from gallotannic acid; it yields by hydrolysis a phlobaphene, oak-red, which may be regarded as the anhydride of quercitannic acid, but no sugar (Etti and Löwe). To the formation of oak-red the reddish-brown colour of oak bark is partly due. Quercite, or oak sugar.

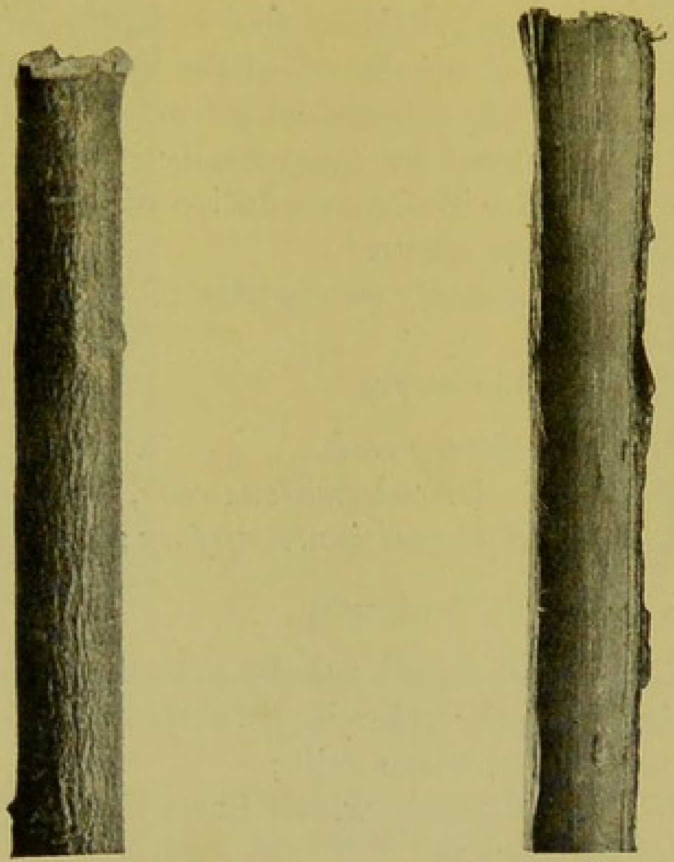
The bark contains also small quantities of *gallic* and *ellagic* acids.

Uses.—Oak bark has been used medicinally as an astringent, but is not much prescribed at present.

WILLOW BARK

(Cortex Salicis)

Source &c.—The willow bark of commerce is generally referred to the white or common willow, *Salix alba*, Linn. (N.O. *Salicineæ*), a common tree on river-banks and marshy ground in *England* and throughout central and southern Europe. Its astringent properties were well known to Dioscorides, but



A B

Fig. 118.—Willow bark, showing, A, outer surface; B, inner surface Natural size.

the bark appears to have fallen into disuse until the latter end of the last century, when it was recommended as a remedy for ague. For this purpose, however, salicin, the principal active constituent of willow bark, has entirely taken the place of the bark, which is now seldom used medicinally. Salicin is usually obtained from the bark of other species of *Salix*, which contain it in greater abundance than *S. alba*. Very frequently, too, the structure of commercial willow bark shows that it is not derived from *S. alba*.

Description.—The willow bark of commerce usually occurs in channelled pieces several inches in length and up to ½ or ¾ inch in width; they are usually of a greenish- or greyish-brown colour.

The outer surface is in young bark a smooth, sometimes glossy cork; in older barks it is dull, slightly longitudinally wrinkled, and usually of a greenish-brown colour. The inner surface has a pale reddish colour, and, in the younger pieces at least, appears smooth to the naked eye, but is seen under the lens to be finely striated longitudinally. Older pieces are more coarsely striated. It is so fibrous in the inner part that it can be bent double without completely breaking, but the outer part has a short fracture.

The section examined under a lens shows numerous minute tangentially arranged groups of bast fibres.

It often has a slight agreeable odour, and an astringent, slightly bitter and aromatic taste.

Constituents.—Willow bark contains, as principal constituents, *tannin* and *salicin* in varying proportions. res The bark of the common willow (*S. alba*) and crack willow (*S. fragilis*, Linn.) is said to be richest in tannin (8 to 13 per cent.), whilst that of the purple willow (*S. purpurea*, Linn.) and bay willow (*S. pentandra*, Linn.) contains more salicin (up to 3 per cent.).

Salicin is a crystalline glucoside yielding, when hydrolysed by a ferment, dextrose and saligenin, but when hydrolysed by a dilute mineral acid, dextrose and saliretin.

Uses.—Willow bark is astringent and has been used in rheumatism and ague; it has, however, been completely replaced by salicin.

LARCH BARK

(Cortex Laricis) or Pinus Lari

Source &c.—The larch, *Larix europæa*, DC. (N.O. *Coniferæ*), a lofty tree, is largely planted in *England*, but is a native of southern and central Europe. In the Austrian Alps, in the neighbourhood of Bozen, Trient, and Meran, forests of larch of considerable extent exist. In this district the turpentine secreted by the trunk (true Venice turpentine) is collected, but not to any great extent.

The bark, in common with that of other coniferous trees, has long been used for tanning; its medicinal use is, however, quite recent and dates only from 1858, when it was recommended as a stimulant, astringent, and expectorant. It was introduced into the British Pharmacopœia of 1867, but was subsequently omitted, and is now seldom used, as it has failed to fulfil the expectations entertained of it.

Description.—Larch bark usually occurs in flat, curved or channelled pieces, seldom in quills. The outer portion (bark), which is commonly largely developed, especially in all but young barks, and sometimes attains a thickness of several inches, is rough externally and of a dark brownish-red colour. It exfoliates in large flakes which can be split off without much difficulty; the surface thus exposed frequently exhibits rose-pink patches, the colour of the remainder being dark reddish-brown. This difference in colour is due to the deposition of a rose-coloured substance in certain layers of cork cells, whereas usually the deposit is reddish brown in colour.

The inner portion of the bark (bast) is nearly white, the inner surface being smooth and whitish or yellowish in colour.

The bark breaks with a short or, in the bast, a slightly fibrous fracture. The section exhibits under a lens a whitish inner portion (bast) and a dark brownish-red outer portion (bark), the latter generally showing distinct curved lines, indicating the formation of bark by production of successive bands of cork.

The bark has a distinctly terebinthinate odour and an astringent terebinthinate taste.

The student should observe

(*a*) The *rose-pink patches of cork* disclosed when fragments of the bark are split off,

(*b*) The *whitish bast*,

(*c*) The *characteristic odour and taste*.

or Laricinic acid

Constituents.—Larch bark contains *tannin* and a crystalline principle, *larixin*, possessing a bitter astringent taste. Oleo-res

Uses.—Larch bark has been used as a stimulant, expectorant, and astringent, but is almost obsolete.

SECTION VIII

RHIZOMES

CIMICIFUGA

(Rhizoma Cimicifugæ, Radix Acteæ, Black Snakeroot)

Source &c.—*Cimicifuga racemosa*, Ell. (*Actæa racemosa*, Linn.), is a tall herbaceous plant belonging to the natural order *Ranunculaceæ*. It grows freely in shady woods in Canada and the United States, extending southwards as far as Florida, and produces a stout perennial rhizome. In the autumn, after the plant has fruited and the leaves have died down, the rhizome is collected, cut into pieces, and dried. It was introduced into medical practice in the United States about 1823, and in this country about 1860.

Description.—The drug consists of a thick, hard and knotty horizontal rhizome with numerous stout ascending branches. The rhizome averages about 2 or 3 inches in length and $\frac{1}{2}$ inch in diameter, but may attain as much as twice these dimensions; the commercial drug consists, however, usually of pieces 1 or 2 inches long. The branches, which are so close together as almost to conceal the rhizome, are about $\frac{3}{8}$ inch thick and 1 inch or more long; they curve upwards, and terminate either in the remains of a bud or more frequently a circular cup-shaped scar exhibiting a distinctly radiate structure. Both the rhizome and its branches bear encircling scars of cata-

FIG. 119.—Black Snakeroot, showing branches curving upwards and marked with leaf-scars. Natural size.

phyllary leaves, those on the branches being the more conspicuous.

From the under surface of the rhizome numerous straight stout roots are given off. These are dark brown in colour and obscurely quadrangular or longitudinally furrowed; they are rather brittle, and are usually broken off near the rhizome. The interior of the drug is hard and horny. The transverse section of the rhizome exhibits a thin dark horny bark [1] surrounding a ring of numerous paler narrow wedges of wood alternating with wide dark medullary rays; the centre is occupied by a large dark pith. The branches have a similar structure.

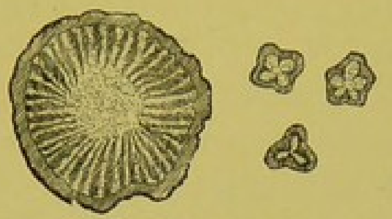


FIG. 120.—Black Snakeroot. Transverse section through a branch of the rhizome, and through roots. Natural size. (Maisch.)

The transverse section of the root frequently exhibits a thick bark and four (or sometimes five or six) distinct wedges of porous whitish wood, arranged in the form of a Maltese cross, the medullary rays being broad and dark; this characteristic structure is usually best seen in the stoutest roots.

The drug has no marked odour, but a bitter acrid taste.

The student should observe

(*a*) The numerous *stout branches curving upwards*,

(*b*) The *structure of the rhizome*, and of the *root*, exhibited by the transverse section;

and should compare the drug with

Black hellebore rhizome, which is tortuous and provided with irregular branches not exhibiting a prominent curve upwards; the section of the rhizome exhibits a thicker bark and few wood-bundles; in that of the roots the wood is much less distinctly cruciate.

Constituents.—The acrid bitter taste is due to a crystalline substance, *racemosin*.

An infusion of the drug is darkened by ferric chloride, but

[1] I have employed the term 'bark' to designate the collection of tissue exterior to the cambium of the rhizome and root as well as of the stem (compare p. 208). The Pharmacopœia has adopted the word 'cortex,' which perhaps is more correct as far as the meaning of the word is concerned, but is liable to misinterpretation owing to the restricted sense in which this term is employed by modern botanists.

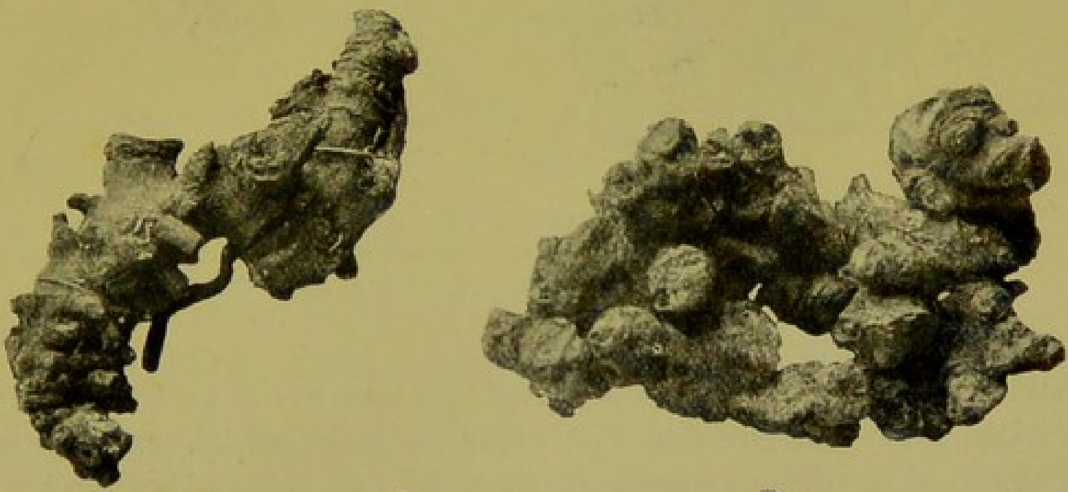
this reaction is not caused by tannin, but by a body allied to quercitrin, which strikes a dark green colour with ferric salts. The reaction is useful as a means of distinguishing this drug from black hellebore.

Uses.—Cimicifuga may be used as a stomachic in diseases of the heart, but is more frequently employed as a remedy for rheumatism and neuralgia.

BLACK HELLEBORE RHIZOME

(Rhizoma (Radix) Hellebori Nigri)

Source.—Black hellebore root, or, as it should be more correctly termed, rhizome, is obtained from the Christmas rose, *Helleborus niger*, Linn. (N.O. *Ranunculaceæ*), a low herb with a perennial rhizome, abundant on the lower Alps of *southern Europe*, especially in Austria, and much cultivated in this



A B

FIG. 121.—Black Hellebore root. A, young rhizome, natural size. B, old knotty rhizome, natural size.

country for its white flowers, which, as the name of the plant indicates, appear in midwinter; our supplies come chiefly from Germany.

The rhizome enjoyed a considerable reputation in the later middle ages as a stimulant, purgative, and digestive, but it is now seldom employed. It should be collected in the autumn.

Description.—The Christmas rose produces a horizontal creeping or frequently oblique or even upright rhizome, which is usually, when dried, about 1 or 2 inches long and $\frac{1}{4}$

inch thick, and nearly black in colour. It is generally very irregular, tortuous and branched, the older pieces often forming small knotty masses. The branches are short and erect, marked with encircling leaf-scars, and usually terminated by the scar of the aerial stem or occasionally by the remains of a stem or bud. On the under surface the scars or short portions of numerous roots may be seen; in the fresh plants these are long, rather stout and straight, but they are commonly removed from the drug.

The rhizome breaks easily with a short fracture; the section is yellowish and exhibits a thick bark, within which is a ring of small wood-bundles, all or some of which are narrow and radially elongated, enclosing a large pith. In the root the

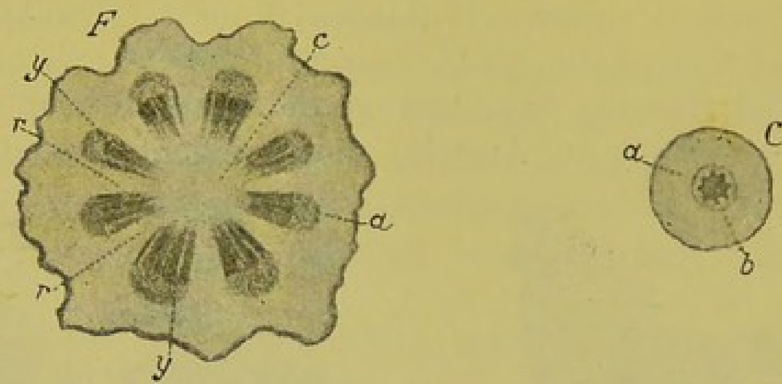


Fig. 122.—Black Hellebore rhizome. *F*, transverse section of rhizome: *a*, bark; *y*, wood-bundles; *c*, pith; *r*, medullary rays; magnified 3 diam. *C*, transverse section of root: *a*, cortex; *b*, stele; magnified 3 diam. (Berg.)

bark is thick and the wood tends to assume a stellate form, which, however, even in the older roots in which it is most marked, is never so conspicuous as it is in the root of *Cimicifuga racemosa*.

The odour of the drug is slight, the taste somewhat bitter and acrid. The dry powder, when inhaled, produces violent sneezing.

The student should observe

(*a*) The *dark colour* and tortuous appearance,
(*b*) The *short erect branches*,
(*c*) The *structure of the rhizome*.

Constituents.—Black hellebore rhizome contains two crystalline glucosides, *helleborin* and *helleborein*, both of which are powerful poisons. Helleborin has a burning acrid taste and is narcotic; helleborein has a sweetish taste and is a highly active cardiac poison.

The drug is free from tannin, and the infusion does not strike a dark colour with ferric chloride, in which particular it differs from *Cimicifuga racemosa*.

Uses.—Black hellebore rhizome has been employed in later times as a drastic purgative and emmenagogue, but is now seldom administered.

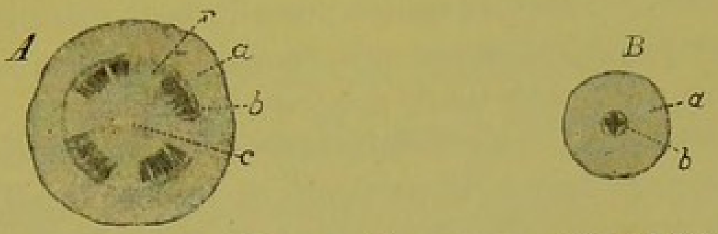


FIG. 123.—Green Hellebore rhizome. Transverse section of rhizome (*A*) and (*B* root: *a*, cortex; *b*, wood; *c*, pith. Magnified 3 diam. (Berg.)

Substitutes.—The rhizome of *H. viridis*, Linn., green hellebore—which should be carefully distinguished from *Veratrum viride*, often called also green hellebore—closely resembles that of *H. niger*; it is, however, far more bitter and acrid, and the transverse section exhibits wood-bundles that are broader and shorter than those of *H. niger*.

HYDRASTIS RHIZOME

(Golden Seal Rhizome, Rhizoma Hydrastis)

Source &c.—Golden seal, *Hydrastis canadensis*, Linn. (N.O. *Ranunculaceæ*), is a small herbaceous plant with perennial rhizome, widely distributed in woods in *Canada* and the *eastern United States*, being most abundant in Ohio, Kentucky, and Indiana. The plant produces but a single leaf, or two leaves and a single flower. The rhizomes are collected in the autumn after the leaves have withered; as the stems persist for some time to ripen the fruits, the remains of them are frequently found attached to the drug. The introduction of the drug into American and European medicine has been of very recent date, although, as might be expected, its yellow colour had long attracted attention.

Description.—The drug consists of small yellowish-brown rhizomes varying from $\frac{1}{2}$ to $1\frac{1}{2}$ inch in length and averaging about ¼ inch in thickness; although they appear to be horizontal and creeping, they are often oblique or even erect, as is indicated by the direction of the buds with which some of the branches terminate, as well as by the presence of rootlets on the (apparently) upper as well as under surface. They are knotty, tortuous, and rough; usually simple, seldom dividing into two equal branches, but frequently giving off short upright branches which are terminated by cup-shaped scars left by the aerial stems of previous years. These branches usually bear distinct encircling scars of cataphyllary leaves, and similar scars are borne by the rhizome also, although there they are less distinct.

Thin, shrivelled, wiry brittle roots of the same colour as the rhizome proceed from all parts of it, but especially from the lateral and ventral surfaces. Many of them break off, leaving small protuberances on the rhizome, which is often therefore comparatively free from roots and rough.

The rhizome is hard, and breaks with a short resinous fracture. The transverse section varies in colour from dark yellow to very dark yellowish-brown, and exhibits a comparatively thick bark and a ring of bright yellow somewhat distant narrow wood-bundles surrounding a large pith. The root also exhibits a dark bark and small bright yellow wood.

The drug has a faint but characteristic odour; when it is chewed a bitter taste is developed and the saliva is coloured yellow.

The student should observe

(*a*) The *yellow colour*,
(*b*) The *structure visible in the transverse section* when examined with a lens,
(*c*) The *characteristic odour*;

and should compare the drug with

(i) *Bloodroot*, which usually has a dark reddish-brown colour, and exhibits in transverse section a more or less prominent red colour without evident wood-bundles.

Constituents.—The principal constituents of hydrastis rhizome are the alkaloids *hydrastine* (about 1·5 per cent.) and *berberine* (about 3·5 per cent.), the former crystallising in colourless prisms, the latter in yellow needles; both of them have a bitter taste. *Canadine* is a colourless alkaloid, present in smaller quantity.

Uses.—Hydrastis rhizome is a bitter tonic and spinal stimulant, in these respects resembling nux vomica. It is used as a stomachic and nervine stimulant, and locally in various kinds of ulceration and hæmorrhage in connection with the nose, rectum, and uterus.

PODOPHYLLUM RHIZOME

(May-apple Root, Rhizoma Podophylli)

Source &c.—The May apple, *Podophyllum peltatum*, Linn. (N.O. Berberideæ ~~*Ranunculaceæ*~~), is a small herb with a long perennial creeping rhizome. It is a native of and common in the *eastern United States and Canada*, producing, when it flowers, but two leaves and a single flower. The drug was well known to the North American Indians as an emetic and vermifuge; it was introduced into the British Pharmacopœia in 1864.

The rhizome, which grows to a length of several feet, is collected in the late summer and dried; it is usually cut into pieces a few inches in length.

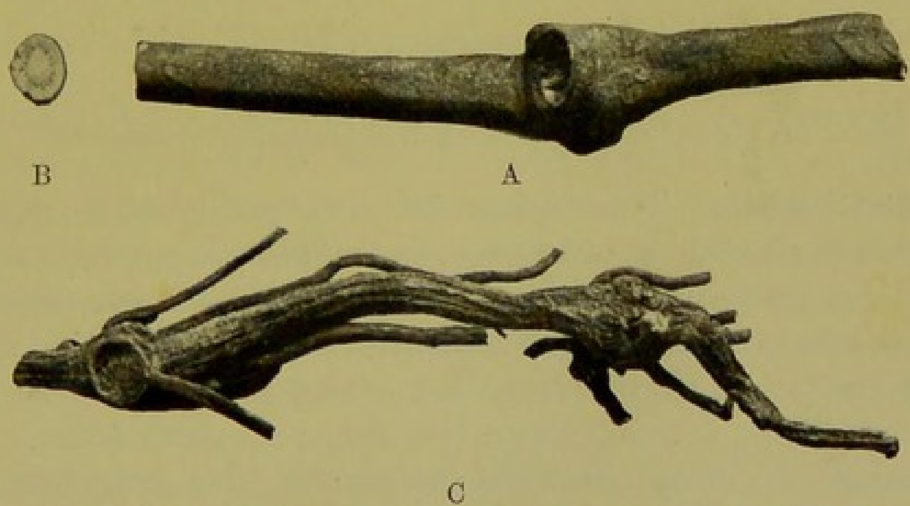


Fig. 124.—Podophyllum rhizome. A, plump autumnal rhizome without roots, showing the scar left by the aerial stem. B, transverse section of the same. C, shrivelled summer rhizome with roots attached. All natural size.

Description.—Podophyllum root, or more correctly rhizome, is seen in commerce usually in nearly cylindrical pieces several inches in length and about ¼ inch in thickness. These are of a dark reddish-brown colour, and are nearly smooth or slightly longitudinally wrinkled; they should not be flattened and strongly wrinkled, as they are then of poor quality.

At intervals of about 2 or 3 inches the rhizome is enlarged, and bears on the upper surface a concave scar surrounded by several circular leaf-scars; these have been left by an aerial flowering stem and its cataphyllary leaves. Below the stem-scar, on the under surface of the rhizome, are the scars of several stout roots, which are occasionally left attached to the rhizome, but which more commonly have been removed. The rhizome occasionally forks, but produces very few lateral branches. When a flowering stem is produced the growth of the main axis is terminated; a bud in the axil of one of the cataphyllary leaves then develops, forming a sympodial system and continuing the growth of the plant.

The rhizome breaks with a short fracture. The transverse section is usually white and starchy, but if the heat employed n drying the rhizome has been sufficient to gelatinise the starch it is yellowish and horny; it exhibits a very thin cork and a circle of small, oval, distant, fibro-vascular bundles.

The drug has a characteristic but not strong odour, and a bitter acrid taste.

The student should observe

(*a*) The *straight cylindrical rhizome* with occasional stem, root and leaf scars,

(*b*) The *structure shown by the transverse section.*

Constituents.—The chief constituent of podophyllum rhizome is a neutral crystalline substance, *podophyllotoxin*, which acts as a powerful purgative and intestinal irritant; it is converted by alkalies into the crystalline isomeric *picropodophyllin*, which is also contained in the root, but, owing probably to its very slight solubility, is much less active than podophyllotoxin. The proportion of podophyllotoxin present in the drug has been variously stated as 0·2 and 1·0 per cent. The rhizome also contains quercetin, a crystalline yellow colouring matter obtainable from quercitron bark (*Quercus discolor*, Ait.) and other plants; and podophylloresin, an uncrystallisable resin said to possess purgative properties.

From a strong tincture of podophyllum rhizome, water (or better water acidulated with hydrochloric acid) throws down a resinous mixture of substances known as podophyllin (Podophylli Resina, B.P.). This mixture contains podophyllotoxin, picro-podophyllin, quercetin, and podophylloresin, and is in no sense an active constituent. Of this podophyllin the rhizome yields between 4 and 5 per cent.

Uses.—Podophyllum rhizome, or at least the podophyllin obtained from it, is used as a purgative, producing free evacuation of the bowels in severe constipation. It is a useful cholagogue when mercurials are contra-indicated.

Substitutes.—*P. Emodi*, Wall., a plant growing freely on the lower slopes of the Himalayas, produces a much stouter, knotty rhizome, from the under surface of which an abundance of stout roots proceed. The rhizome and roots have been imported in the hope that they might replace the American drug. They yield more resin (podophyllin), viz. 10 to 12 per cent. (Dunstan and Henry, 1897), and are said to contain from four to five times as much podophyllotoxin as the American drug, but the purgative action does not vary to this extent owing to the other substances with which the podophyllotoxin is associated.

BLOODROOT

(Rhizoma Sanguinariæ)

Source &c.—Bloodroot is the rhizome of *Sanguinaria canadensis*, Linn. (N.O. *Papaveraceæ*), a herb with a perennial rhizome, widely distributed throughout *Canada and the United States*, growing freely in shady places on rich soils; the plant produces in early spring a single flower succeeded by one or two leaves about 4 or 6 inches high, and exudes, when cut, an orange-red juice. The rhizome is collected in the autumn and dried.

Description.—Bloodroot varies usually in length from 1 to 2 inches, and in thickness from $\frac{1}{4}$ to $\frac{3}{8}$ inch. It has a dark grey or dark reddish-brown colour, and is generally plump, straight or somewhat curved, and nearly cylindrical, but it is sometimes much shrivelled and shrunken, and contains then less starch, due probably to its having been gathered before the end of the period of active growth. It is bluntly conical at the apex, and shows only traces of a bud or aerial stem. From the lower surface numerous dark, threadlike, brittle, wiry roots spring, commonly more or less interlaced, but easily breaking off, leaving inconspicuous raised scars; in the commercial drug the roots are mostly detached. The rhizome bears also more or less distinct encircling leaf-scars, and sometimes short knob-like branches at right angles to it.

The rhizome breaks with a short fracture; the fractured surface is sometimes whitish and starchy, with numerous minute deep red dots (cells containing secretion), sometimes of a more or less uniform deep blood-red or nearly black colour, and then hard and resinous instead of starchy, a difference due to the escape of the deep red secretion from the cells in which it was originally contained into the surrounding tissue. The appearance of the section varies not only in different rhizomes, but even in different parts of the same rhizome. The fibro-vascular bundles are distributed in a circle near the bark, but they are so inconspicuous as to be with difficulty discernible even under a lens. The drug has little odour, but an unpleasant bitter and acrid taste.

The student should observe

(*a*) The *cylindrical shape* and comparative *absence of roots*,
(*b*) The *colour of the transverse section*,
(*c*) The *inconspicuous wood-bundles*;

and should compare the drug with

Hydrastis rhizome (see before).

Constituents.—Bloodroot contains several remarkable and interesting alkaloids.

1. *Sanguinarine*, which crystallises in colourless needles or warty masses, but yields with acids deep red crystalline salts.

The alkaloid sanguinarine should not be confused with the eclectic resinoid sanguinarin. The latter is a mixture of substances obtained by precipitating a strong tincture of the drug with water, and is in no sense an active principle.

2. *Chelerythrine*, characterised by the yellow colour of its salts. This alkaloid also occurs in the celandine, *Chelidonium majus*, Linn. (N.O. *Papaveraceæ*).

3. *Protopine*, identical with the protopine of opium and celandine root, and found in several other members of the same natural order.

4. *β homochelidonine*, a colourless, crystalline alkaloid, also found in celandine.

The drug also contains a red resin.

Uses.—Bloodroot in full doses depresses the action of the heart, and produces nausea and vomiting; in smaller doses it increases the appetite and improves digestion. It has been used in atonic dyspepsia, croup, bronchitis, and asthma.

VALERIAN ROOT

(Rhizoma Valerianæ)

Source &c.—The common valerian, *Valeriana officinalis*, Linn. (N.O. *Valerianeæ*), is an herbaceous plant widely diffused over Europe and northern Asia. It is *common in England* in moist situations, attaining a height of 3 or 4 feet, and producing terminal corymbs of small white or pinkish flowers with gamopetalous corolla and three stamens. It is cultivated in Holland and Germany, to some extent also in England, our supplies being derived partly from English and partly from foreign sources, but chiefly from cultivated plants. The drug, or at least a species of valerian, was well known to the Greeks and Romans; whilst the common valerian, or 'all-heal' as it is sometimes called, was a domestic medicine of the Anglo-Saxons. In the middle ages the root was used not only as a medicine but also as a spice, and, curiously enough, even as a perfume as we now use lavender.

The plant produces a short upright rhizome which grows for several years before it flowers, and from which slender horizontal branches are emitted; the buds that terminate these branches develop into aerial shoots, which in their turn form erect rhizomes, and continue the life of the plant, the mother-rhizome perishing after flowering and fruiting. The drug is collected in the autumn, the lateral shoots are cut off for the propagation of the plant, and the rhizomes usually, especially if of large size, sliced longitudinally and dried.

Description.—The commercial drug consists of a short erect conical rhizome not more than ½ inch thick and 1 inch long, of a dull yellowish-brown colour, usually halved, or quartered if large, but entire if small, and sometimes crowned with the remains of the stem and leaves. Internally the rhizome is firm and horny and of a whitish or yellowish colour; sometimes it becomes hollow, portions of the tissue remaining as transverse septa.

From the rhizome numerous brittle roots of the same colour and about $\frac{1}{16}$ inch thick are given off, as well as occasionally short, slender, lateral branches. In the commercial drug the roots seldom exceed 3 or 4 inches in length and $\frac{1}{12}$ inch in diameter; they are plump or longitudinally striated, but usually not much shrivelled.

Sometimes the drug consists of small rhizomes about $\frac{1}{4}$ inch long, which are crowned with the remains of several leaves and bear rather short slender roots. These are formed from the lateral branches (runners) produced by the principal rhizome, which bear cataphyllary leaves; the buds in the axils

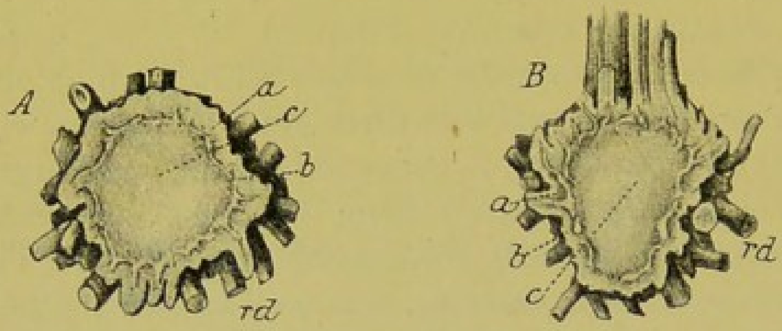


Fig. 125.—Valerian rhizome. A, transverse, B, longitudinal section through the rhizome: *a*, bark; *b*, wood; *c*, pith; *rd*, roots. Natural size. (Berg.)

of these develop leaves, roots are developed below, and independent plants are produced. Such plants may occasionally be found mingling their roots with those of the principal rhizome. Had they been allowed to continue their growth, they would ultimately have developed rhizomes as large as those of the parent plant.

The transverse section of the rhizome is irregular in outline and exhibits a comparatively narrow bark separated by a dark line (cambium) from an irregular circle of wood-bundles of varying size. The section of a root shows a thick bark and small wood.

Valerian rhizome has a powerful characteristic disagreeable odour and a camphoraceous, slightly bitter taste. The odour of the fresh rhizome, though disagreeable, is not strong, but it develops, during the drying, into the penetrating unpleasant odour of the drug.

The student should observe

(*a*) The *colour* and *odour* of the drug,

(*b*) The *short erect rhizome* surrounded by numerous roots,

(*c*) The characters of the *section of the rhizome* as given above;

and should compare the drug with

Serpentary rhizome, which is slender, usually horizontal, and has a distinctive odour and taste.

Constituents.—The principal constituent of valerian root is the *volatile oil* which is contained in the sub-epidermal layer of cells in the root, not in any special oil cells or glands. Good valerian root yields about 1 per cent. of volatile oil, one of the constituents of which is bornyl isovalerianate. This constituent gradually decomposes, yielding free isovalerianic acid, an oily liquid possessing an unpleasant odour of valerian; to this body the unpleasant odour of valerian root is to be ascribed, and its gradual production from bornyl isovalerianate explains the development of the odour as the root dries.

Valerian root also contains two alkaloids, chatinine and valerianine, which require further investigation.

Uses.—The drug is used as a powerful carminative, stimulant, and antispasmodic; it is given chiefly in hysteria, palpitation of the heart, &c.

SUMBUL RHIZOME

(Sumbul Root, Musk Root, Radix Sumbul)

Source &c.—The botanical origin of the drug at present known in commerce and official in the British Pharmacopœia under the name of Sumbul Root is not definitely known. It is generally referred to *Ferula Sumbul*, Hook. f. (N.O. *Umbelliferæ*) a plant of considerable size, growing in *Turkestan*. This plant, however, according to Holmes, produces a large napiform root that could scarcely furnish the cylindrical pieces, 1 to 2 inches long, that form much of the commercial drug, although it was probably the source of the drug of twenty-five years ago, which was apparently obtained from a large fragrant root.

Description.—Sumbul root occurs in short, more or less cylindrical pieces that are remarkable for their extreme lightness; they vary considerably in size, but are usually from 1 to 2 inches in width and about the same in length, often dividing in the upper part into two, three, or more branches. The latter are occasionally not more than ½ inch in diameter, and some of them bear a depressed scar left by the aerial stem after it has perished. Most of the pieces bear numerous short bristly fibres arranged in encircling lines, or at least show the scars of such; these fibres are the remains of the fibro-vascular bundles of leaves that have perished, and prove that the major part of the commercial drug consists of rhizome, not root. All the pieces exhibit regular transverse wrinkles and are covered with a thin but tough cork, which often shows a disposition to exfoliate, or at least can easily be stripped off.

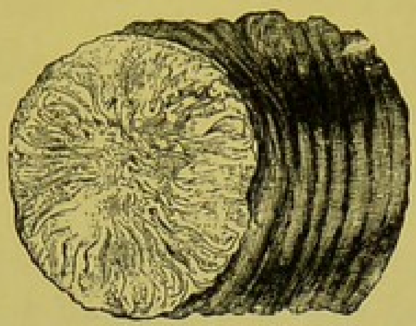


FIG. 126.—Portion of Sumbul root, showing section. (Maisch.)

Internally the drug is whitish or yellowish, spongy and irregularly fibrous, exhibiting numerous fissures which have possibly originated during the process of drying. The transverse section of a small rhizome shows a pale bark, within which is a ring of narrow, finely porous yellow wood-bundles; the central portion is parenchymatous tissue through which vascular bundles pass in varying directions, a structure that is exhibited by many rhizomes, and to which in this case the fibrous nature of the drug is due. In the larger pieces the structure is usually less distinct. The drug has an agreeable musky odour and a bitter, slightly aromatic taste.

The student should observe

(*a*) The *transverse wrinkles*, from which *short fibres* proceed,
(*b*) The *whitish, fibrous and spongy interior*,
(*c*) The *musky odour*.

Constituents.—Of the constituents of the sumbul root of commerce very little is known. Hahn (1897) found it to yield to petroleum benzin 17·25 per cent. of a *yellow viscid oil*, from which crystals of a substance not further investigated were obtained. The drug yielded 8 per cent. of ash. Probably there is present a little volatile oil, to which the perceptible musky odour is due.

Utech (1893) obtained 6·1 per cent. of an aromatic *amber-coloured resin* having a bitter taste and possessing the aromatic odour of the root.

Uses.—Sumbul is considered to possess stimulant and antispasmodic properties resembling those of valerian. It has been given in hysteria and certain nervous disorders, but is now not much prescribed.

ARNICA RHIZOME

(Arnica Root, Rhizoma Arnicæ)

Source &c.—Arnica rhizome, or arnica root as the drug is commonly termed, consists of the rhizome and roots of *Arnica montana*, Linn. (N.O. *Compositæ*), a small plant with a creeping perennial rhizome, indigenous to *central Europe*. In the warmer districts it is common in the meadows on the lower mountain spurs; in the more northern districts it grows in the valleys. It should be collected in the autumn, after the aerial parts have died down, and dried.

Description.—The rhizome, which is horizontal or oblique, is slender, nearly cylindrical in shape, and usually curved. It averages about 2 inches in length and about $\frac{3}{16}$ inch in thickness, and varies in colour from yellowish brown to nearly black. From the flanks and under surface numerous dark, brittle, wiry, curved and twisted roots about 3 inches in length are given off, and the scars that are left, when these break off or perish, together with the encircling scars of cataphyllary leaves, render the surface of the rhizome, which is in addition longitudinally shrivelled, distinctly rough. Usually it is simple and often terminated by the hairy remains of leaves; sometimes, after the plant has flowered, the growth of the rhizome, which has thus been terminated, is continued in the same

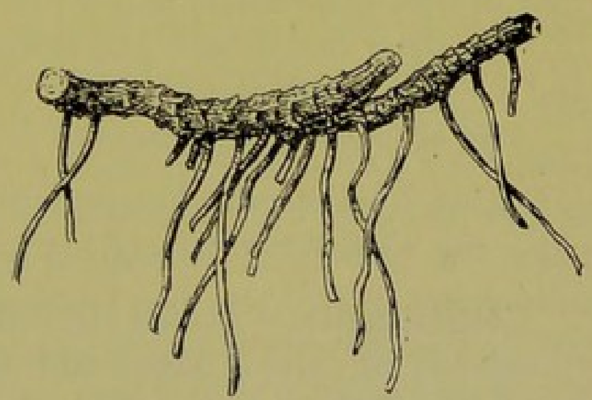


Fig. 127.—Arnica rhizome. Natural size. (Holmes.)

direction by the development of a bud on its under surface; the rhizome thus formed will in due course itself flower, and the further growth will again be ensured by the development of one of the lower buds. Thus the rhizome occasionally assumes a jointed appearance.

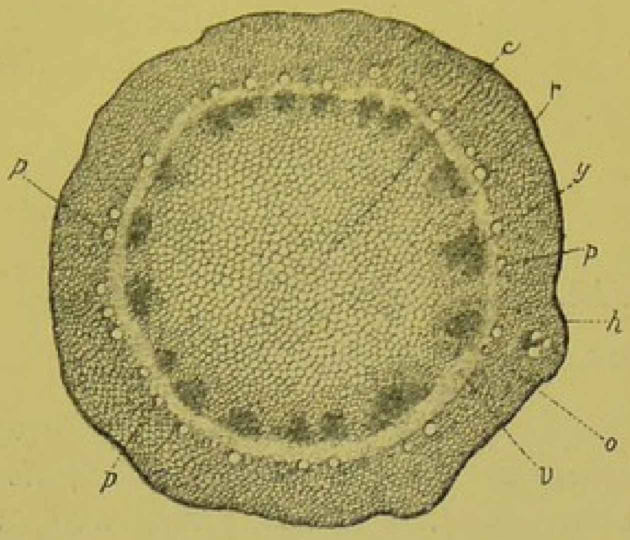


FIG. 128.—Arnica root. Transverse section of rhizome. *v*, bast; *o*, primary cortex; *y*, wood-bundles; *r*, medullary rays; *c*, pith; *p*, oleo-resin ducts. Magnified 10 diam. (Berg.)

The rhizome breaks with a short fracture, and is often discoloured in the interior. The transverse section of a favourable specimen shows a comparatively thick whitish or yellowish bark, in which near the wood is a circle of darker oleo-resin ducts. The wood consists of yellow wedge-shaped wood-bundles and broad medullary rays enclosing a large whitish pith which in longitudinal sections is seen to be continuous. The root also shows a thick white bark with a ring of oleo-resin ducts and a yellowish wood.

The drug has a faint but rather agreeable apple-like odour and a bitter acrid taste.

The student should observe

(*a*) The *curved rhizome* with *wiry roots*,
(*b*) The *characters of the transverse section*.

Constituents.—Arnica rhizome contains about 0·5 per cent. of *volatile oil*, and a bitter and acrid principle, *arnicin*, which has been obtained in the form of a minutely crystalline yellow powder. It also contains *tannin*, but no starch, the reserve material being inulin, the latter character being useful in distinguishing it from any starch-forming rhizome.

Uses.—The tincture diluted with water is a popular application for bruises, preventing swelling and hastening the absorption of effused blood. It appears to increase the activity of the circulation in the skin, but should be used with caution, as it is liable to produce eczema or even erysipelas.

Arnica is not often given internally; it has a depressing or, in overdoses, irritant action, causing vomiting, pain, and purging.

GELSEMIUM RHIZOME

(Yellow Jasmine Root, Radix Gelsemii)

Source &c.—The yellow jasmine, *Gelsemium nitidum*, Michaux (N.O. *Loganiaceæ*), is an elegant climbing plant indigenous to the *southern United States*; it ascends lofty trees and forms festoons, scenting the atmosphere with its fragrant yellow flowers. It has long been known, but its medicinal use is of recent date. The rhizome and roots should be collected in the autumn.

This plant should not be confounded with *Jasminum nudiflorum*, Lindl., a yellow-flowering jasmine commonly cultivated in this country.

Description.—The drug consists of the rhizomes, to which portions of both slender aerial stems and small and large roots are sometimes attached; usually the rhizomes and larger roots, cut into pieces about 6 inches in length, constitute the commercial drug.

The rhizomes are generally in nearly straight cylindrical pieces varying from $\frac{1}{4}$ to about $\frac{3}{4}$ inch in thickness, of a dark purplish-brown colour, or at least marked with a more or less distinct network of purplish lines, the intervening spaces being yellowish brown. This difference in colour is due to the fact that the outer cork-cells are filled with a dark reddish-brown substance, the inner with a yellowish deposit; by the growth of the rhizome the outer dark layer is fissured, disclosing the paler inner layer. The rhizomes are hard and woody, and break with an irregular splintery fracture, frequently exhibiting in the bast silky fibres, which, however, are much more conspicuous in the slender aerial stems.

The roots are, on the average, rather smaller than the rhizomes; they may be distinguished by their uniform yellowish-brown colour and finely wrinkled surface, and by their rather more sinuous course.

Both rhizome and root exhibit in transverse section a comparatively narrow bark enclosing a large yellowish-white wood; the latter consists of narrow wood-bundles with small pores alternating with distinct, straight, whitish medullary rays, the section thus assuming an elegant radiate appearance. The section of the rhizome is distinguished from that of the root by the presence of a small pith which, however, is more evident in the smaller (younger) than in the larger (older) pieces; it differs also from that of the aerial stem in the arrangement of the fibres in the bark; in the stem these are grouped into bundles, whilst in the rhizome they form an interrupted ring of isolated fibres or groups of two or three (Sayre, 1897).

The drug has a bitter taste, especially conspicuous in the bark, and a very slight aromatic odour.

The student should observe

(*a*) The *splintery fracture*,
(*b*) The *radiate structure* of the transverse section,
(*c*) The *purplish colour* of the rhizome,
(*d*) The *yellowish colour* and *tortuous appearance* of the root.

Constituents.—Gelsemium rhizome contains two alkaloids, *gelsemine* and *gelseminine*, the former yielding crystalline, the latter amorphous salts. Gelseminine is much more poisonous than gelsemine; it has even been doubted whether gelsemine, when quite pure, has any toxic action whatever. Both gelsemine and gelseminine have been employed medicinally, the latter on account of its property of dilating the pupil of the eye; neither is now much prescribed, but it is important that both should be carefully distinguished from the eclectic resinoid gelsemin, which is a mixture of substances obtained by evaporating an alcoholic tincture to dryness.

The drug also contains a crystalline substance, β *methyl-æsculetin* (Schmidt), which exhibits an intense bluish-green fluorescence in alkaline solution; evidence of the presence of this body can easily be obtained by macerating a little of the powdered bark in lime water, which will acquire a distinct fluorescence. β methyl-æsculetin (scopoletin, Eykman; chrysatropic acid, Kunz) is also present in scopola rhizome (derived from *S. carniolica*, Jacq.) and in belladonna root.

Uses.—Gelsemium has been given in tetanus, asthma, whooping cough, and other convulsive diseases, with uncertain results. It has been much used for, and appears to relieve certain forms of neuralgia and sick headache.

SERPENTARY RHIZOME

(Serpentary Root, Virginian Snakeroot, Rhizoma Serpentariæ)

Source &c.—Two varieties of serpentary, or, as it is sometimes termed, snakeroot, are official in the British Pharmacopœia, viz. *Virginian snakeroot* and *Texan* or *Red River snakeroot.*

Virginian snakeroot is obtained from *Aristolochia Serpentaria*, Linn. (N.O. *Aristolochiaceæ*), a small herbaceous plant with slender perennial rhizome, growing in the *United States, to the east of the Mississippi.*

Texan or *Red River snakeroot* is the produce of *Aristolochia reticulata*, Nutt., a rather stouter plant, growing, as its name indicates, in the *south-western States.*

The drug is collected in the autumn and dried. It was known in England in 1632, its use having been undoubtedly learnt from the American Indians, and it found a place in the London Pharmacopœia of 1650.

Description.—The snakeroot at present in commerce is the variety known as Texan, and is derived from *A. reticulata*. It consists of a short, slender, rather tortuous rhizome about 1 inch long and $\frac{1}{10}$ inch thick, to the flanks and lower surface of which are attached numerous long, curved, but not wiry or interlacing roots ; these are comparatively stout, being frequently half the thickness of, or even as thick as the rhizome itself, and seldom much shrivelled. The latter is usually horizontal, but not unfrequently assumes an oblique or even vertical position, and gives off from its upper surface (or from one side) numerous closely approximated slender aerial stems. These, when they die down, leave short portions, bearing the scars of

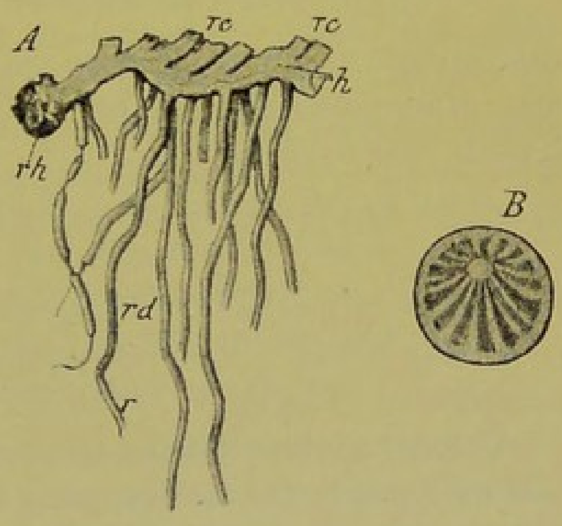


Fig. 129.—Virginian Snakeroot. *A*, longitudinal section of rhizome and roots : *rc*, remains of aerial stems ; *rd*, roots ; *rh*, rhizome. *B*, transverse section of rhizome, magnified 3 diam. (Berg.)

leaves, attached to the rhizome; occasionally a fruiting stem may also be found.

Both rhizome and roots are brittle, breaking with a short fracture. The former exhibits in transverse section a whitish pith that is distinctly eccentric, being much nearer to the upper than the under surface of the drug; the wood-bundles are numerous, yellow and curved, the bark yellowish brown and thin; the section of the root shows a slender yellow wood and a thick white bark.

The drug, by far the greater part of which consists of the roots, has a tolerably uniform yellowish-brown colour, a characteristic camphoraceous odour, and a strong, disagreeably bitter and acrid taste.

Virginian snakeroot, which appears to be seldom imported, differs from the foregoing in having a shorter and thinner rhizome and thinner, wiry, interlacing roots forming little matted masses, but resembles it in colour, odour, and taste.

The student should observe

(*a*) The *slender rhizome with portions of the stem arising from the upper surface in close succession,*
(*b*) The *eccentric position of the pith,*
(*c*) The *very characteristic odour and taste*;

and should compare the two varieties with one another, noting the differences alluded to. He should further compare the Texan variety with

(i) Small specimens of *valerian root*, which possess a short erect rhizome from which a single stem arises and which has a very different odour and taste.
(ii) The rhizome of *Indian pink*, which is darker and has not the eccentric pith that characterises serpentary.

Constituents.—Serpentary rhizome contains *volatile oil* (about 1 per cent.), *tannin*, and a *bitter principle*, apparently an alkaloid, crystallising in light yellow needles. The latter is probably identical with Chevalier and Fenuelle's amorphous aristolochine, and with the aristolochine isolated by Hesse from *A. argentina*, Griseb.

Uses.—Serpentary possesses local and general stimulant and tonic properties closely resembling those of valerian and cascarilla. It is occasionally used in nervous, despondent, and excitable conditions, as well as in low fevers and febrile states.

Substitutes.—Serpentary has been confounded with valerian root, to which it bears a superficial resemblance, the difference in the rhizome as well as in the odour being most marked. Indian pink root (*Spigelia marilandica*, Linn.) much more closely resembles it, but may be distinguished by its darker colour, by the absence of characteristic odour, and by the section of the rhizome, which exhibits an oval or crescent-shaped pith, surrounded by a ring of wood in which no particular structure is visible when examined with a lens. Serpentary is also particularly characterised by its taste.

RHUBARB RHIZOME

(Rhizoma Rhei, Radix Rhei)

Source &c.—The botanical source of this important drug, which has been known and used in Europe since the eleventh century, and probably much longer, is still involved in obscurity. Even the districts from which it is obtained are not definitely known. Much is certainly collected on the slopes of the mountains that stretch from a little west of Hankow to the east of Thibet, dividing the province of Shensi on the north from that of Szechuen on the south. Probably the eastern districts of Thibet, and the Chinese provinces of Kansu and Szechuen, also yield commercial rhubarb. *Eastern Thibet* and *north-western China* may therefore be indicated as the geographical origin of the Chinese drug.

Two plants are generally referred to as probable sources of Chinese rhubarb, viz. *Rheum palmatum*, Linn., and *R. officinale*, Baill. (N.O. *Polygonaceæ*). There is, however, insufficient evidence in favour of the former, which yields a root markedly different from the commercial drug (Dragendorff, 1877); the latter (*R. officinale*), which was first raised from a root sent from Hankow to Paris in 1867, is probably one at least of the sources of Chinese rhubarb. It has been extensively cultivated in England and elsewhere, and yields a root closely resembling in structure and quality good samples of the commercial drug.

The plants produce very large radical leaves and tall flowering stems, springing from a massive upright rhizome, from which a few stout roots proceed. The rhizomes are collected in the autumn from wild plants (China), trimmed and peeled; if of small size they are dried entire, but if large they are sliced.

Fig. 130.—*Rheum officinale*. Entire plant, much reduced. *A*, flower; *B*, longitudinal section of same: *d*, disc. *C*, ovary. *D*, half-ripe fruit of *R. compactum*, Linn. (Luerssen.)

The drying is effected either by solar or by artificial heat, or both, the roots being commonly strung on cords during the process.

At present the drug is brought chiefly to Hankow, on the Yang-tse-Kiang river, and sent thence down the river to Shanghai, whence it is exported to Europe, other Chinese sea-ports sending small quantities only. Formerly the drug was conveyed by caravan *viâ* Persia to the Syrian ports, whence it reached Europe and was known as Turkey rhubarb ; some was sent direct from China (China or Canton rhubarb), and some was shipped *viâ* India (East Indian rhubarb), the latter being the most common variety as early as 1640. Subsequently, by a commercial treaty between Russia and China, the trade was diverted to the Russo-Siberian route, and the drug was conveyed *viâ* Irkutsk to Moscow, still retaining its designation of Turkey rhubarb. Later, however, when the Chinese opened some of their northern ports to European trade, the drug was exported by the route which it now takes, and the trade names of Turkey and East Indian rhubarb indicate nothing more than the routes by which the drug formerly found its way to the European market. As already stated, Asiatic rhubarb is collected over a very extensive area in eastern Thibet and north-western China, and is exported chiefly from Shanghai.

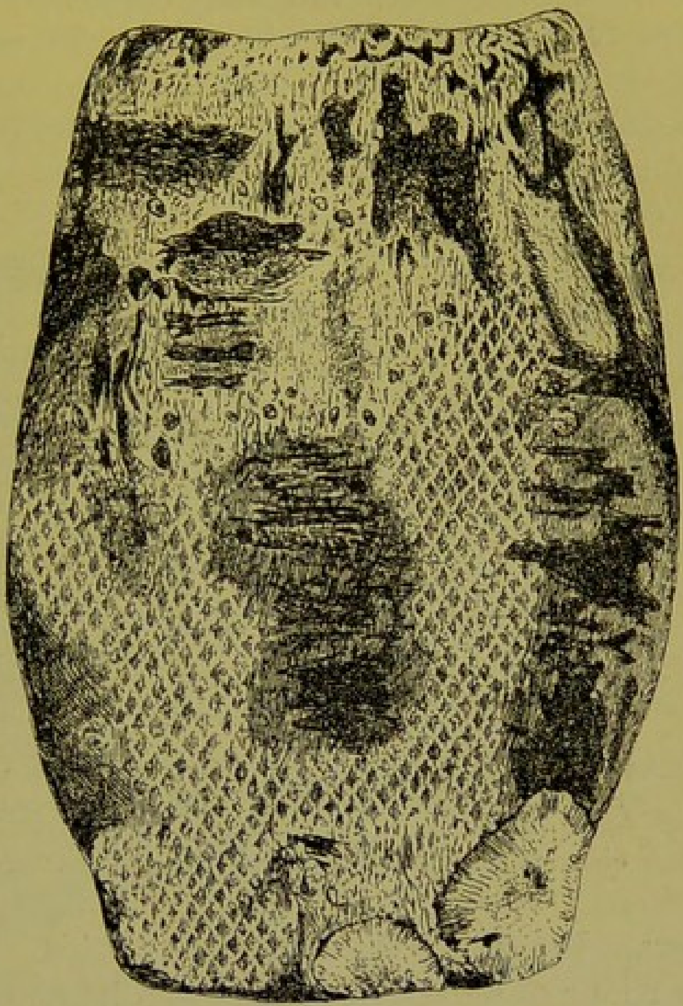


FIG. 131.—Chinese Rhubarb, showing network of whitish lines. (Planchon and Collin.)

Description.—The official drug occurs in pieces of very varying size and shape. Those derived from smaller rhizomes that have not been sliced occur in cylindrical, conical, or barrelshaped pieces varying in size, but frequently from 3 to 4 inches in length and $1\frac{1}{2}$ to 2 inches in thickness, although of course they may be larger or smaller. The larger rhizomes, which are usually cut longitudinally, yield plano-convex pieces, frequently tapering more or less towards either end; such pieces often measure 3 or 4 inches in length or breadth and $1\frac{1}{2}$ inch in thickness. These two principal forms are known as 'rounds' and 'flats' and are commonly exported in separate cases. They are frequently bored with a hole in which a piece of string may often be found. The outer surface is dusted over with a fine bright yellow powder, and bears evidence of having been not only peeled with a knife, but carefully dressed with a file or

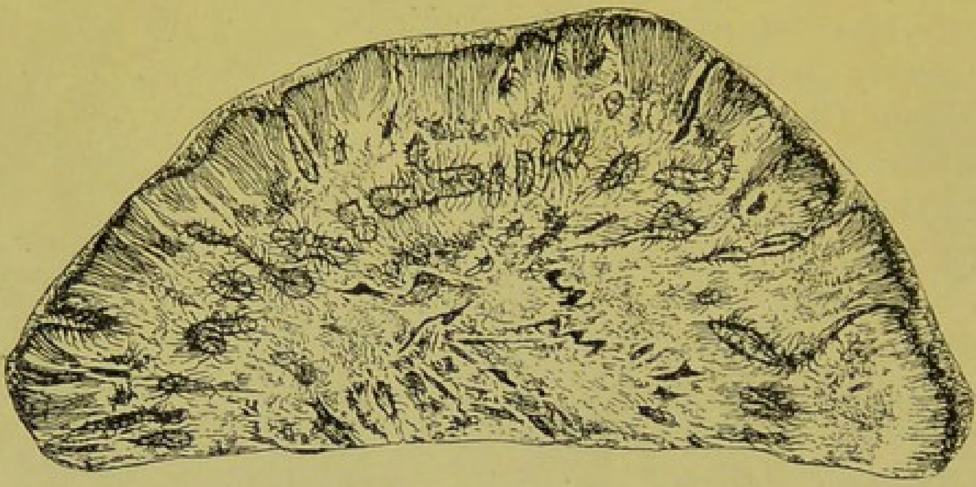


Fig. 132.—Chinese Rhubarb. Transverse section, showing the remains of the bark (as a narrow exterior layer), the cambium (as a dark line), the wood (with a more or less distinctly radial structure), and an irregular circle of star-spots (abnormal fibro-vascular bundles).

scraped after the drug has been dried. Here and there small portions of a dark layer may still be found.

If the outer surface, freed from the yellow powder that adheres to it, is examined with a lens, a number of minute, longitudinal, dark reddish-brown lines and dots can be observed imbedded in a white ground mass, which latter frequently forms a delicate network, in the meshes of which the alternating white and dark red lines alluded to can be seen. The dark lines are medullary rays containing brown colouring matter; the white lines consist of bast parenchyma containing starch and calcium oxalate. Occasionally minute dark points or projections may be detected which, when carefully shaved off with a knife, exhibit radiating red and white lines; these are the remains of fibro-vascular bundles from the leaves (leaf-traces) and pass through the bark into the central portion of the rhizome.

The drug is hard, heavy, and compact; it breaks with an uneven fracture, the smoothed surface exhibiting under the lens dark reddish-brown lines alternating with white ones, an appearance that has been termed 'marbled.' The transverse section shows near the periphery a more or less continuous ring of large, conspicuous, starlike spots, each of which consists of dark red lines (medullary rays) radiating from a common

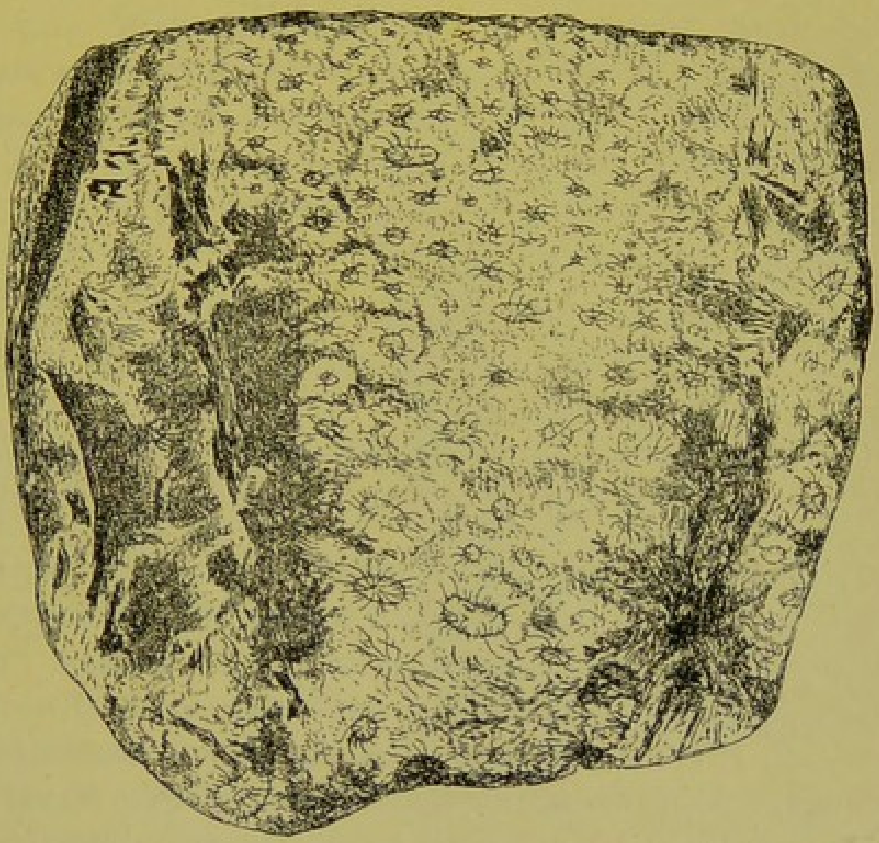


FIG. 133.—Chinese Rhubarb. Flat (inner) surface of a plano-convex piece, showing irregularly distributed star-spots.

centre through a white groundwork (parenchyma). These star-spots are fibro-vascular bundles which are arranged in a more or less continuous ring and also traverse the inner part of the drug in varying directions, an appearance not uncommon in rhizomes the internodes of which are very short. Exterior to this ring the drug exhibits a radiate appearance due to the formation of secondary wood by the cambium, but the latter is often not seen, as not only the whole of the bark but even part of the secondary wood may have been removed by the peeling. If the peeling has been sufficiently deep to remove the bark and the secondary wood as well, then the star-spots appear on the outer surface, but until then they are indistinct. They can always be seen on the flat (inner) surface of the plano-convex pieces. Beyond the secondary wood is the cambium, usually visible as a dark line, and here and there the narrow remains of the bark. Small cylindrical pieces are generally more favourable for examination than flat slices of a larger rhizome.

The structure of this drug is complex, but it must be remembered that it is a very fleshy rhizome, the internodes of which are so closely approximated as to be almost suppressed.

The drug possesses a characteristic odour and bitter, astringent taste; when chewed it is very gritty between the teeth, a character due to the calcium oxalate, which occurs in considerable quantity in large cluster-crystals.

The student should particularly observe

(*a*) The *firm, hard texture*,
(*b*) The *outer surface, seldom much wrinkled*,
(*c*) The *continuous ring of star-spots on the transverse section*,
(*d*) The *network of white lines on the outer surface* (not shown when the peeling has been carried too deep).

Constituents.—Although rhubarb has been repeatedly subjected to chemical investigation, we are still in doubt as to the nature of the cathartic substances that it contains. One of the chief of these is probably *cathartic acid* (Kubly and Dragendorff, 1878), a substance bearing a close resemblance to the cathartic acid of senna leaves and soluble in ether, by which menstruum the cathartic principles are almost entirely extracted. Other more definite bodies that have been obtained, but the laxative nature of which is doubted, are *chrysophanic acid* (Schlossberger and Dipping, 1844), *emodin* (Warren de la Rue and Müller, 1857), and *rhein* (Hesse, 1895), all of which are crystalline and appear to be, in the order named, oxidation products of another, at present unknown, constituent. Rhubarb contains, further, *rheo-tannic acid*, a *bitter principle*, and certain *resinous bodies* the nature of which has not been definitely ascertained. The gritty taste is due to *calcium oxalate*, which occurs in varying proportion, the ash, part only of which is derived from calcium oxalate, amounting to as little as 3 or as much as 43 per cent. Good rhubarb (Chinese) that yielded

12·9 per cent. ash contained 7·3 per cent. of calcium oxalate (Flückiger). The drug also contains considerable quantities of starch.

Uses.—In small doses rhubarb is a bitter stomachic and intestinal astringent; in larger doses it causes purgation. It is given in cases of indigestion with diarrhœa and as a mild laxative.

Varieties &c.—*English Rhubarb from R. officinale.*—From the root sent to Paris in 1867, which proved to be a new plant and was named *R. officinale*, plants were obtained and cultivated. They yielded rhizomes practically identical in structure with Chinese rhubarb and possessing similar properties.

FIG. 134.—English Rhubarb (*R. officinale*), showing the shrunken outer surface. Natural size.

In England *R. officinale* is cultivated in several localities (Oxfordshire, Bedfordshire), and considerable quantities of the drug of excellent quality are obtained. Such rhubarb comprises both rhizomes and roots, which, however, are sold separately. The former closely resemble the Chinese drug, but are usually to be distinguished from it by their greater sponginess; they wrinkle therefore deeply as they dry, and are softer to cut, both of which characteristics are perceptible in the drug. Moreover, the network of white lines on the outer surface, which distinguishes most pieces of the Chinese drug, is usually not discernible in the English, the white and red lines running commonly parallel to one another. The structure is otherwise practically identical with that of Chinese rhubarb, and the drug appears to contain the same constituents.

The roots of *R. officinale* are much narrower than the rhizome, and exhibit in transverse section a distinctly radiate structure without star-spots.

English Rhubarb from R. rhaponticum.—This plant, which is of Asiatic origin, or according to Holmes a hybrid between this and *R. undulatum*, is also cultivated in England to a certain extent. The rhizomes differ from those of *R. officinale* in exhibiting in transverse section a diffuse circle of star-spots, which show little or no tendency to form a continuous ring. The cambium is often visible as a dark line near the margin; within it is a ring of radiate wood, and without is the narrow remnant of the cortex, which also exhibits a radiate structure.

Fig. 135.—English Rhubarb (*R. officinale*), showing the star-spots on the radial section. Natural size.

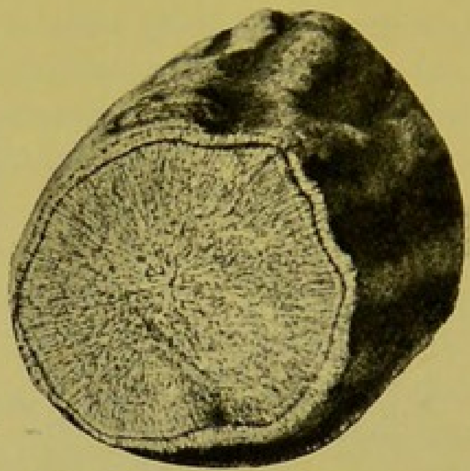


Fig. 136.—English Rhubarb from *R. rhaponticum*; transverse section of root.

The outer surface is marked with parallel longitudinal white lines, no network of whitish lines, as seen on Chinese rhubarb, being visible; it is also usually much shrunken.

The roots are much smaller than the rhizomes; they are sold separately, and exhibit in transverse section a conspicuously radiate structure.

No. 6.

GALANGAL RHIZOME

(Lesser Galangal, Rhizoma Galangæ)

Source &c.—Galangal root is the rhizome of *Alpinia officinarum*, Hance (N.O. *Scitamineæ*), a reedlike plant, attaining about 4 feet in height, a native of and cultivated on the island of *Hainan* and the neighbouring *south-east coast of China*. The rhizome is dug up in the autumn, washed, trimmed, cut into pieces, and dried ; during the latter process the pale colour of the fresh rhizome turns to a reddish brown.

The drug has been used in Europe as a spice for more than a thousand years; probably it was introduced by means of the Arabian physicians. It is not now much used in England, but is still employed in some parts of Russia both as a spice and as a medicine.

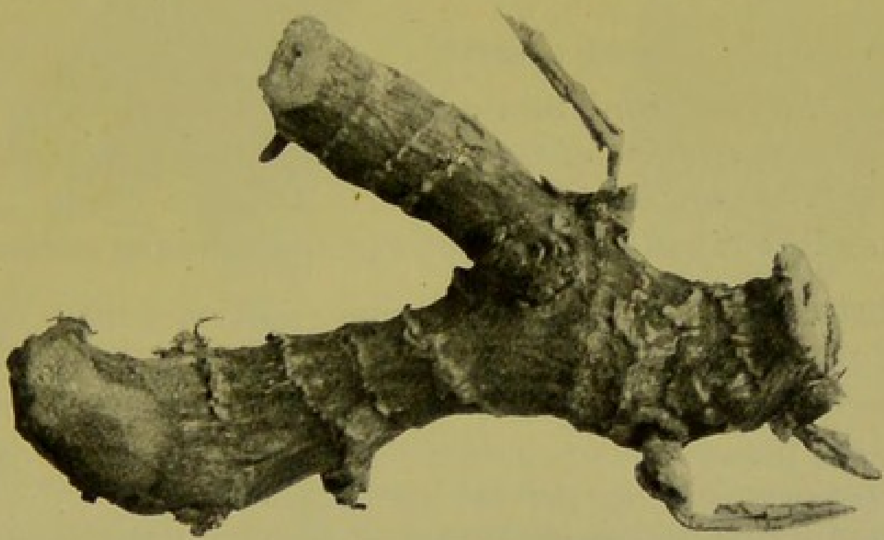


Fig. 137.—Galangal root. Natural size.

Description.—The drug consists of a branched rhizome, about ½ inch thick, that has evidently been cut whilst fresh into pieces about 2 or 3 inches long. These are frequently cylindrical, but sometimes tapering or enlarged, and often branched. They are of a dull reddish-brown colour, longitudinally striated or shrivelled, and bear, at intervals of about ¼ inch, pale encircling sinuous or frilled remains of cataphyllary leaves. Here and there the broken upper end of a root remains attached to the rhizome, but these are by no means numerous. It is hard, tough, and difficult to break.

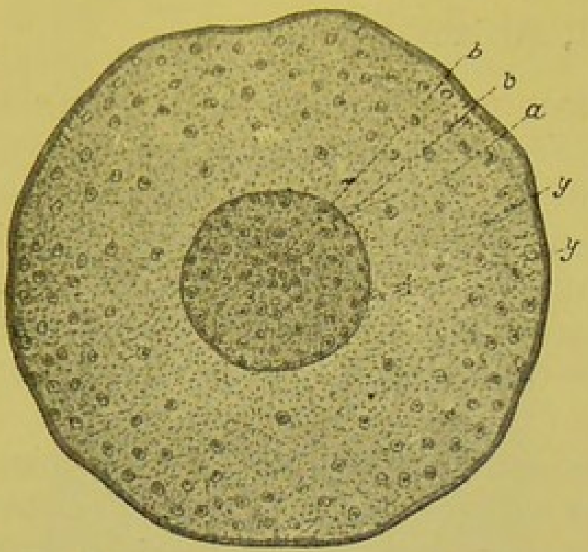


FIG. 138.—Galangal rhizome. Transverse section, magnified 3 diam. *a*, bark; *v*, endodermis; *b*, central cylinder (stele); *y*, vascular bundles. (Berg.)

The interior of the drug has a reddish-brown colour, sometimes deeper, sometimes paler than that of the exterior. The transverse section exhibits a distinct central column (stele) surrounded by a wide bark. In both of these portions paler fibro-vascular bundles and numerous deep red resin-cells may be distinguished under the lens. The drug has an agreeable spicy odour and a strongly pungent spicy taste.

The student should observe

(*a*) The *reddish-brown colour*,
(*b*) The *remains of the cataphyllary leaves*,
(*c*) The *pungent taste*,
(*d*) The *structure exhibited by the transverse section.*

Constituents.—Galangal rhizome contains a little *volatile oil* (0·7 per cent., Schimmel), three yellow crystalline bodies, *kæmpferid, galangin,* and *alpinin,* all of which are tasteless, and a very pungent body, *galangol*; the latter is a pale yellow oily substance that has not yet been crystallised.

The drug also contains a trace of tannin, to the decomposition of which the brown colour of the rhizome is due.

TURMERIC

(Rhizoma Curcumæ)

Source &c.—The plant yielding turmeric, *Curcuma longa*, Linn. (N.O. *Scitamineæ*), is apparently a native of southern Asia, though no longer known in the wild state. It is cultivated to a large extent in *India, China*, Java, and other tropical countries. The rhizome has long been employed both as a spice and as a colouring agent, the latter quality gaining for it the name of *Crocus indicus*. It was certainly known to Dioscorides, and described by him as a root resembling ginger, but having a yellow colour and bitter taste. During the middle ages it fell into disuse, and is now considered much inferior to ginger and other spices, whilst in India it is largely employed as a dye and as a condiment.

The rhizomes are dug up after the herbaceous aerial stems have died down ; there is then found an upright, bulb-shaped rhizome, from which the stem has sprung and to which

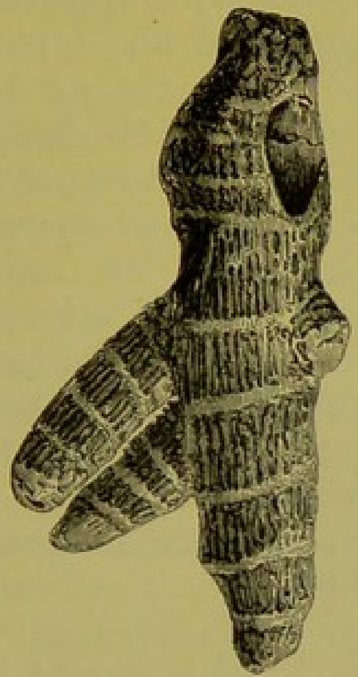


Fig. 139.—Madras Long Turmeric. (Pereira.)

Fig. 140.—China Round Turmeric. (Pereira.)

several cylindrical descending branches are attached. One or more of the latter, destined to produce aerial stems in the following year, will curve upwards and thicken to form bulb-shaped organs. The rhizomes so obtained are then steamed in their own juice or boiled in water for a half to one day, by which the vitality that they otherwise obstinately retain is destroyed. They are finally dried either in the sun or in an oven, and (sometimes) sorted into 'fingers' and 'bulbs,' the former being the cylindrical descending branches, the latter the erect, stem-producing ones.

Description.—Finger or long turmeric occurs in curved or nearly straight cylindrical pieces bluntly tapering at each end.

The outer surface is of a deep yellowish-brown colour, longitudinally wrinkled, and marked with transverse rings (leaf-scars). Occasionally they bear short knob-like branches, or show large circular scars where these have been broken off. They are hard and heavy, and break with a short fracture; internally they have a uniform dull brownish-yellow, waxy appearance and tough horny consistence. The transverse section exhibits little of its structure beyond a paler (or sometimes darker) ring separating the stele from the bark. This remarkable appearance of the interior of the rhizomes is due to the prolonged boiling they undergo, by which not only is the starch gelatinised and a horny consistence imparted to the drug, but the colouring matter, previously restricted to certain scattered cells, becomes uniformly diffused throughout the rhizome.

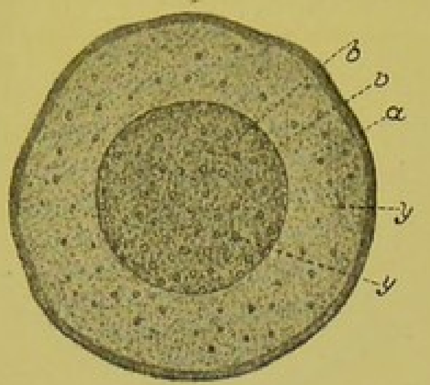


FIG. 141.—Turmeric rhizome. Transverse section. *a*, bark; *v*, endodermis; *b*, central cylinder (stele); *y*, vascular bundles. Magnified 3 diam. (Berg.)

Bulb or round turmeric resembles the finger variety, but is, as its name indicates, shorter and thicker.

The drug has a characteristic aromatic odour and taste, and when chewed colours the saliva yellow.

The student should observe

(*a*) The *difference in shape* between '*bulbs*' and '*fingers*,'
(*b*) The *yellowish-brown colour*,
(*c*) The *horny consistence and waxy appearance of the interior*.

Constituents.—Turmeric contains about 1 per cent. of *volatile oil*, and a crystalline yellow body, *curcumin*. These are confined, in the fresh rhizome, to the particular secreting cells in which they have been produced, but pass during the scalding into the surrounding tissue, the parenchymatous cells of which are filled with amorphous masses of gelatinised starch.

Curcumin dissolves in alcohol, forming a deep yellow solution, the colour of which is changed to reddish brown by alkalies. Evaporated after the addition of boric acid the colour is reddish brown, which alkalies then change to blue.

Uses.—Turmeric is now used to a limited extent as a condiment and colouring agent.

Varieties &c.—Several commercial varieties of turmeric are known. The majority of the drug is shipped from India, that from Madras being the most esteemed. Other species of *Curcuma* (*C. angustifolia*, Roxb., *C. leucorhiza*, Roxb.) have paler coloured rhizomes which are utilised in India for the production of starch, which is known as 'East Indian Arrowroot.'

GINGER

(Rhizoma Zingiberis)

Source &c.—Ginger is the dried rhizome of *Zingiber officinale*, Roscoe (N.O. *Scitamineæ*), a reed-like plant producing leafy stems 3 or 4 feet high, springing from branching rhizomes. It is a native of Asia, but is *cultivated in many tropical countries*, notably in the West Indies, in India, Africa, and Japan.

There can be little doubt that ginger was well known in India as a spice from the earliest times. The Greeks and Romans were well acquainted with it, and its use spread in the ninth and tenth centuries through Europe to England. It was introduced by the Spaniards into the West Indies and Jamaica.

In Jamaica the plant is largely cultivated. It is propagated by dividing the rhizome into 'fingers,' each of which contains a bud, and planting these about a foot apart. They grow rapidly and flower in the autumn. When the aerial stems wither the rhizomes are dug up, freed from the roots, and washed. They are then peeled with a narrow-bladed knife, by which the layer of cork and part of the parenchyma of the bark are removed, after which they are again washed, and dried in the sun. The product is known as unbleached Jamaica ginger. Although the use of a revolving drum for removing much of the peel and of a drying machine for rapidly drying the rhizomes has been suggested, this machinery does not appear to have been successfully introduced.

Much ginger is found in commerce from which the cork layer has not been removed, or which has been deprived of it on the flatter sides only. Such ginger is known as 'coated' or 'unscraped,' whilst that which has been completely peeled is called 'scraped.' Sometimes, too, the rhizomes are treated with sulphurous acid or chlorine, by which they are bleached, or they are dusted over with calcium sulphate or carbonate which imparts to them a whitish appearance; ginger that has been treated in either of these ways is termed 'bleached' ginger. In addition therefore to being obtained from different countries, ginger may be 'scraped' or 'unscraped,' 'bleached' or 'unbleached.'

Description.—Unbleached Jamaica ginger, which is the official variety and the one that is most esteemed, occurs in flattened branched pieces technically termed 'races' or 'hands.' These vary in length, but average about 3 or 4 inches. From

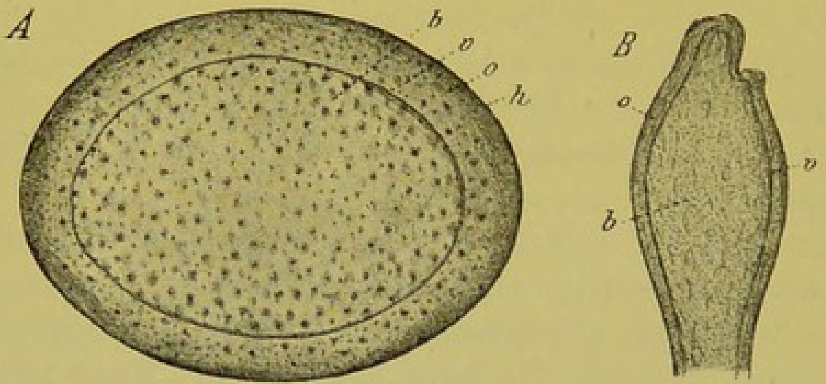


FIG. 142.—Ginger. *A*, transverse section through the rhizome, magnified 3 diam. *B*, longitudinal section through a branch, natural size. *o*, bark; *v*, endodermis; *b*, central cylinder (stele). (Berg.)

the upper surface of the main rhizome, which is usually straight, numerous branches about 1 inch in length appear to arise and take an upward course; they are often slightly compressed laterally, enlarged near the rhizome, and, tapering abruptly, terminate in the remains of an undeveloped bud or a small depressed scar indicating the point of attachment of the aerial stem. The branches themselves also produce lateral branchlets. All these branches and branchlets arise from buds on the under surface of the rhizome in the axils of cataphyllary leaves. When the growth of the main axis is terminated by the production of an aerial shoot, one of these buds develops, curves upwards, and itself in due time produces an aerial shoot and develops a lateral branch. Each piece of the drug or 'hand' is therefore a sympodial branch system.

The colour of the drug is usually pale yellowish-buff; the surface is strongly striated or even fibrous, the fibres being the leaf-traces passing through the bark to the leaves, and laid bare by the peeling of the rhizome. It breaks with a short, mealy or sometimes resinous fracture, short scattered fibres usually protruding from the fractured surface; these are the fibro-vascular bundles in the stele and bark.

The smoothed transverse section exhibits a large stele which is sharply delimited by a fine yellow line from a narrow bark, both stele and bark containing numerous yellow oil-cells. No cork layer is to be discerned. Ginger has an agreeable aromatic odour and a strong pungent taste.

The student should observe

(*a*) The *fibrous surface*,
(*b*) The *short fracture with protruding fibres and yellow oil-cells*.

Constituents.—Ginger contains about 2 per cent. of a *volatile oil* possessing the aroma but not the pungency of the drug. The latter property is due to a yellowish oily body, *gingerol*, which is odourless, but has an intensely pungent taste. The drug contains in addition *resin* and abundance of *starch*.

Uses.—Ginger is largely used as a condiment, and medicinally as a stimulant.

Varieties.—The chief commercial varieties of ginger are Jamaica, Cochin, and African. Japanese ginger is also imported to a limited extent, and an inferior grade of Jamaica ginger, obtained by allowing a part of the 'hand' to remain in the ground after the first crop has been collected and grow without further attention, is known as 'ratoon' ginger.

Cochin ginger occurs in both the scraped and coated varieties; the latter bears on its ventral and dorsal surfaces, but not on the lateral, portions of a reddish-grey cork, coarsely wrinkled both longitudinally and transversely. The lateral surfaces, that have been freed from the cork, are striated and of a rather paler colour. The drug is usually in smaller 'hands' than the Jamaica, the branches ('fingers') are commonly shorter and the aroma less agreeable. In addition to these characters the reddish-grey colour of the drug serves to distinguish it from Jamaica ginger, which has a yellowish tinge.

African ginger occurs in hands of about the same size as, or in fine samples rather larger than, Cochin. It is a coated ginger, the ventral and dorsal surfaces bearing patches of wrinkled cork of an earthy-brown colour. The cortical tissue that is exposed on the lateral surfaces is sometimes of a dingy grey colour and lighter than the cork, sometimes nearly black and then much darker. The drug in bulk is darker than Cochin ginger and appears discoloured from want of care in the preparation of it for the market. Although deficient in aroma, it is an exceedingly pungent ginger, in this respect excelling the Jamaica drug.

Japanese ginger resembles Cochin, but the pieces are usually smaller and less regular.

Ratoon ginger is seen in the branched hands with slender fingers characteristic of Jamaica ginger. It is, however, of a dull dingy greyish-brown colour, darker than Cochin, and bears evidence of having been imperfectly peeled and carelessly cured. It is of inferior aroma and pungency.

Of all the commercial varieties of ginger, Jamaica is the most aromatic and African the most pungent.

ORRIS RHIZOME

(Orris Root, Rhizoma Iridis)

Source &c.—Orris rhizome or root, as the drug is commonly termed, is derived from three species of *Iris* (N.O. *Irideæ*), all of which are cultivated for that purpose.

Iris germanica, Linn., is a handsome plant with dark blue or purplish-blue flowers, distributed over central and southern Europe, extending to Africa and India, and is a common garden plant in England. It is cultivated in Italy, especially in the neighbourhood of *Florence* and *Verona*, and also in *Morocco*.

Iris pallida, Lamarck, has pale bluish flowers and is a native of the eastern Mediterranean countries; it is also cultivated in *Italy*, and yields with *I. germanica* the bulk of the drug.

Iris florentina, Linn., with large white flowers, is also a native of eastern Mediterranean regions, and is cultivated in *Italy*, but not so abundantly as the other two.

The rhizomes of all three species so closely resemble one another that there are no definite means of distinguishing them.

They are dug up in the late summer, trimmed and peeled; they are then allowed to dry slowly in the sun. During the slow drying the rhizomes, which in the fresh state are almost inodorous and have an acrid taste, acquire an agreeable fragrance and lose their acridity.

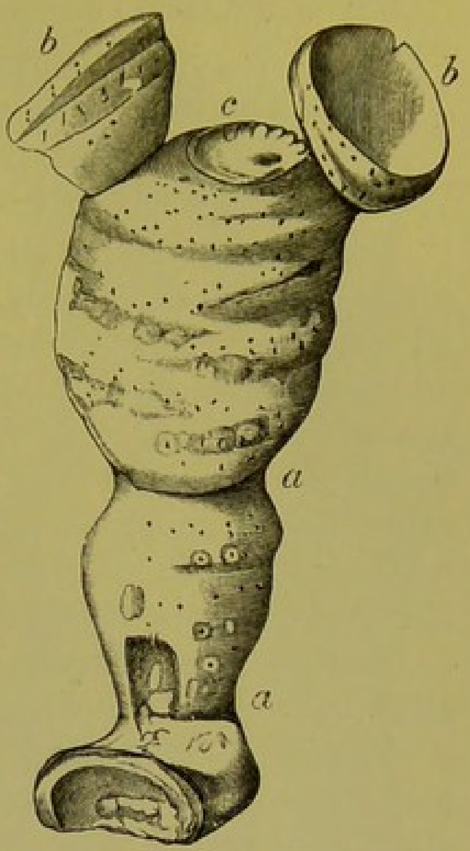


FIG. 143.—Orris rhizome. Rhizome of *Iris germanica*. *a*, constrictions indicating winter growth; *b*, *b*, young branches; *c*, scar left by previous year's flowering shoot. (Tschirch, after Hartwich.)

Description. — Orris rhizome occurs usually in pieces from 2 to 4 inches long and about 1 inch thick, of a dull white colour. They are often dorsi-ventrally flattened and commonly contracted at intervals of an inch or more, bearing one or two short lateral branches at the apex. Each of the contractions corresponds to a year's growth of the rhizome; the branches are developed from buds after the rhizome has flowered, which may not occur for three or four years.

The under surface is marked with the small dark circular scars of roots, and on the upper surface traces of the leaves, or at least of the fibro-vascular bundles that passed into them, can be discerned, the drug showing distinct evidence of having been peeled. It is hard, heavy, and compact, and breaks with a short

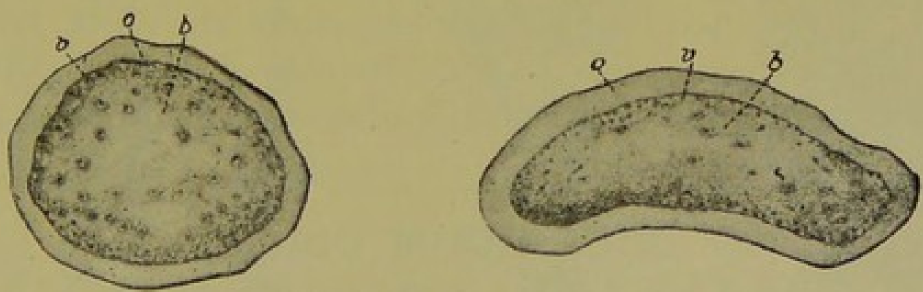


FIG. 144.—Orris rhizome. Transverse sections. *o*, bark; *v*, endodermis; *b*, central cylinder (stele). Natural size. (Berg.)

fracture, the interior being yellowish and horny. The transverse section exhibits a large stele containing scattered darker bundles and a comparatively narrow bark.

The drug has an agreeable aromatic odour and a slightly bitter taste.

The student should particularly observe

(*a*) The *contractions* of the rhizome,

(*b*) The *scars of leaves upon the upper* and of *roots on the under* surface,

(*c*) The characters of the *transverse section.*

Constituents.—By distillation with steam orris rhizome yields a yellowish, buttery, aromatic substance, commonly called oil of orris; this consists principally of myristic acid, with which is associated an odorous liquid, *irone*; the latter is the aromatic constituent of the rhizome, and is present in minute quantity only. The drug also contains a crystalline glucoside, *iridin*, which must be carefully distinguished from the brown resinous eclectic remedy of the same name; the latter is obtained from the rhizome of *Iris versicolor*, Linn.

Uses.—Orris rhizome is used as a perfume, dentifrice, &c., although formerly medicinal qualities were attributed to it.

Varieties.—The chief commercial varieties of orris root are the Florentine, Veronese, and Mogadore. A very inferior quality, of small size, dark colour, and little fragrance, is occasionally imported from Bombay.

Florentine orris root is usually nearly white in colour, carefully peeled, plump, and very fragrant.

Veronese orris root closely resembles the Florentine, but generally has a yellower colour, is rather less carefully peeled and often more wrinkled.

Mogadore orris root is altogether inferior to both the foregoing varieties. It is in smaller, flatter, and more shrunken pieces, which often bear at their apices the shrivelled remains of numerous concentric leaves. Patches of reddish cork are left attached to the drug, which is of darker colour and inferior fragrance.

COLCHICUM CORM

(Colchicum Root, Radix Colchici)

Source &c.—Colchicum corm is the contracted subterranean stem of the meadow saffron, *Colchicum autumnale*, Linn. (N.O. *Liliaceæ*), a plant widely distributed over *Europe* and abundant in some parts of *England* in moist meadows and pastures.

FIG. 145.—*Colchicum autumnale.* *A*, flowering plant, much reduced. *B*, lower part of the same, natural size. *C*, corm, cut vertically: *k*, corm; *k′*, young corm for the next year; *k′′*, bud destined to reproduce the plant after *k′* has developed. *D*, portion of the same, showing *h*, the leaves enveloping the corm. *E*, upper part of perianth, halved. *F*, ovary, *o*, with the three styles. *G*, ovary, magnified. *H*, fruit. *J*, the same, cut transversely, showing the seeds. *K*, seed, magnified. *L*, the same, cut to show the embryo. (Luerssen.)

The meadow saffron produces in the autumn a conspicuous reddish-purple flower springing from the side of a contracted and enlarged stem (corm) situated several inches below the surface of the ground. This corm has supplied the flower with the necessary materials for its growth, and has thereby been deprived of part of the reserve material which the leaves that die down in the summer have stored up in it. The proper time for collecting the corm is therefore after the early summer leaves have filled it with reserve material, but before the production of the flower in the autumn has partially exhausted it. But at this time the plant is difficult to find, and the corms are probably collected when the plant is in flower. This possible variation in the time of collection has been presumed to cause notable variations in the activity of the corm, and has led to a preference being given to the seeds. As a matter of fact, commercial corms have been shown to vary but little in the proportion of active constituent contained in them.

Description.—The fresh corms are about $1\frac{1}{2}$ inch long and 1 inch broad, bluntly conical in shape, flattened on one side, and enveloped in an outer brown and inner reddish-yellow membranous coat derived from the leaves of the previous summer. Internally the corm is firm, white, and fleshy ; it has a disagreeable odour and exudes, when cut, a bitter juice that is white and milky from the presence in it of numerous starch grains.

The corms are also cut into thin transverse slices, which are dried at a gentle heat (65·5° C.) so as to avoid the gelatinisation of the starch, and freed from the remains of the membranes by winnowing. They then form whitish slices about $\frac{1}{8}$ inch thick, yellowish on their outer surface and reniform in outline, the depression corresponding to the position of the flower. They break readily with a short starchy fracture. The transverse surface exhibits, when smoothed, numerous scattered darker points (fibro-vascular bundles). The drug is inodorous, but has a bitter taste.

The student should observe

(*a*) The *reniform outline of the sliced drug*,
(*b*) The *starchy fracture*,
(*c*) The *bitter taste*.

Constituents.—Colchicum corm contains the poisonous alkaloid *colchicine*. Analyses have shown from 0·5 to 0·6 per cent. of alkaloid to be present, whilst in the seed the proportion appears to be about 0·7 per cent.

Uses.—Colchicum is chiefly used to relieve the pain and inflammation and shorten the duration of acute gout and certain gouty affections.

SQUILL

(Scilla, Bulbus Scillæ, Radix Scillæ)

Source &c.—The squill, *Urginea Scilla*, Steinh. (N.O. *Liliaceæ*), is a bulbous plant indigenous to the countries bordering on the *Mediterranean*, and frequently appearing in great abundance. It is one of the most ancient of medicinal plants, having been well known to the Greeks and Romans; the drug was introduced into European medicine by the Arabian physicians of the early ages.

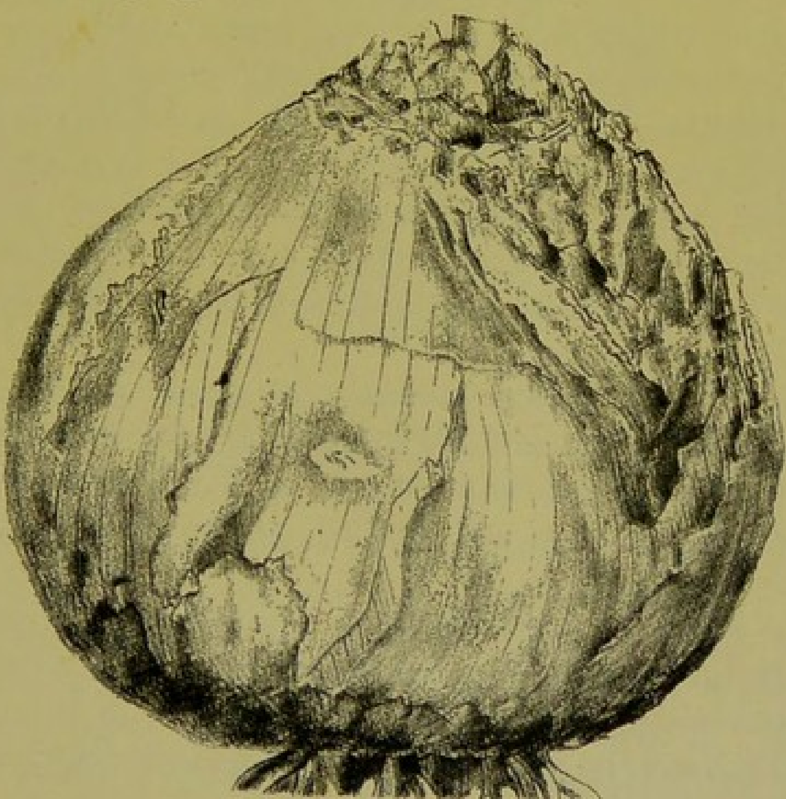


FIG. 146.—Squill bulb, reduced. (Bentley and Trimen.)

The plant produces a large tunicated bulb, often weighing several pounds, which lies partially imbedded in the ground. Two varieties are known, the white and the red; the former is collected largely in Malta and is preferred in England, the latter is collected in Algeria and is the variety used in France, where it is considered to be the better of the two. The scales of the white squill are whitish or yellowish in colour, whilst those of the red variety have a roseate hue, but many intermediate forms are known.

The outer coats, which are reddish brown in colour, dry and scarious, are removed and the inner ones cut into transverse slices and dried. The innermost scales, which are very juicy and scarcely bitter in taste, are rejected.

Description.—The commercial drug usually consists of narrow, flattish, curved strips from 1 to 2 inches in length and about $\frac{1}{12}$ inch thick. They frequently taper towards both ends, are of a yellowish-white colour and more or less translucent. When quite dry they are brittle and can easily be powdered, but they rapidly absorb moisture from the air, becoming tough and flexible. They have only a slight odour, but a disagreeable bitter and acrid taste. Occasionally the entire bulbs are imported, but they are difficult to keep in the fresh state, as they preserve their vitality for a long time, and if allowed to remain in a warm place rapidly develop an aerial shoot.

Constituents.—The constituents of squill are imperfectly known. Merck (1879) separated *scillitoxin*, *scillipicrin*, and *scillin*, all of which exhibit glucosidal properties. Scillitoxin and scillipicrin are both amorphous and act upon the heart, the former being the more active of the two ; scillin is crystalline, but is inactive.

The bulbs also contain *mucilage*, *sinistrin* (a carbohydrate soluble in water but insoluble in alcohol), and *calcium oxalate* in bundles of long acicular crystals ; the latter easily penetrate the skin when the bulbs are handled, and give rise to excessive irritation.

Uses.—Squill closely resembles digitalis in increasing the vigour and diminishing the frequency of cardiac action ; it is also a powerful expectorant, and is much used in chronic bronchitis and for coughs generally, though its indiscriminate use is much to be deprecated.

WHITE HELLEBORE RHIZOME

(Rhizoma Veratri Albi)

Source &c.—White hellebore, *Veratrum album*, Linn. (N.O. *Liliaceæ*), is an herbaceous plant with erect perennial rhizome, common in the mountains of *central and southern Europe.* It produces large, ovate, ribbed leaves and a flowering stem that attains a height of 3 or 4 feet. The rhizome appears to have been known and used medicinally for many years, but owing to its powerful and uncertain action it has been employed chiefly as an external application, though to a limited extent only.

The rhizome is dug up in the autumn, and the leaves, which are all radical until a flowering stem is produced, are cut off close to it. It is then usually dried entire, but is sometimes cut longitudinally into halves or quarters to facilitate drying, sometimes deprived of its roots, and occasionally sliced transversely. The separation of the roots is to be deprecated, as they appear to be more active than the rhizome. When fresh the

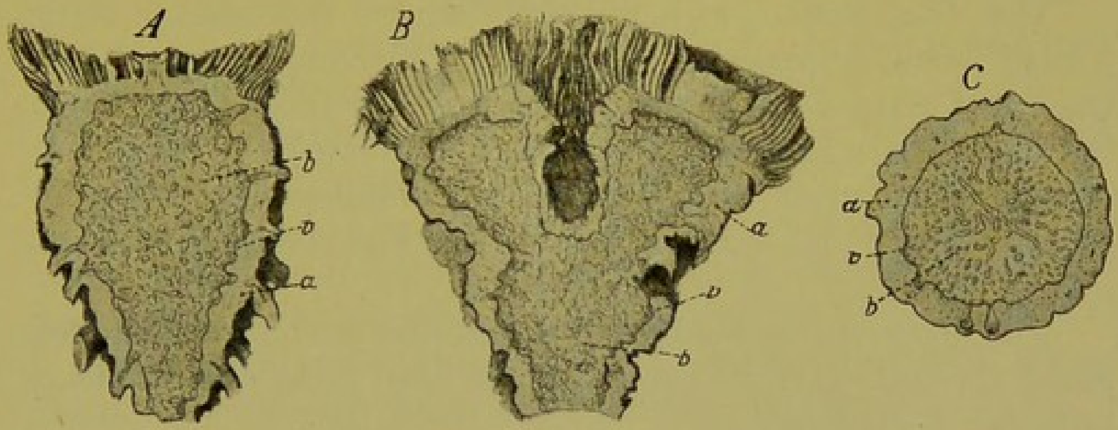


Fig. 147.—White Hellebore rhizome. *A*, longitudinal section of simple, *B*, of branched rhizome; *C*, transverse section of the former. *a*, bark; *v*, endodermis; *b*, central cylinder (stele). All natural size. (Berg.)

rhizome has an alliaceous odour, but this is lost by drying. Our supplies are imported chiefly from Germany.

Description.—White hellebore rhizome (when freed from the roots) averages about 2 inches in length and ¾ inch in thickness, and is of a dull black colour externally. The upper part is nearly cylindrical, but the lower extremity, where the rhizome gradually perishes and rots away as growth progresses, is usually bluntly conical or truncate. It is crowned with a dense leafy mass consisting of the thin, dry remains of numerous concentrically arranged leaf-bases which have been cut off level close to the rhizome; the outer of these are coarsely fibrous, the parenchymatous tissue having perished, leaving the veins persistent. The surface of the rhizome is rough and wrinkled, and shows encircling scars of leaves that have perished. The roots leave circular scars, in the centre of which the slender wood is distinctly visible. In the untrimmed rhizome these are very numerous and stout; they completely envelop the rhizome, so that the untrimmed drug is much more bulky than the rhizome alone. They are usually dull grey or yellowish in colour, and commonly show a disposition to shrivel longitudinally rather than transversely.

The rhizome frequently branches, two or even three branches springing from the same rhizome. This is caused by the production of a flowering stem; the main axis being thus terminated, the growth of the rhizome is continued by the development of one or more of the buds that are situated in the axils of the inner radical leaves. Such a branch may grow for several years before it flowers.

The drug breaks with a short fracture, the interior being whitish, firm, compact, and starchy. The bark is about $\frac{1}{8}$ inch thick, and separated by a wavy, brownish line (endodermis) from the stele, the latter being irregularly traversed in a characteristic manner by yellowish fibro-vascular bundles. The bark also exhibits occasional bundles (leaf-traces), and gives off here and there a root.

The drug can easily be powdered, and the powder excites, when inhaled, violent sneezing. It has little odour, but a bitterish, acrid taste.

The student should observe

(*a*) That the rhizome is *usually entire*,
(*b*) That the *roots are greyish* in colour, and *not often much shrivelled transversely*,
(*c*) The characters of the *transverse section*;

and should compare the drug with American veratrum. (See below.)

Constituents.—White hellebore contains several alkaloids, the most toxic of which is *protoveratrine* (Salzberger, 1890), a very poisonous alkaloid and a powerful sternutatory; it is present to the extent of about 0·03 per cent., the roots containing more than the rhizome. Alkaloids of less virulence are, *protoveratridine, jervine, rubijervine*, and *pseudojervine*; they possess little or no toxicity.

White hellebore also contains resin (as much as 25·8 per cent., Flückiger and Hanbury) and starch.

Uses.—White hellebore is a powerful emetic and purgative when administered in full doses. It has been prescribed for gout, but is now usually employed as an external application in certain skin diseases, and for the destruction of pediculi and other noxious vermin.

AMERICAN VERATRUM

(Green Hellebore, Rhizoma Veratri Viridis)

Source &c.—*Veratrum viride*, Aiton (N.O. *Liliaceæ*), is a plant so closely resembling *V. album* that its claim to be considered a distinct species is very doubtful. It is common in the *eastern United States*, growing in rich woods. The plant is dug up in the autumn, the leaves are cut off close to the crown, and the rhizome is then usually halved or quartered to facilitate drying; occasionally the roots are cut off ('trimmed' rhizomes), but more frequently they are left attached to the rhizome ('with fibre').

The drug is commonly termed 'green hellebore,' but this name is better restricted to the rhizome of *Helleborus viridis*, Linn.; American veratrum is a more suitable designation.

Description.—The rhizome closely resembles that of *V. album*, the chief difference being the fact that American veratrum is usually cut longitudinally, whilst white veratrum is commonly entire; other characters are the brighter yellowish-brown colour and the more shrivelled appearance of the roots. These are, however, variable characters, and there is no definite means of distinguishing the two drugs.

Constituents.—The constituents of *Veratrum viride* are apparently identical with those of *Veratrum album*, with the (doubtful) exception that the former contains an alkaloid—*cevadine*—that is not present in the latter.

SWEET FLAG RHIZOME

(Rhizoma Acori Calami)

Source &c.—The sweet flag or sweet sedge, *Acorus Calamus*, Linn. (N.O. *Aroideæ*), is a native of eastern Europe and central Asia, but has become widely diffused by cultivation. It has established itself in *England* as a wild plant on the edges of lakes and streams, and is cultivated for medicinal use in *Holland* and *Germany*.

The rhizome has long been esteemed as a most valuable medicine in India, whence probably its use spread to Europe. For many years the drug was imported from India, but it is now obtained from the cultivated plant.

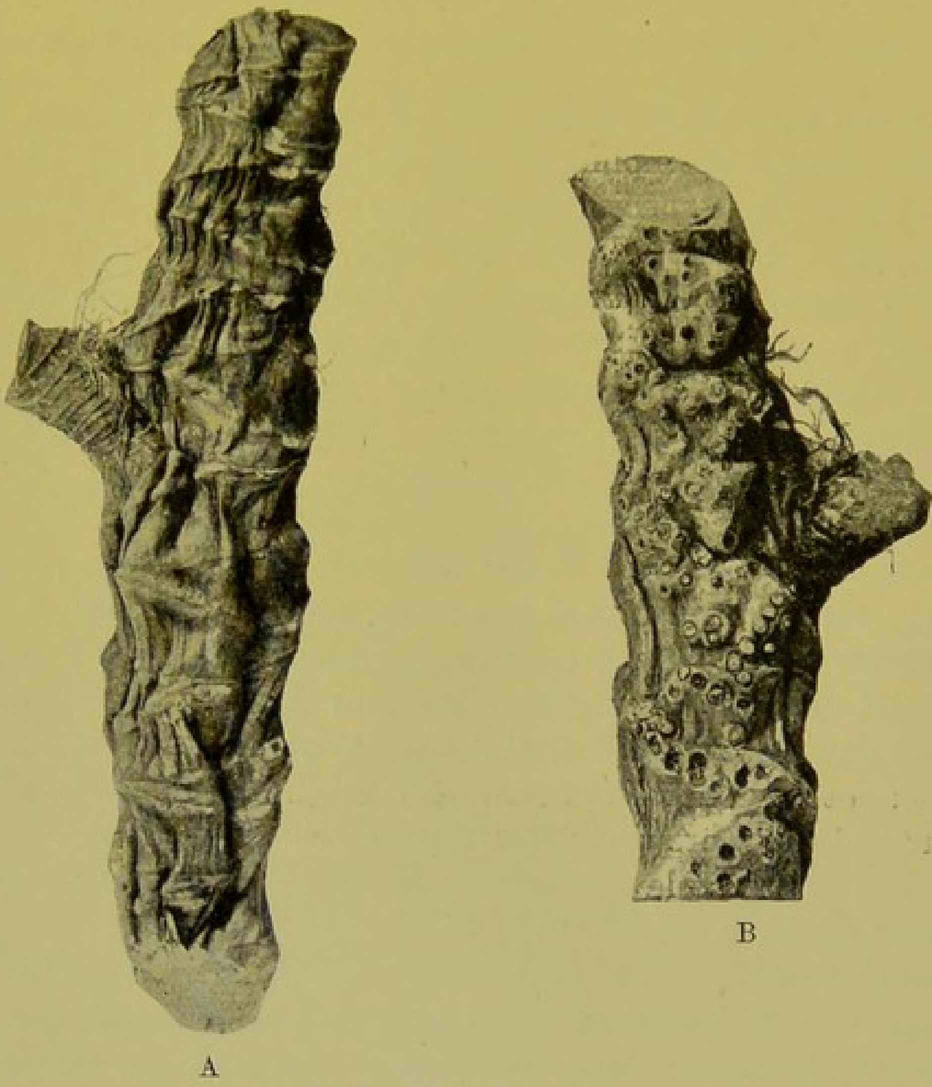


Fig. 148.—Sweet Flag rhizome. A, upper surface, showing leaf-scars. B, under surface, showing root-scars. Natural size.

The long, creeping, horizontal rhizome is collected in the autumn, trimmed, cut into pieces several inches in length, and dried. Sometimes it is partially deprived of the outer cork layer by peeling or scraping.

Description.—The rhizome commonly occurs in pieces varying from 2 or 3 to 6 inches or more in length, and from $\frac{1}{2}$ to $\frac{3}{4}$ inch in thickness. They are covered with a thin brownish cork and are much shrunken, bearing deep longitudinal wrinkles. They are marked on the upper surface with large triangular leaf-scars that encircle the rhizome, springing from each side alternately. To these scars the fibrous leaf-traces are sometimes attached. The under surface bears an irregular zigzag line of small raised root-scars that are circular and exhibit a central stele surrounded by a narrow bark. The rhizome produces an occasional slender lateral branch which is distinctly marked with the scars of leaves and roots.

The scraped rhizome is of a pale brownish-buff colour, has a roughish surface, and bears less conspicuous scars of leaves and roots.

The drug breaks with a short corky fracture, and is pale brown, or nearly white, and spongy internally. The section exhibits a

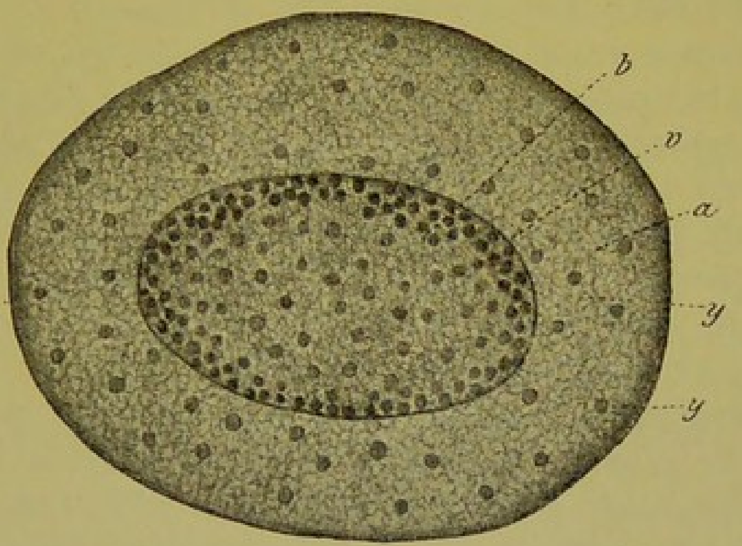


FIG. 149.—Sweet Flag rhizome. Transverse section, magnified 3 diam. *a*, bark ; *v*, endodermis ; *b*, central cylinder (stele) ; *y*, vascular bundles. (Berg.)

large stele separated by a yellowish line from a thick bark of similar appearance. Both stele and bark are traversed by numerous small, oval, scattered, fibro-vascular bundles.

The freshly fractured surface has an agreeable aromatic odour. The taste is disagreeably bitter and pungent.

The student should observe

(*a*) The *large triangular leaf-scars*,
(*b*) The *zigzag line of root-scars*,
(*c*) The *spongy texture*,
(*d*) The *bitter, pungent taste*.

Constituents.—Sweet flag rhizome contains an aromatic *volatile oil*, of which it yields as much as 2·8 per cent. It contains also a bitter principle, *acorin*, the nature of which has not yet been satisfactorily ascertained. Certain alkaloidal substances (choline, trimethylamine) appear also to be present, but they require further investigation. The drug contains an abundance of starch and a little tannin.

Uses.—The drug has stimulant and tonic properties; it has been used for ague and for atonic dyspepsia.

COUCH GRASS RHIZOME

(Rhizoma Tritici, Radix Graminis)

Source &c.—The couch grass, *Agropyron repens*, Beauv. (N.O. *Gramineæ*), is *abundant in this country*, being in some places a troublesome weed. It produces a slender rhizome, running for a considerable distance just below the surface of the ground, giving off lateral branches, and at the nodes, which are about an inch apart, small fibrous roots. The rhizome, which appears to have been used by the Greeks and Romans for certain affections of the bladder, is collected, cut into pieces about $\frac{1}{4}$ inch long, and dried.

Description.—Couch grass is generally met with in commerce cut into short pieces. The rhizome is very slender, averaging about $\frac{1}{12}$ inch in diameter, and of a dark straw-yellow colour. The surface is quite glabrous, hard and shining,

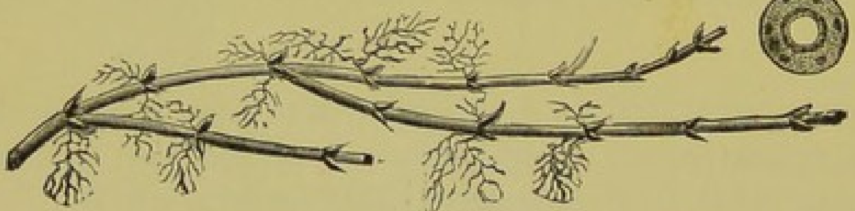


FIG. 150.—Couch Grass rhizome and transverse section; the latter magnified 3 diam. (Maisch.)

and usually bears five or six rather prominent longitudinal ridges. Some of the pieces bear the nodes, at which there may be found the persistent fibrous remains of a sheathing leaf-basis, and either a few threadlike paler roots or the scars left by them. The transverse section exhibits, under a lens, a narrow pale inner ring (the stele), hollow in the centre, surrounded by a darker translucent bark.

The drug has but little odour, and a sweetish, mucilaginous taste.

The student should observe

(*a*) The *slender hollow rhizome,*
(*b*) The *translucent* (*not starchy*) *bark.*

Constituents.—Couch grass contains a carbohydrate, *triticin*, which is not very soluble in water, and yields by hydrolysis levulose; it appears to occur in the rhizomes of other graminaceous plants, and possibly is widely diffused in the vegetable kingdom. *Mucilage* and *inosite* are also constituents of the rhizome, but it is impossible to say to what substance or substances the action of the drug is to be ascribed. Starch is *not* present, a character that should be noted, as certain rhizomes containing starch (notably that of *Cynodon Dactylon*, Pers.) have been mistaken for couch grass rhizome.

Uses.—Couch grass has been employed as a diuretic in certain affections of the bladder.

MALE FERN RHIZOME

(Rhizoma Filicis Maris, Filix Mas)

Source &c.—The male fern, *Aspidium Filix-mas*, Swartz (N.O. *Filicineæ*), is abundant in *Great Britain*, and one of the commonest of our indigenous ferns. It produces a circular tuft of fronds arising from a stout rhizome and attaining a height of 2 or 3 feet. The lamina is divided pinnately, and bears on its under surface, when in fruit, kidney-shaped or sometimes nearly peltate sori. The petiole bears numerous brown, scarious scales, especially in the lower part.

The rhizome is collected in the autumn; the fronds are cut off, leaving the lower swollen portion, about an inch in length, attached to the rhizome, the roots are removed, and the drug is then dried. Sometimes the rhizome is cut longitudinally to facilitate the drying.

Description.—The drug occurs in pieces up to about 5 or 6 inches in length, but usually shorter, and 1½ inch or more in thickness; only about one-half of this is due to the rhizome itself, the rest being formed by the bases of the petioles that have been left attached to it. These, which constitute the major part of the drug, are usually about an inch in length and swollen near the middle, attaining from $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness. They are curved, bluntly angular or longitudinally furrowed, and of a dark brown or nearly black colour externally. They are more or less densely covered with dry, brown, membranous scales. Examined under the microscope the marginal cells of these scales will be seen to be prolonged at intervals into simple hairlike processes, each consisting of two parallel and contiguous cells, but it does not bear any glandular hairs, excepting sometimes two at its base; this is an important diagnostic character of the drug (Lauren, 1896). When broken the petioles should be (if recently dried) green internally, and the smoothed section should exhibit about eight (usually seven, eight, or nine) steles arranged in a diffuse circle.

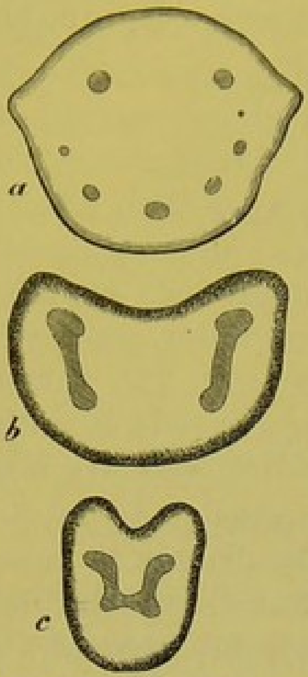


FIG. 151. —*a*, transverse section of base of petiole of *Aspidium Filix-mas*. *b*, transverse section of petiole of *A. Filix-fœmina*; *c*, the same just below the lamina. Slightly magnified. (Luerssen.)

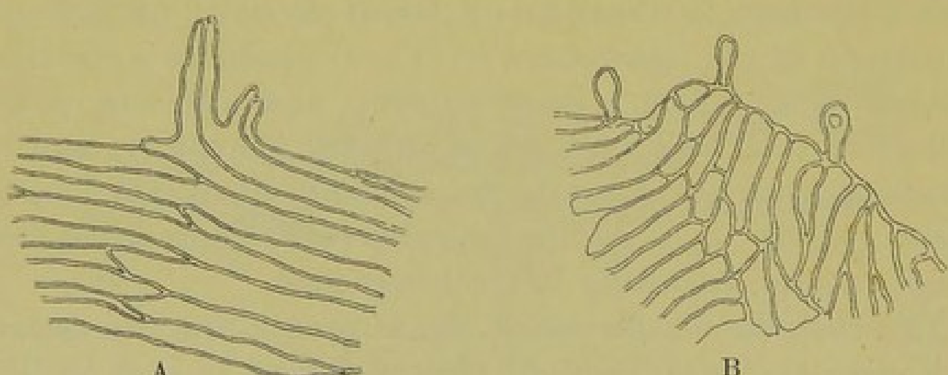


FIG. 152.—A, margin of scale from petiole of *A. Filix-mas*; B, from that of *A. spinulosum*. (Lauren.)

The rhizome itself should also be green internally, and exhibit in section about as many principal steles as the petiole. The drug has a disagreeable, nauseous, bitter taste.

Constituents.—Male fern contains several important constituents, but to which of these the medicinal activity is due is a matter of some doubt. *Filicic acid* (Poulson, 1892) is an amorphous, therapeutically active body which, however, appears to pass easily into its crystalline anhydride (filicic acid of Luck, 1860); this is formed in the deposit in liquid extract of male fern, and is said to be inactive, but to yield the active amorphous acid when redissolved and reprecipitated. Kraft (1896) showed that the proportion of filicic acid in the extract varied considerably, that obtained from rhizome collected in the autumn containing most (Cæsar and Loretz, 1898). The rhizome contains, further, *fixed oil* (about 6 per cent.) and *tannin*. In addition, Boehm (1897) has isolated several crystalline substances—*aspidin, albaspidin*, &c.

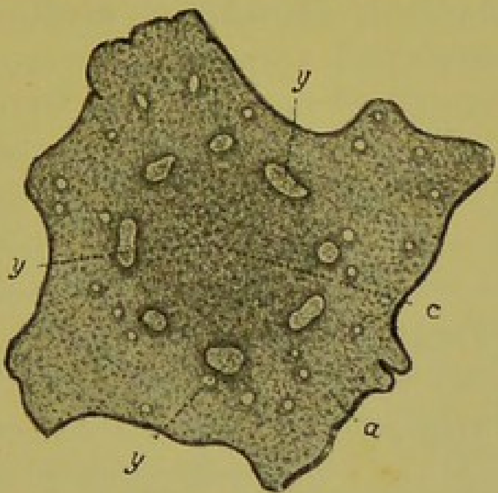


FIG. 153.—Male Fern rhizome. Transverse section, magnified 3 diam. *y*, steles. (Berg.)

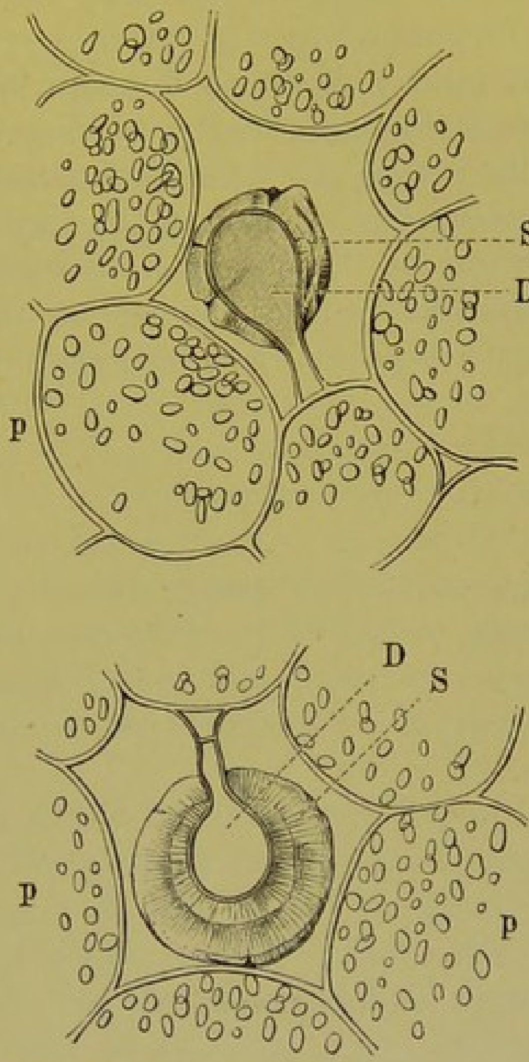


FIG. 154.—Intercellular spaces in the rhizome of Male Fern, showing the secreting glands, D, and secretion, S. P, cortical parenchyma containing starch-grains. Magnified 240 diam. (Vogl.)

These constituents are probably all formed by the peculiar secreting cells produced by the rhizome and the petioles in intercellular spaces in the parenchymatous tissue.

Uses.—Male fern rhizome is used as a vermifuge, usually in the form of the liquid extract.

Substitutes.—Although the male fern is a common British fern, there are several others that closely resemble it and might be gathered in its place. Of these the most important are *A. Filix-fœmina*, Swartz, the lady fern, and *A. spinulosum*, Swartz, the shield fern. The former may easily be distinguished by the number of bundles in the leaf-base, for whilst the male fern has from seven to nine the lady fern has only two large ones. Moreover the lady fern produces no secreting cells in the parenchyma of rhizome or petiole. The shield fern rhizome is more difficult to distinguish, as it produces in the rhizome secreting cells similar to those of the male fern, and contains in the petiole about the same number of bundles. According to the researches of Lauren, the character of the margin of the scales borne by the petiole is distinctive, that of *A. Filix-mas* bearing hairlike projections, whilst that of *A. spinulosum* produces glandular secreting cells on its margin.

SECTION IX

ROOTS

ACONITE ROOT

(Radix Aconiti)

Source &c.—The aconite, monkshood, or wolfsbane, *Aconitum Napellus*, Linn. (N.O. *Ranunculaceæ*), is a perennial herb growing abundantly on the lower mountain slopes of *central Europe.* It is *cultivated in England* as a garden plant as well as for medicinal use, and is found apparently wild in some localities, but in these cases has probably escaped from cultivation. The drug has only recently been introduced into medicine, although the poisonous properties of the plant have long been known. Both the fresh leaves and flowering tops, as well as the dried roots, have been used ; the latter are, however, now alone official.

The root should be collected in the autumn after the stem and leaves have died down, but before the bud destined to produce the stem for the following year has begun to develop. This bud is protected by cataphyllary leaves, in the axils of which lateral buds are situated. As the terminal bud grows and forms a flowering stem, certain (usually from one to three) of these lateral buds develop into short lateral shoots, each of which produces a long and slender, descending, adventitious root crowned with a bud. These roots rapidly enlarge and fill with reserve material produced by the parent plant, the root of which shrivels and perishes in proportion as the daughter roots increase in size. Towards the autumn the parent plant dies down, and the daughter roots, which have then attained their maximum development, are plump and full of starch. If allowed to remain in the soil the buds that crown the daughter roots begin to grow in the late winter or very early spring, and this growth is effected at the expense of the starch in the root, which for that purpose is converted into sugar. The root therefore becomes gradually exhausted of its reserve material, and it is generally assumed that the proportion of alkaloid it contains simultaneously diminishes, although this point has not been definitely established by analysis. On account of the extreme toxicity of the drug and the absence of any satisfactory method of assay by which the potency of preparations made

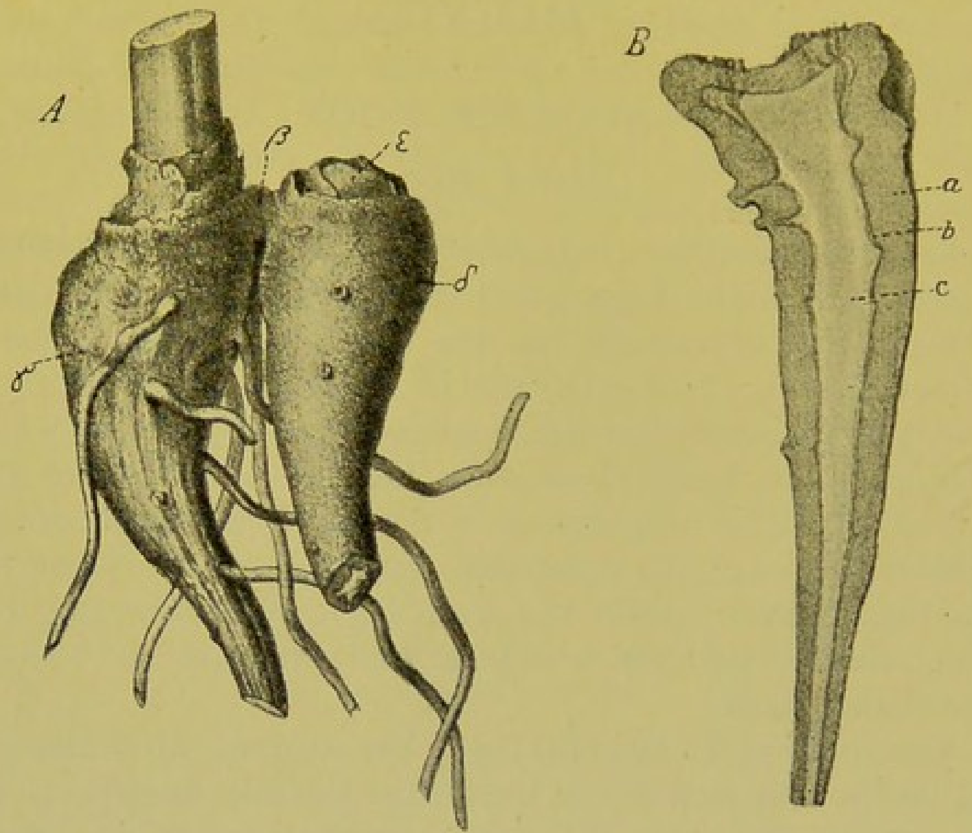


FIG. 155.—Aconite root. *A*, old and daughter roots of the autumnal plant connected together: γ, old root; δ, daughter root; β, short branch connecting them; ϵ, bud at the apex of the daughter root; natural size. *B*, transverse section through the daughter root: *a*, bark; *b*, cambium; *c*, pith; natural size. (Berg.)

from it can be regulated, it is extremely desirable that aconite root should always be grown and collected under the same conditions in order to ensure uniformity in the drug. This can best be attained by specifying, as the Pharmacopœia does, that the roots should be collected in the autumn from plants cultivated in Britain. In some continental countries the wild plant is considered to be more active than the cultivated, and as experiments have shown that *A. Napellus* is more toxic than *A. variegatum*, Linn., and its varieties, the root is directed to be gathered from wild plants when in flower, at which time they can be most easily distinguished. Hence the aconite root that is imported in large quantities from Germany consists of the partially exhausted summer roots of the wild flowering plants.

After collection the roots are washed, freed from the rootlets, and dried, sometimes entire, sometimes longitudinally sliced to facilitate the loss of moisture.

Description.—Aconite root of commerce varies usually from 2 to 4 inches in length, although the entire root is often considerably longer. At the upper extremity, where it is crowned with an undeveloped bud enclosed by scaly leaves, it is about $\frac{1}{2}$ or $\frac{3}{4}$ inch in diameter, tapering gradually downwards. It is dark brown in colour, and marked with the scars of rootlets that have been broken off. The surface is usually longitudinally wrinkled, especially if it has been dried entire. The root breaks with a short fracture, and is whitish and starchy internally. The smoothed transverse section exhibits a thick bark, separated from the inner portion by a well-marked darker line (cambium) which often assumes a stellate appearance, with a group of vessels distinctly visible at each of the projecting angles, usually five to seven in number. The root has a pungent odour when fresh, but this disappears during the drying. The taste is at first slight, but is followed by a persistent sensation of tingling and numbness in the mouth.

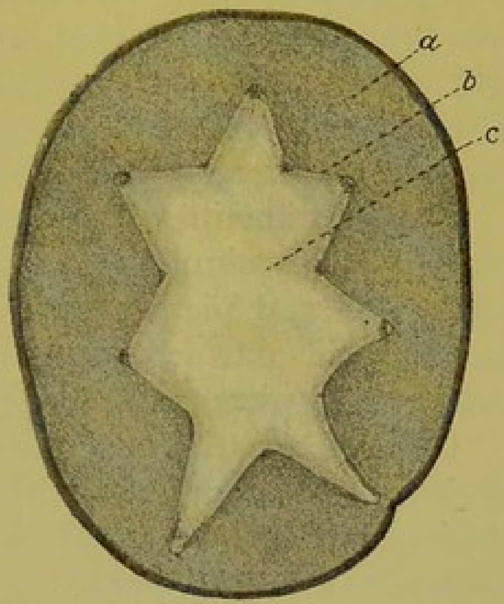


FIG. 156.– Aconite root. Transverse section of daughter root. *a*, bark; *b*, cambium; *c*, pith. Magnified 3 diam. (Berg.)

The student should observe

(*a*) The *elongated conical shape*,
(*b*) The *starchy interior* and *stellate cambium*,
(*c*) The *characteristic tingling taste*.

Constituents.—Aconite root contains three closely allied alkaloids, of which one only, *aconitine*, has been isolated in the crystalline form, and this alone possesses toxic properties. This extremely virulent alkaloid is obtainable in colourless rhombic prisms, and produces, even in minute quantity, the persistent tingling that characterises aconite root.

Picraconitine and *aconine* are alkaloids of secondary importance; they differ from aconitine in being amorphous, non-toxic, and having a bitter taste.

Very varying statements are made as to the proportion in which these alkaloids are present. Keller extracted on an average about 1·0 per cent. of total alkaloid from dry (German) root, most of it being crystalline and probably aconitine; other investigators have obtained much less (0·2 per cent., 0·36 per cent.). No method has yet been devised by which the amount of poisonous aconitine can be accurately determined in the presence of picraconitine and aconine.

The relation in which these three alkaloids stand to one another is very simple. Aconitine is easily hydrolysed, yielding acetic acid and picraconitine; picraconitine in its turn yields benzoic acid and aconine. Aconitine is therefore acetylbenzaconine, and picraconitine is benzaconine.

Uses.—Preparations of aconite and of its principal alkaloid, aconitine, when applied to the skin, produce tingling followed by numbness; they are used in certain forms of neuralgia and rheumatism. Administered internally, aconite produces a steady fall of temperature, moistening of the skin, increase in the amount of urine, and lowering of the sensibility; it is given in cases of fever and pain, usually in the form of small doses of the tincture frequently repeated.

Varieties and Substitutes.—*Foreign Aconite Root.*—Much aconite root has been imported from Germany. It is collected from wild plants when in flower, and consists largely of the parent roots, as shown by their being crowned with the lower portions of the stems. Occasionally daughter roots are mixed with them; they may be identified by being crowned with buds. By these characters, and by its usually smaller size, more shrivelled appearance, and less starchy fracture, it can be distinguished from the home-grown drug.

Japanese aconite root (*A. ~~Fischeri~~*, Reich.) is regularly imported in considerable quantities. It tapers gradually, and is either dark grey and nearly smooth (daughter root) or brownish, and marked with not very prominent, paler, longitudinal ridges (parent root). Both kinds of root are smaller than the English;

they are, however, very starchy, less wrinkled than the English root, and exhibit, in transverse section, the groups of vessels arranged in a more regular circle. The root has evidently been carefully collected and dried. It contains an alkaloid apparently identical with aconitine.

Indian aconite root (*A. ~~ferox~~*, Wall.) is much larger than the English, measuring frequently 6 inches in length and 1½ inch in thickness near the crown; it is crowned with the remains of a bud and is coarsely wrinkled, the outer portions often separating from the inner portion, which is yellowish and horny. This horny character is due to the starch having been completely gelatinised by the prolonged application of heat, the roots being, according to some accounts, boiled in cow's urine to preserve them. The drug contains a toxic alkaloid, pseudaconitine.

N.O.

PAREIRA BRAVA

(Pareira Root, Radix Pareiræ)

Source &c.—The drug official in the British Pharmacopœia under the name Pareira Root, is derived from *Chondrodendron tomentosum*, Ruiz and Pavon (N.O. *Menispermaceæ*), a climbing plant with a stout woody stem, growing to a considerable height. It is a native of *Peru* and *Brazil*, from the latter of which countries the drug was formerly exported.

It is regarded by the Brazilians as a valuable medicine, and was introduced into Europe towards the end of the seventeenth century. Its botanical origin remained long in an obscurity that was increased by Linnæus, who founded a species of *Cissampelos* (*C. Pareira*) and quoted it as the source of Pareira brava.

Description.—True Pareira brava occurs in long, woody, nearly cylindrical pieces averaging 1 to 1½ inch in diameter, but attaining 2 inches or even more. It is nearly black in colour, tortuous and knotty. It is marked externally with longitudinal furrows and transverse ridges and fissures. It is hard and heavy, breaking with a coarsely fibrous fracture; internally it is yellowish or brownish-grey. The fractured root, when cut with a knife, exhibits a glossy, waxy, rather than woody surface. The transverse section shows four or five crenate, concentric or more or less eccentric zones, separated from each other by lighter lines of parenchymatous tissue. Each zone consists of a varying number of wedge-shaped wood-bundles with large pores alternating with wide medullary rays. A similar abnormal structure is found in many menispermaceous stems and roots. The innermost zone is usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter.

The drug has no odour, but a decidedly bitter taste.

The student should observe

(*a*) The *nearly black outer surface*,
(*b*) The *crenate outline of the zones*,
(*c*) The *waxy cut*,
(*d*) The *bitter taste.*

Constituents.—True Pareira brava contains about 0·5 per cent.

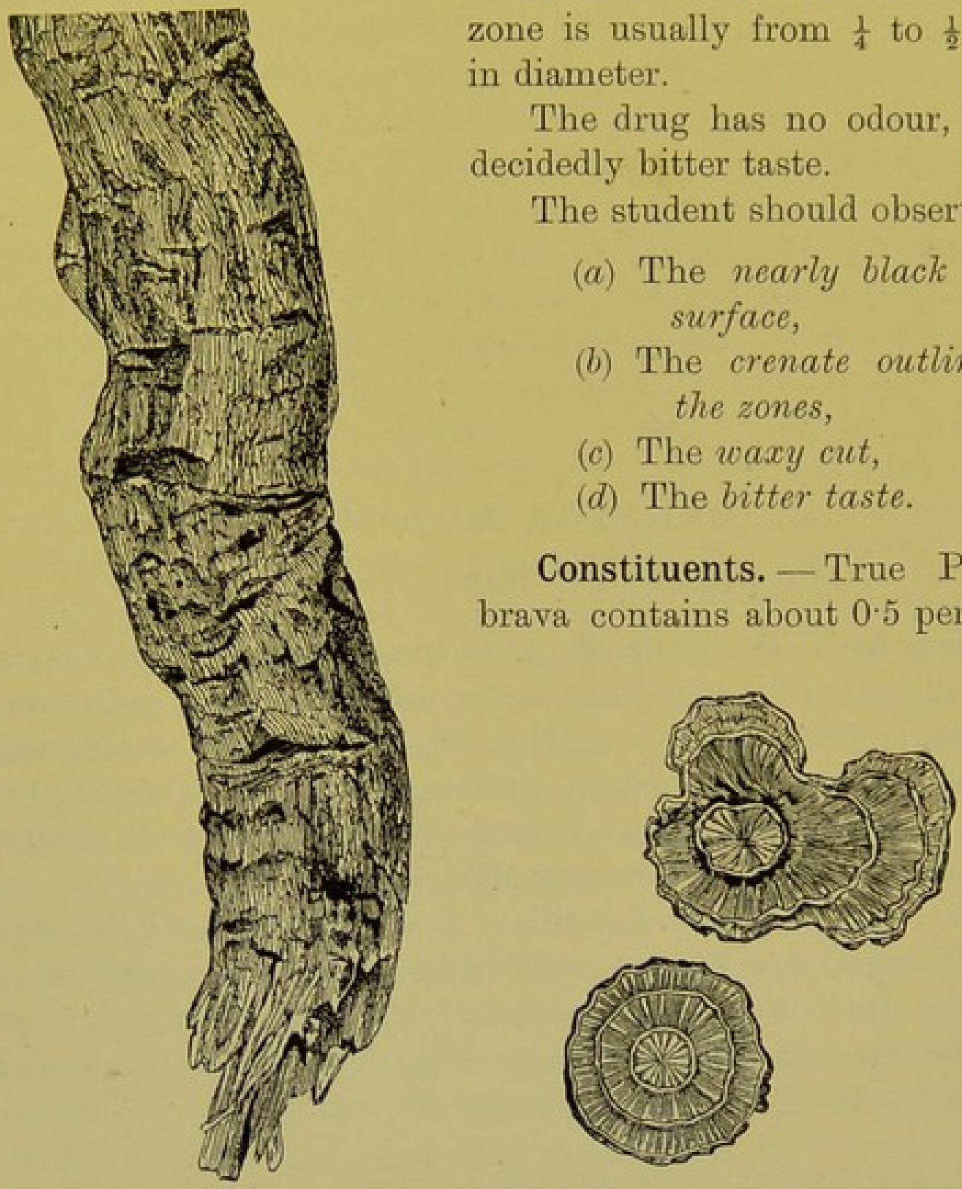


Fig. 157.—True Pareira Brava. Portion of a root, and transverse sections. (Bentley, after Hanbury.)

of *pelosine*, an alkaloid usually considered identical with the beberine of bebeeru bark and the buxine of box bark (*Buxus sempervirens*, Linn.). Some doubt has, however, lately been thrown upon the identity of these three alkaloids.

The drug also contains starch and wax.

Uses.—Pareira brava is used in inflammatory affections of the urinary tract; it is considered to relieve pain and promote healing and cessation of muco-purulent discharge. It is not now much used, owing possibly to the substitution of other roots for the genuine drug.

Varieties and Substitutes.—Genuine Pareira brava appears at uncertain intervals on the London market. Its place has for some years been taken by the root of a menispermaceous plant of unknown botanical origin. This, the common substitute, may be distinguished by its distinctly brownish colour, the larger number of narrower zones which are not distinctly crenate, the larger vessels in the wood, and the less bitter taste. The drug is, further, not so heavy as true Pareira brava, and does not exhibit, when cut transversely, the same waxy nature.

Occasionally the stems of the plant are mixed with true Pareira brava; they are paler in colour, frequently bear the minute apothecia of lichens, and exhibit a small pith.

Other substitutes have occurred, and are likely to occur; it is essential therefore, in this as in all cases, that the student should make himself familiar with the characters of the true drug, so as to be able to distinguish it from any substitute that may occur at any time.

CALUMBA ROOT

(Colombo Root, Radix Calumbæ)

Source &c.—Calumba root is obtained from *Jateorhiza Columba*, Miers (N.O. *Menispermaceæ*), a lofty climbing plant with annual herbaceous stems and swollen fleshy roots. It is indigenous to *Portuguese East Africa*, growing in abundance in the forests in the region of the Zambesi. The root is much used by the natives as a remedy for dysentery and other diseases, and also on account of the yellow colouring matter it contains. It was brought to Europe towards the end of the seventeenth century, and after being long neglected came at last into general use. The roots are dug in the dry season, cut into transverse slices, and dried.

Description.—Calumba root occurs in commerce in irregular, elliptical or nearly circular slices averaging about 1½ inch in diameter and $\frac{1}{4}$ inch in thickness, but often much larger and thicker. They are usually depressed in the centre on both sides, the tissue there being apparently less loaded with starch and less woody than the outer portions, and consequently contracting more on drying. The exterior of the root is covered with a thin, dark brownish, wrinkled cork, which readily separates, disclosing the yellowish-brown bark beneath. The transverse surface is of a dull greyish or greenish-yellow colour. When smoothed with a knife the interior is seen to be

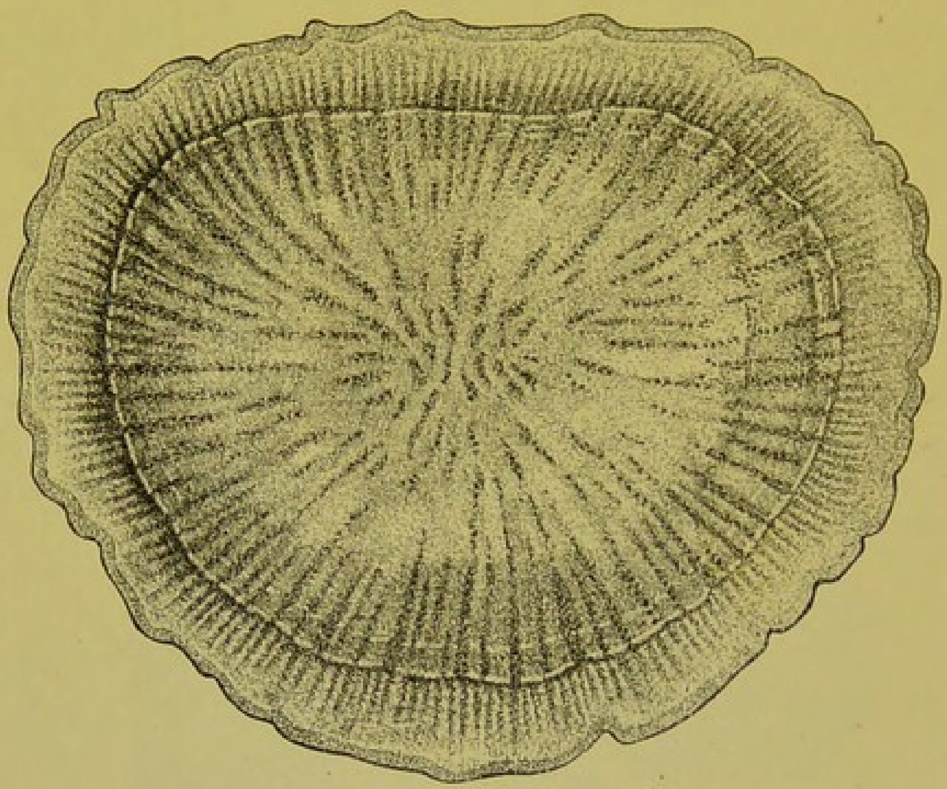


Fig. 158.—Calumba root. Transverse section, magnified 3 diam. (Moeller.)

much brighter and exhibits a thick bark marked with radiating lines (sieve tissue), separated by a dark line (cambium) from the large central portion (wood), in which the vessels are arranged in narrow, rather distant, radially elongated groups. The parenchyma in the wood, like that of the bark, is loaded with starch-grains which under the microscope are seen to be simple with eccentric hilum. The yellow colour is most marked near the cork and near the cambium.

The drug breaks with a short starchy fracture; it has a slight, musty odour and a marked bitter taste.

The student should observe

(*a*) The *yellow colour* and *depressed centre* of each slice,
(*b*) The *thick bark* and largely developed *parenchymatous tissue*,
(*c*) The *short fracture* and *abundance of starch*.

Constituents.—Calumba root contains three bitter principles, viz. *berberine*, *columbic acid*, and *columbin*.

Berberine is a yellow crystalline alkaloid that has already been noticed as a constituent of barberry bark and golden seal rhizome; to it the yellow colour of the root is due.

Columbin is the anhydride of columbic acid. Both these principles are colourless and crystalline.

The roots contain, further, *mucilage* and abundance of *starch*, but no tannin.

Uses.—Calumba is employed as a stomachic and bitter tonic.

Substitutes.—The following drugs are occasionally offered as Calumba:

(i) Slices of the stem of *Coscinium fenestratum*, Colebr (N.O. *Menispermaceæ*, Ceylon); these are dark yellow in colour, hard and woody (not starchy), and not depressed in the centre.

(ii) Slices of the root of *Frasera caroliniensis*, Walter (N.O. *Gentianeæ*, North America); the slices are usually smaller and thicker, and are free from starch, but contain tannin.

Genuine calumba may therefore easily be distinguished from both these substitutes by the characters already detailed.

HORSERADISH ROOT

(Radix Armoraciæ)

Source &c.—The horseradish, *Cochlearia Armoracia*, Linn. (N.O. *Cruciferæ*), is indigenous to eastern Europe, but naturalised in several parts of Britain, and *cultivated in this country* as well as in many others. It possesses a large perennial root, and produces stout, erect, flowering stems 2 or 3 feet high.

Description.—The root, which is used in the fresh state only, attains a length of over 2 feet and a thickness of an inch or more. It is nearly cylindrical except at the crown, where it often divides into a few short branches, each of which is enlarged in its upper part and marked with closely approximated semi-amplexicaul leaf-scars. It gives off but few slender, lateral roots, is pale yellowish or brownish-white in colour, and fleshy in consistence. The transverse section exhibits a thick bark and a distinct cambium, within which is a wood consisting principally of parenchymatous tissue, groups of vessels being visible as minute points, especially near the cambium.

The root is odourless until broken, bruised, or scraped, when a pungent mustard-like odour is evolved; the taste is also pungent.

The student should observe

(*a*) The *pale yellowish colour and cylindrical shape*,
(*b*) The *pungent odour* (*when crushed*) *and taste.*

Constituents.—Horseradish root contains *sinigrin* and *myrosin*, and yields, when crushed and distilled, about 0·05 per cent. of allyl isosulphocyanide. The decomposition is the same that takes place in the case of black mustard seed, and the pungent principle is identical with that obtained from the latter drug.

Uses.—Horseradish root has properties similar to those of black mustard seed, viz. stimulant and rubefacient.

SENEGA ROOT

(Radix Senegæ)

Source &c.—Senega root is obtained from *Polygala Senega*, Linn. (N.O. *Polygaleæ*), a small plant producing a perennial knotty rootstock, from which numerous slender stems 6 to 12 inches high arise. It is widely distributed over the *United States* and the southern parts of British America, the root being collected largely in *Minnesota* and *Manitoba* (western senega) and in the north-western of the United States (northern senega). It was formerly collected in the more southern States, but is now nearly exterminated there. The root was used by the Seneca Indians as a remedy for snakebite, and was introduced into medicine about the middle of the eighteenth century.

Description.—Senega root consists of a slender, greyish- or brownish-yellow root surmounted by a knotty crown, to which are attached the remains of numerous slender aerial stems and small shoots beset with the scars or remains of purplish scaly leaves. The root is usually about $\frac{1}{4}$ to $\frac{1}{8}$ inch thick at its upper extremity, but it soon divides into two or three spreading branches. It is frequently curved and contorted, and is longitudinally and sometimes, especially near the crown, transversely wrinkled. Very frequently, but not always, it exhibits a prominent keel resembling a contracted sinew and following a gently spiral course; this keel may generally be found on the concave surface of the curves of the tap-root, and often extends a considerable distance.

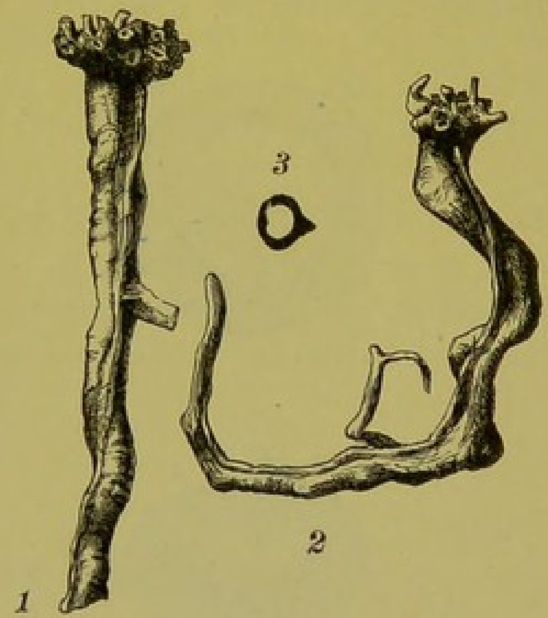


Fig. 159.—Senega root. 1 and 2, roots, showing the keel; 3, transverse section. Natural size. (Vogl.)

The root breaks with a short fracture, the fractured surface exhibiting a whitish wood and yellowish translucent bark. The former frequently presents an abnormal appearance. Instead of a complete circle of wood a wedge-shaped portion, or sometimes two, of varying extent, is replaced by parenchymatous tissue, and the wood therefore appears to have had a segment cut out of it. This appearance varies in different parts of the same root, the segment that is missing being sometimes narrow and wedge-shaped or occasionally increasing to nearly a semicircle, thus reducing the wood to one-half its normal amount. If a keeled root is soaked in water and the bark stripped from it, the wood will be seen to have transverse cracks or a longitudinal fissure on the convex surface, the latter usually extending for some distance and widening from a narrow crack into a broad fissure. These cracks and fissures are filled with easily removable parenchymatous tissue.

The concave sides of the curved roots bear the keels, and these are seen in the transverse sections to be due to a largely developed bast; the keels do not arise from any abnormal development of the wood.

The root has a distinct odour, recalling wintergreen; the taste is at first somewhat sweet, but soon becomes sour and acrid. The powdered root is very irritating to the throat and nostrils when inhaled, and imparts to water the property of frothing.

The student should observe

(*a*) The *prominent keel,*
(*b*) The *irregular wood in transverse sections,*

and should strip the bark from the root and examine the wood.

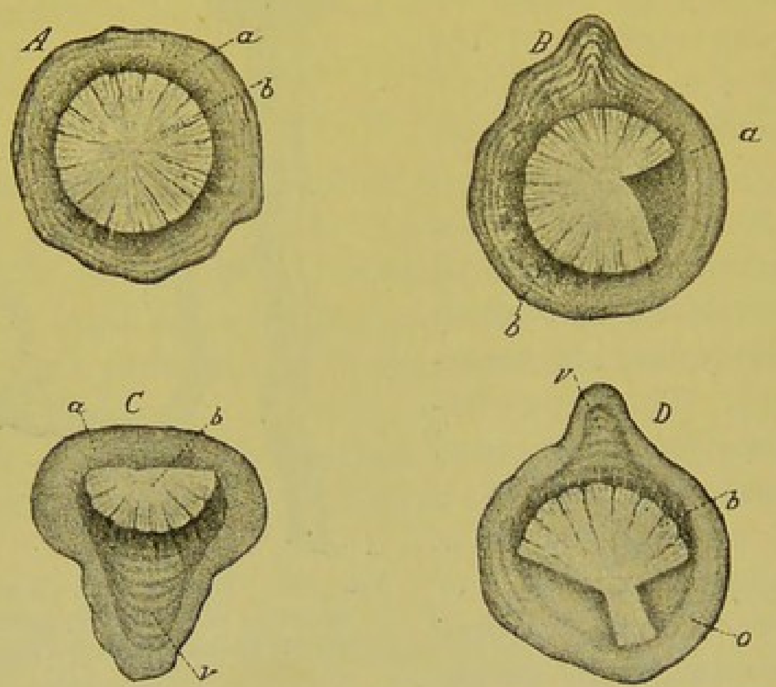


Fig. 160.—Senega root. *A*, transverse section of normally developed root; *B*, *C*, *D*, of abnormally developed roots. *a*, bark; *b*, wood; *v*, bast. Magnified. (Berg.)

Constituents.—Senega root contains as principal constituents *senegin* and *polygalic acid.* These substances are both glucosides, and resemble, but are not identical with, sapotoxin and quillajic acid, constituents of quillaia bark, their action being qualitatively the same, but quantitatively different (Atlass, 1890). Polygalic acid is sternutatory, and imparts to water the property of frothing. Senegin is decidedly toxic. Both these bodies require, however, further investigation.

The drug contains a small percentage of methyl salicylate (oil of wintergreen), to which the characteristic odour is due. Fixed oil is also present, but there is no starch in the drug.

Uses.—Senega is used as a stimulant expectorant in bronchitis.

Varieties.—*Northern senega*, which is collected in the north-western States, does not reach the European market to any appreciable extent. It is considerably larger than the usual variety (western senega), and darker in colour; it is less contorted and shows the keel less distinctly, but it has a very acrid taste, and is undoubtedly a good senega. It is said to be derived from *Polygala Senega*, var. *latifolia*.

White senega, from *Polygala alba*, Nuttall, is collected to some extent in the southern States. The root is more slender than western senega, has descending branches rather than spreading, and is lighter in colour. It has no keel and a normal wood. The taste is much less acrid than that of western senega, and it is presumably less active.

Other roots occasionally find their way into parcels of senega, frequently as a result of careless collection; the characters given sufficiently distinguish the genuine drug; to enumerate all the accidental or occasional admixtures would serve no useful purpose.

RHATANY ROOT
(Radix Krameriæ)

Source &c.—Two varieties of rhatany root, commercially distinguished as Pará rhatany and Peruvian rhatany, are official; they are derived from two distinct species of *Krameria* belonging to the natural order *Polygaleæ*.

1. *Peruvian rhatany* is the root of *K. triandra*, Ruiz and Pavon, which grows on the mountain slopes of *Peru and Bolivia*.

2. *Pará rhatany* is presumably obtained from *K. argentea*, Mart., a shrubby plant growing in *Brazil*.

Rhatany root has apparently been used for many years by the Peruvians for cleaning and preserving the teeth. The Spaniards became acquainted with it in Lima and introduced it into Europe.

Description.—1. The root of Peruvian rhatany is large and knotty at its upper extremity, but divides near the crown into several long stout branches, from which again smaller branches proceed. The larger pieces have a dark reddish-brown

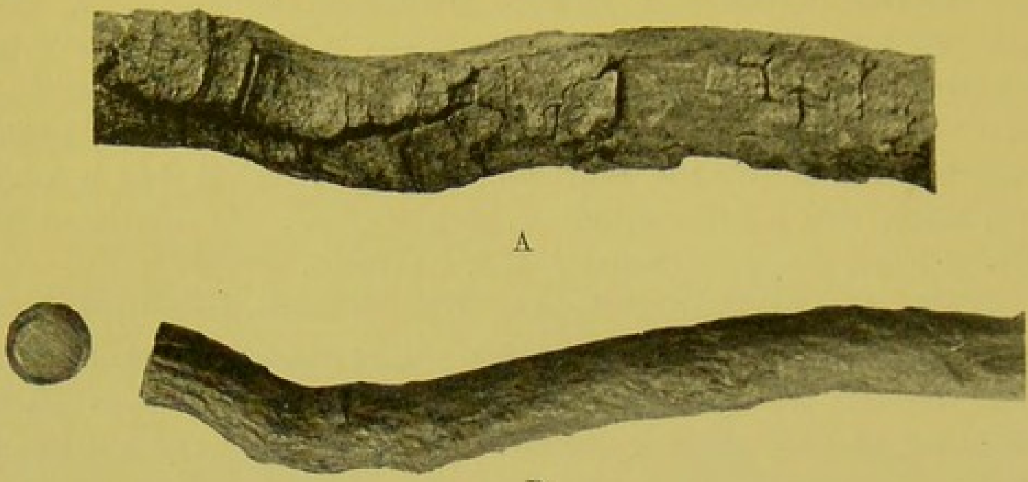


FIG. 161.—Peruvian Rhatany root. A, portion of an older root, showing scaly cork; natural size. B, portion of a younger root, natural size.

colour and a rugged scaly bark; the smaller are usually rather brighter and smoother, not exhibiting any conspicuous transverse fissures. The bark, which can easily be separated from the smaller roots, is rather fibrous, but the wood breaks with a splintery fracture. The transverse section exhibits a pale reddish or yellowish wood and a comparatively narrow reddish-brown bark occupying about one-fourth of the radius of a root of medium size. The wood is dense, and marked with numerous narrow medullary rays and minute vessels. The drug is quite odourless; the bark has a strongly astringent taste, but the wood is practically tasteless.

FIG. 162.—Pará Rhatany. Natural size.

2. *Pará rhatany* is usually imported in long, nearly straight, cylindrical pieces, not often exceeding $\frac{1}{2}$ inch in thickness. They are well characterised by their dark purplish-brown colour, and by the presence of deep transverse cracks at more or less regular intervals in the bark, which in this variety is

never rough or scaly although transversely fissured and longitudinally wrinkled. The transverse section shows a reddish wood and a dark reddish-brown bark, which, in this case, occupies about one-half the radius of a root of medium size. In respect to odour and taste Pará rhatany resembles Peruvian.

The student should carefully compare these two roots, and observe in Peruvian rhatany

(*a*) The *reddish-brown bark*, which is *scaly in large pieces*, *smoother in the smaller*, and *free from deep transverse cracks*,

(*b*) The *proportion of bark to wood* as exhibited in the transverse section ;

in Pará rhatany

(*a*) The *dark purplish-brown colour of the bark*, which is *not scaly*, but *exhibits deep transverse cracks*,

(*b*) The *proportion of bark to wood* in the transverse section, which is greater than in Peruvian rhatany.

Large pieces of Indian sarsaparilla occasionally bear a considerable resemblance to small pieces of Pará rhatany, both in colour and in the presence of transverse cracks. They may be distinguished by their agreeable odour and by the difference in the transverse section.

Constituents.—The principal constituent of rhatany root is the *tannin* (krameria-tannic acid) that it contains. The proportion in which this substance is present has not been satisfactorily determined, but it has been stated to be 8·4 per cent. in the Peruvian root. The Pará variety contains about the same quantity, one assay of the root showing rather more, and another rather less tannin than the Peruvian. These analyses are, however, of comparatively little value, since the proportion of bark, in which alone the tannin resides, varies in different roots of each variety. The Peruvian root appears to contain a much larger amount of substances soluble in absolute alcohol than the Pará root does (23·0 per cent. against 12·6 in the Pará—Dunwody, 1890), and certainly yields a tincture possessing different properties, that from the Peruvian giving a cloudy and that from the Pará a clear mixture with water. Notwithstanding this difference, the Pharmacopœia retains both, since the supply of each is subject to considerable irregularity.

The root contains in addition a dark red phlobaphene, krameria-red, produced by decomposition of the tannin.

Uses.—Rhatany root is employed solely as an astringent.

Varieties.—Several other species of *Krameria* are known to yield astringent roots, but none are of commercial importance.

MARSHMALLOW ROOT

(Radix Althææ)

Source &c.—The marshmallow, *Althæa officinalis*, Linn. (N.O. *Malvaceæ*), is not uncommon in moist or marshy places in southern England, and is widely distributed in similar situations in central and southern Europe. Our supplies are derived from plants cultivated in *Germany*, *France*, and *Belgium*.

The roots are collected in the autumn from plants about two years old, trimmed, and deprived of their cork by scraping; they are then dried. Sometimes the root is also split longitudinally, or cut into transverse sections.

Description.—After being trimmed, scraped, and dried, the roots as met with in commerce are generally in straight, tapering, whitish pieces about 6 or 8 inches in length, and attaining ½ inch or more in diameter at their upper extremity. They are usually obscurely quadrangular or rounded, with a few broad and deep longitudinal furrows. The surface is softly fibrous from the presence of bast fibres that have been liberated by the scraping, and bears brownish scars of lateral roots. The bark, which can readily be removed in long strips, is tough and fibrous, but the wood breaks with a short granular fracture; internally the root is whitish and starchy. It can easily be cut, and the smoothed transverse section exhibits a bark of moderate thickness, separated by a yellow sinuate cambium line from the wood. Both bark and wood possess a radiate structure that is more distinct when the

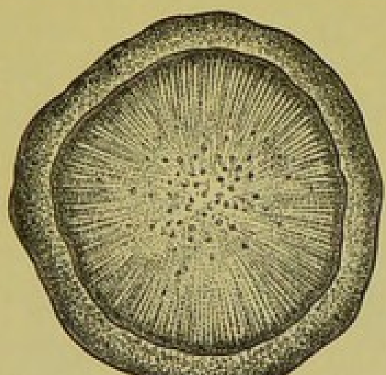


Fig. 163.—Marshmallow root. Transverse section. Magnified. (Moeller.)

surface of the smoothed section is moistened; numerous cells containing a translucent mucilage then become also visible.

The drug has a faint but characteristic odour, and a mawkish, mucilaginous taste.

The student should observe

(*a*) The *fibrous bark*,
(*b*) The *yellow cambium line*,
(*c*) The *radiate structure of the wood*,
(*d*) The *presence of mucilage*;

and should compare the root with

(i) *Belladonna root*, which closely resembles *unpeeled* marshmallow root, but may be distinguished by the non-fibrous nature of the bark, by the absence of mucilage, and by the scarcely radiate structure of the wood,
(ii) *Liquorice root*, the transverse section of which is yellow, and the taste sweet.

Constituents.—The principal constituent is *mucilage*, of which the root is said to contain as much as 25 to 35 per cent., but these figures require confirmation. The drug contains also an abundance of starch.

Uses.—Marshmallow root is used as an emollient and demulcent.

LIQUORICE ROOT

(Radix Glycyrrhizæ)

Source &c.—The liquorice plant, *Glycyrrhiza glabra*, Linn. (N.O. *Leguminosæ*), is widely distributed over southern Europe, extending to central Asia; it is cultivated to a limited extent in England (Yorkshire), our supplies of the official drug and the extract prepared from the fresh root being derived chiefly from *Spain* and *Italy*.

The plant produces a tall, erect, herbaceous stem, and a stout perennial root, dividing, a few inches below the surface, into several long, straight, descending branches. Near the surface it also throws out long horizontal runners provided with scaly cataphyllary leaves and buds which in the second year may develop into aerial stems. In England the plant is dug up in the late autumn, and either sold in the fresh state or cut transversely and dried. The drug consists therefore of both runners and roots, the former constituting the major part.

Spain and the south of France furnish considerable quantities of carefully dried liquorice root; in the former country the plant is cultivated in the northern provinces of Murcia, Aragon, and Toledo. In southern Italy large quantities of liquorice root are grown, but it is chiefly converted into extract, comparatively little of the root being exported.

Description.—Spanish liquorice is exported in large bundles of straight cylindrical pieces of considerable length. They have a rather dark reddish-brown colour, and are usually longitudinally wrinkled. On the surface they also bear small scars of roots, and, on the majority of pieces (the runners), here and there minute dark buds may be seen.

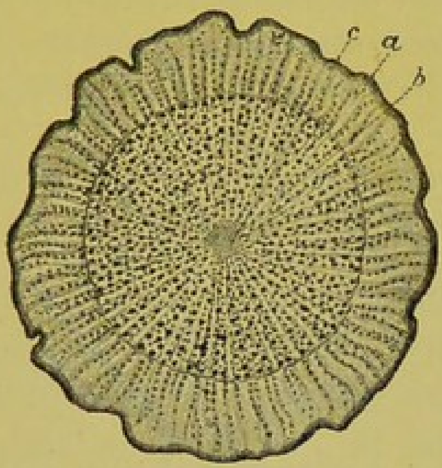


Fig. 164.—Spanish Liquorice root. Transverse section of rhizome (runner). *a*, bark; *b*, wood; *c*, pith. Magnified 3 diam. (Berg.)

The drug breaks with a fracture that is fibrous in the bark, splintery in the wood; the fractured surface exhibits, when smoothed, a yellow wood surrounded by a moderately thick yellowish-grey bark, the pieces of runner being distinguished by the presence of a small pith. Under the lens the wood is seen to consist of very numerous medullary rays, between which are very narrow, porous wedges of vascular tissue; opposite to these in the bark are radial rows of dark points (groups of bast fibres).

The drug has a characteristic but not powerful odour, and a very sweet taste without perceptible bitterness or acridity.

The student should observe

(*a*) The *yellow colour of the section*, and *fibrous bark*,
(*b*) The *minute buds and pith in most of the pieces*,
(*c*) The *characteristic sweet taste, free from acridity*;

and should carefully compare this (the Spanish) variety with the Russian, which is not official.

Constituents.—The principal constituent of liquorice root is the sweet principle, *glycyrrhizin* (glycyrrhizic acid), which has been obtained in the form of a brown horny mass, almost insoluble in water, alcohol, and ether. It possesses the properties of an acid, and combines with alkalies to form crystallisable soluble salts, which have an intensely sweet taste; it is said to exist in the root in combination with ammonia and calcium. The (Russian) root is said to contain as much as 7·5 per cent. of glycyrrhizin.

Glycyrrhizin, or at least a substance closely resembling it, has been isolated from other plants besides liquorice, as, for instance, the rhizome of *Polypodium vulgare*, Linn., the leaves of *Myrrhis odorata*, Scop., the bark of *Lucuma glycyphlœa*, Mart., &c., and appears therefore to be somewhat widely distributed.

Varieties and Substitutes.—Very large quantities of liquorice root are collected in southern Russia, where the plant grows wild on the banks of the Volga and other rivers, needing no cultivation. The plant that yields this root is *G. glandulifera*, W. & K. Instead of producing numerous runners this plant forms a large rootstock, from which long perennial roots are given off. These are usually freed from the purplish-brown cork by scraping.

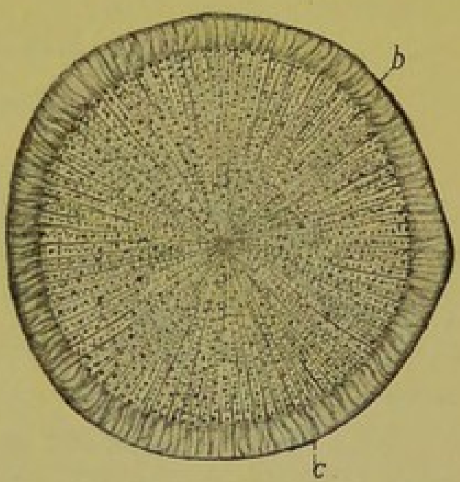


FIG. 165.—Russian Liquorice root. Transverse section. *b*, wood; *c*, pith. Magnified 1½ diam. (Berg.)

Nearly all the Russian liquorice root that reaches this country has been peeled, and presents therefore a smooth yellow exterior, to which loose fibres are attached, the larger pieces being often longitudinally split. It attains a larger size than the Spanish, the crown of the root, which shows the remains of several stems, being occasionally as much as 4 inches in diameter. The texture is commonly looser and more fibrous than that of the Spanish drug, and the taste, although sweet, is accompanied by a more or less perceptible but not strong bitterness or acridity.

Unpeeled Russian liquorice shows a close resemblance to the Spanish. It consists, however, chiefly of roots (instead of runners) which are destitute of pith and exhibit no traces of buds; their colour is purplish rather than brown, and the cork is often scaly. No distinctive constituent has been isolated from the Russian root, nor is it known to what the slight bitterness is due. It is not official, the Pharmacopœia admitting only the peeled roots or runners of *G. glabra*.

Stick Liquorice.—The manufacture of stick or block liquorice is carried on chiefly in southern Italy. The runners and roots of both wild and cultivated plants are collected, crushed, boiled with water, and pressed. The decoction thus obtained is allowed to clear by standing, and is then run off into large pans, where it is concentrated by boiling until it has acquired a suitable consistence, when it is formed into blocks or sticks, which are stamped with the name of the manufacturer (e.g. Solazzi), and dried.

Stick liquorice contains about 17 per cent. of water and about 60 or 70 per cent. of substances soluble in water, the brown, slimy residue that is left consisting principally of more or less altered starch, together with inorganic matter and a little glycyrrhizin which can be removed by treatment with dilute ammonia.

BRYONY ROOT

(Radix Bryoniæ)

Source &c.—The common bryony, *Bryonia dioica*, Jacq. (N.O. *Cucurbitaceæ*), is a climbing and trailing plant, with rough, hairy leaves, common in hedges and thickets in *southern England*. It must not be confounded with the so-called black bryony, which is the common Tamus, a very different plant with entire shining leaves.

The root is collected in the autumn and used in the fresh state. It was well known to, and much used by, the Greeks and Romans, but is now seldom employed.

Description.—The plant produces in the spring aerial stems attaining a great length and springing from a large tuberous rhizome which is continuous with a thick fleshy root. This subterranean part of the plant is often of very considerable size and weight, measuring occasionally at the upper extremity 4 inches in diameter, and reaching a length of 2 feet, the whole weighing several pounds. It tapers more or less gradually towards the tip, and is usually simple, though sometimes it divides into two nearly equal descending branches. When fresh it is of a dirty yellow colour externally, and marked at close intervals with prominent transverse corky ridges often extending half round the root. Internally the root is whitish and fleshy, exuding when cut a juice that is milky from the presence of numerous minute starch grains. The transverse section exhibits a fine line separating a narrow bark from a large fleshy wood; the latter contains, more or less uniformly distributed over it, small groups of vessels, radially arranged and extending from the centre to the bark.

The fresh root has an unpleasant odour and a nauseously bitter and acrid taste.

The student should observe

(*a*) The *large size* and *gradually tapering shape*,
(*b*) The *transverse corky ridges*,
(*c*) The *nauseously bitter taste*,

and should compare small specimens with horseradish root, which is cylindrical and smooth, and has a pungent taste.

Constituents.—Bryony root contains a white, amorphous, very bitter glucoside *bryonin*, and a resinous substance *bryoresin*. The autumnal root contains, further, large quantities of starch, the grains of which are exceedingly small and impart a milky appearance to the juice that exudes from a freshly cut surface.

Uses.—The root when taken internally in full doses acts as a hydragogue cathartic; applied to the skin it is irritant and may cause vesication. It has been recommended for pleurisy, whooping cough, and bronchitis, and has been given as a hydragogue cathartic.

Varieties.—*Bryonia alba*, Linn., a continental species, is distinguished by its monœcious flowers and black berries, the common bryony having diœcious flowers and scarlet berries. It produces a similar root containing probably the same constituents.

IPECACUANHA ROOT

(Radix Ipecacuanhæ)

Source &c.—Ipecacuanha root is obtained from *Psychotria* (*Cephaëlis*) *Ipecacuanha*, Stokes (N.O. *Rubiaceæ*), a small plant about a foot in height with a stem that is at first prostrate or ascending and afterwards becomes erect. It is found in most parts of *Brazil*, but especially in the province of Matto Grosso, in the interior, whence much of the drug is obtained.

Endeavours have not been wanting to cultivate the ipecacuanha plant in other countries, and they have met with some

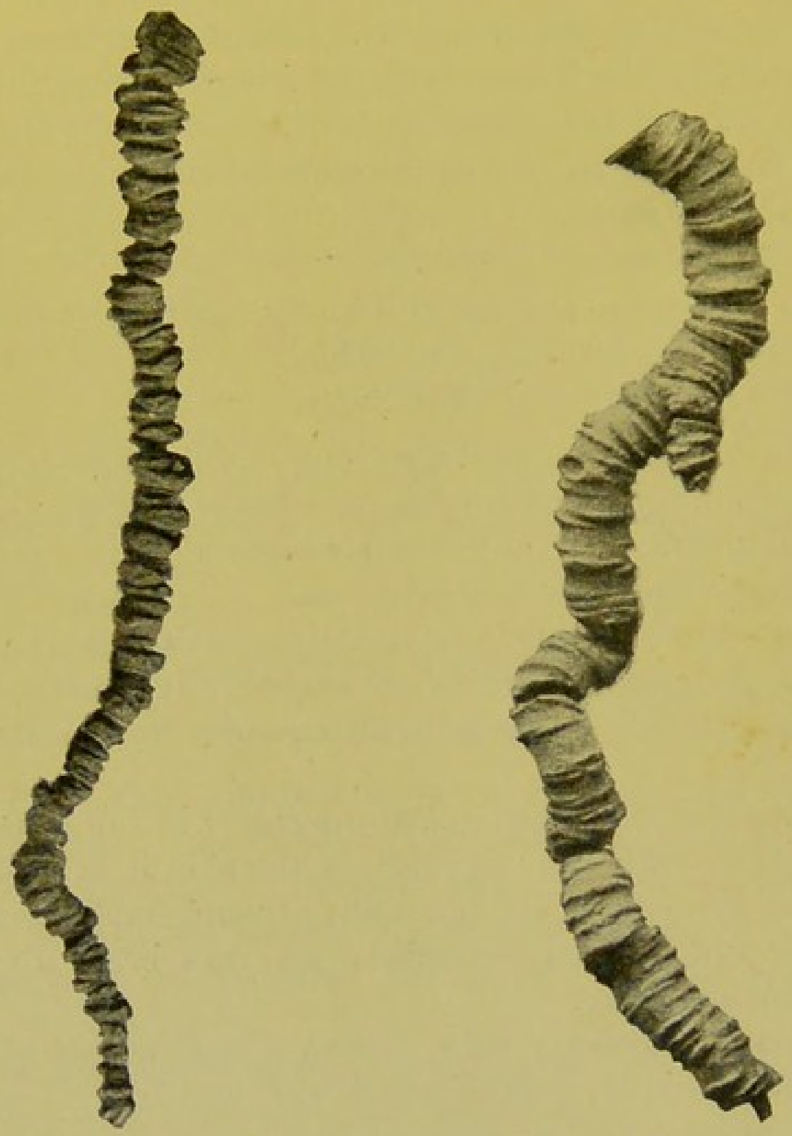


Fig. 166.—A, Brazilian Ipecacuanha (*P. Ipecacuanha*) cultivated in India. B, Carthagena Ipecacuanha. Large specimens. Natural size.

success. From Johore (near Singapore) ipecacuanha root of unusually fine appearance and rich in alkaloid has been imported, but up to the present not in sufficient quantity to render it commercially important. In Java the cultivation has not been successful.

From the slender, prostrate stem fibrous roots are given off at intervals; some of them in the course of their growth develop an abnormally thick bark in which abundance of starch is deposited, whilst the wood remains comparatively small. These thickened roots should constitute the commercial drug; they are collected by raising the plant, which usually forms clumps, from the earth, removing the roots, drying them, and finally breaking them into fragments and sifting them from adherent sand and earth. Very frequently much of the prostrate or ascending stem finds its way into the drug.

Ipecacuanha appears to have long been used in Brazil for dysentery; it was introduced into Europe about 1672.

Description.—The official ipecacuanha root, which is distinguished as Brazilian or Rio ipecacuanha, is slender and rather tortuous, seldom exceeding, in the commercial drug, 6 inches in length or a quarter of an inch in thickness. The colour varies from dark brick-red to dark-brown, the former being due, partly at least, to adhering particles of earth. Very characteristic of the root is the annulated appearance that it presents, the bark of typical pieces being constricted at short intervals so as to resemble a number of discs somewhat irregularly strung together; the constrictions are sometimes quite shallow, but sometimes they penetrate nearly to the wood. These annulations seldom, however, take the form of distinct, rather distant, narrow, raised ridges. (Compare Carthagena ipecacuanha.)

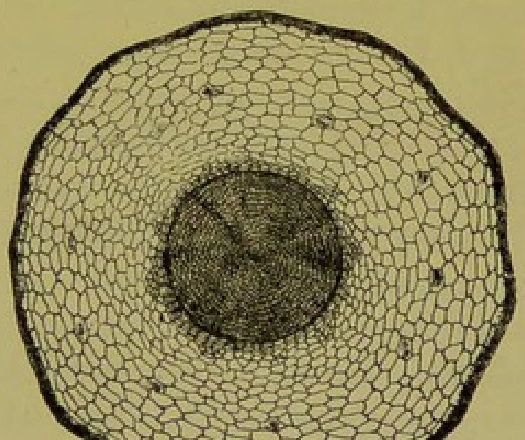


FIG. 167.—True Ipecacuanha (*Psychotria Ipecacuanha*). Transverse section, showing dense wood. Magnified. (Planchon and Collin.)

The root is hard and breaks with a very short fracture. The transverse section exhibits a thick, dark grey bark which is usually horny, but sometimes starchy, and a small wood in which no distinct pores or pith can be discerned when examined with a lens. The bark, when examined under the microscope, is found to contain abundance of starch grains that are mostly compound and, in addition, acicular crystals of calcium oxalate; the wood is free from vessels. These characters are useful in distinguishing ipecacuanha from

Z

certain substitutes that appear from time to time, and are referred to below.

The drug has a slight odour which to many persons is particularly unpleasant; the taste is slightly bitter.

The student should particularly observe

(*a*) The *closely approximated disc-like annulations*,
(*b*) The *thick, starchy bark*,
(*c*) The *small, dense wood*;

and should compare this variety (Rio or Brazilian) with that known as 'Carthagena,' which is usually rather thicker, and in which the annulations assume the form of distinct, somewhat distant, narrow, raised ridges.

Constituents.—Ipecacuanha root contains *three alkaloids*, two of which, *emetine* and *cephaëline*, have been more closely examined, whilst the third, which occurs in much smaller quantity, awaits further investigation. These alkaloids exist in good root to the extent of from 2 to 3 per cent.

Emetine, which is colourless and amorphous, but yields crystalline salts, constitutes about 72 per cent. of this total alkaloid, whilst cephaëline, which is crystalline, amounts to about 26 per cent., the remainder being the third alkaloid (Paul and Cownley, 1896). Emetine is superior to cephaëline as an expectorant, but cephaëline has more powerful emetic properties (Wild). The therapeutic effect of the root will therefore be influenced by the relative proportion in which these alkaloids are present.

Ipecacuanha contains, further, an amorphous organic acid, *ipecacuanhic acid*, of which little is known, *calcium oxalate in acicular crystals* (raphides), and abundance of *starch in small compound grains*.

Varieties and Substitutes.—*Carthagena Ipecacuanha.*—For some years past large quantities of ipecacuanha root have been regularly imported from New Granada. This variety, which is known as Carthagena or New Granada ipecacuanha, is distinguished from the Brazilian drug by being usually of larger size and by the annulations which in this case assume the form of narrow, distinct, transverse, raised ridges arranged at a little distance from one another, and the root does not therefore assume the appearance of a number of discs strung together. The starch grains are also rather larger than those of Brazilian ipecacuanha. The drug has been attributed to *Psychotria acuminata*, Benth., but definite evidence on this point has not yet been adduced. Carthagena ipecacuanha contains the same constituents as Brazilian, but in rather smaller proportion. The chief difference in this respect lies in the proportion in which *each* of the alkaloids emetine and cephaëline is present rather than in the amount of total alkaloid contained in the root. In Carthagena ipecacuanha the emetine amounts to only 40 per cent. of the total alkaloid, whilst the cephaëline reaches as much as 57 per cent.; in other words, it contains twice as much of the latter alkaloid as the Brazilian root, and its physiological action is therefore much more emetic and less expectorant. For this reason the Carthagena variety has been excluded from the Pharmacopœia; but although in the majority of cases the identification of each variety is possible, it is not difficult to find small roots that are practically indistinguishable.

Ipecacuanha Stem.—Much of the Brazilian drug is imported mixed with the stems of the plant. These are slender and longitudinally striated, exhibiting no annulations. The transverse section shows a thin bark surrounding a ring of wood within which is a distinct pith. They contain less alkaloid than the root, various assays yielding from 0·97 to 1·8 per cent.; they should therefore be excluded from the drug.

East Indian Ipecacuanha.—Under this name the rhizome of a small monocotyledonous plant, probably *Cryptocoryne spiralis*, Fisch. (N.O. *Aroideæ*), has been imported from the south of India. It occurs in short, nearly cylindrical pieces, ½ to 2 inches long, often tapering at one end and there bearing the remains of leaves; they are slightly enlarged and constricted at regular intervals, which gives them an annulated appearance somewhat resembling ipecacuanha, and are marked with encircling leaf scars. The transverse section exhibits a typically monocotyledonous structure, and distinguishes this drug at once from genuine ipecacuanha; for instead of the central column of dense wood there is a parenchymatous stele, through which scattered bundles run, surrounded by a white starchy bark. This substitute for ipecacuanha contains no emetine or cephaëline.

Undulated Ipecacuanha, derived from *Richardsonia scabra*, St.-Hil. (N.O. *Rubiaceæ*, Brazil), occurs in tortuous pieces, the upper part being cylindrical and bearing at the crown the remains of numerous very slender aerial stems. On one side of the root the bark is occasionally fissured nearly to the wood, and this gives the drug a somewhat annulated appearance, which, however, is quite different from the regular annulations of Brazilian ipecacuanha. The

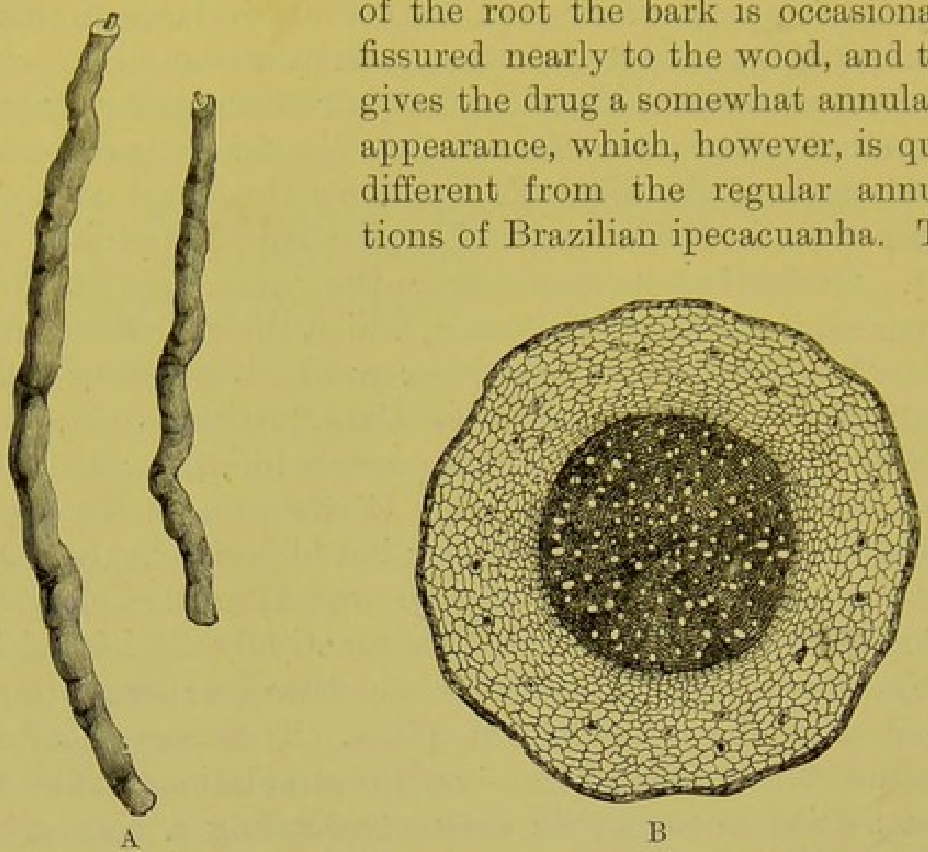


Fig. 168.—Undulated Ipecacuanha (*Richardsonia sp.*). A, root, natural size. B, transverse section, magnified, showing porous wood. (Planchon and Collin.)

transverse section exhibits a porous wood, and a thick, starchy bark that often possesses a violet colour.

Lesser Striated Ipecacuanha.—This drug, which is occasionally found on the market, is

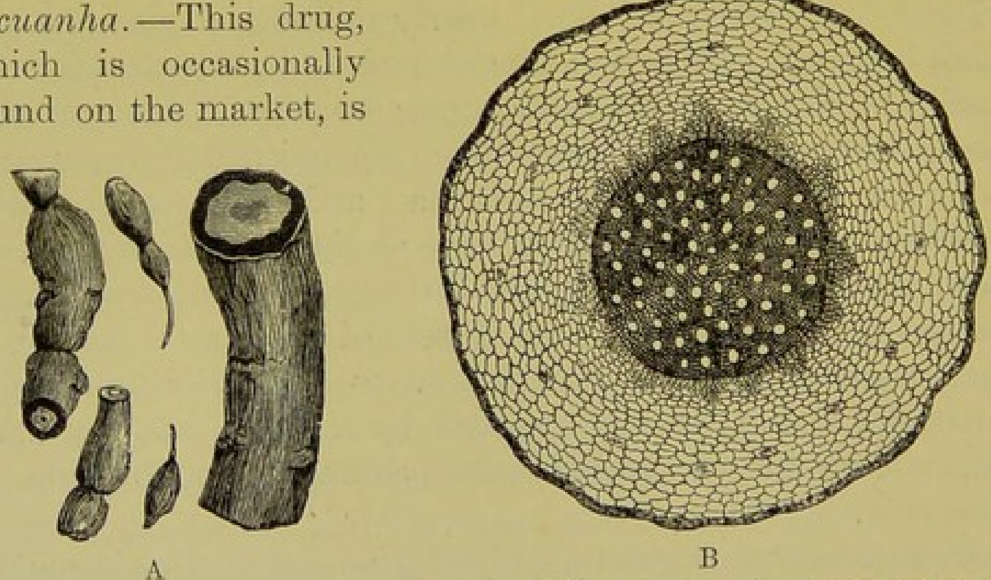


Fig. 169.—Lesser Striated Ipecacuanha (*Richardsonia sp.*). A, root, natural size, cut transversely to show the dark bark. B, transverse section, magnified, showing the porous wood. (Planchon and Collin.)

apparently derived from a species of *Richardsonia*, as it possesses a starchy, violet (often dark violet) bark and porous wood, but is distinguished from the foregoing by its darker colour and stouter aerial stems.

Greater Striated Ipecacuanha is the root of *Psychotria emetica*, Linn. It is about the size of Carthagena ipecacuanha and closely resembles the foregoing, being irregularly constricted, dark in colour, and exhibiting in transverse section a dark, violet-coloured bark ; it may be distinguished by its dense wood, and by the presence of sugar in the bark, starch being completely absent. The colour of the bark and the absence of starch easily distinguish this root from either Brazilian or (which it closely resembles in appearance) Carthagena ipecacuanha.

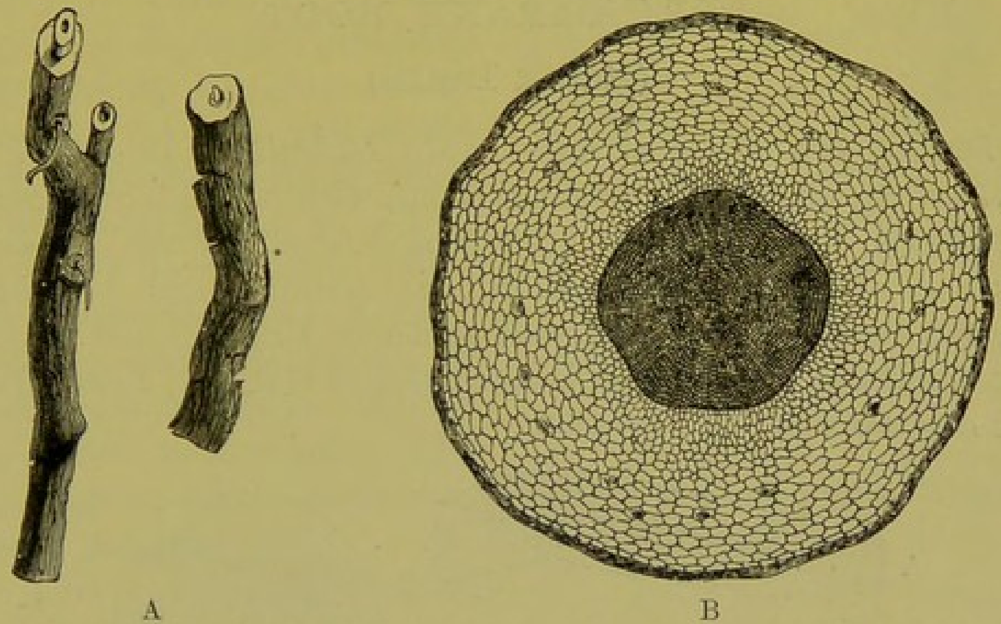


FIG. 170.—Greater Striated Ipecacuanha (*Psychotria emetica*). A, root, natural size. B, transverse section, magnified, showing the dense wood. (Planchon and Collin.)

White Ipecacuanha is the root of *Ionidium Ipecacuanha*, Vent. (N.O. *Violaceæ*, Brazil). It is greyish-white or yellowish in colour, $\frac{1}{16}$ to $\frac{1}{8}$ inch thick, and frequently branches. The section exhibits a large, porous, yellowish wood and narrow, darker bark.

None of the five last drugs, all of which reappear from time to time as substitutes for the genuine drug, contain any emetine or cephaëline.

The following test for emetine is useful in distinguishing roots containing that alkaloid from numerous substitutes which do not :—0·5 gramme of the finely powdered root is mixed with

20 c.c. of strong hydrochloric acid and 5 c.c. of water ; to 2 c.c. of the filtrate 0·01 gramme of potassium chlorate is added ; if emetine is present the liquid assumes a yellow colour, changing in the course of an hour to red.

Uses.—Ipecacuanha is largely used as an expectorant and emetic ; it also possesses diaphoretic and cholagogue properties. One of its most important uses is as a remedy for dysentery, for which purpose large doses are given (30 to 90 grains). In such cases a remarkable tolerance of the drug is often readily established, or the drug deprived of its alkaloids (de-emetinised ipecacuanha) is administered.

ELECAMPANE ROOT

(Radix Inulæ)

Source &c.—Elecampane, *Inula Helenium*, Linn. (N.O. *Compositæ*), is a tall, herbaceous plant, with perennial rhizome, distributed over temperate Europe and Asia. It was formerly much cultivated in gardens in this country, and is found apparently wild in some parts of southern England and Wales. For medicinal use the plant is *cultivated* in *Holland*, *Thuringia*, and *Switzerland*.

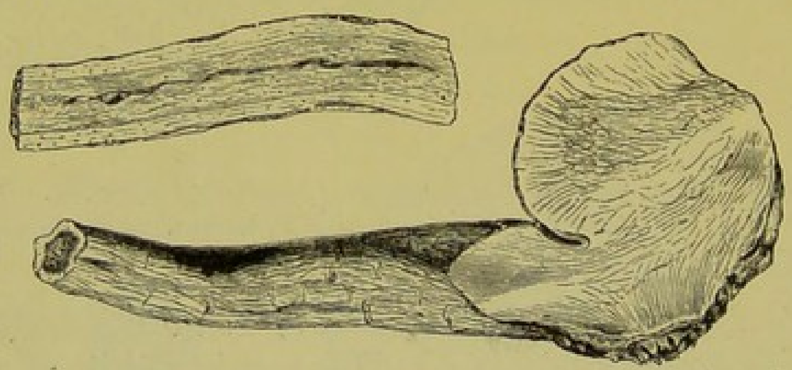


Fig. 171.—Elecampane root. A, longitudinally cut ; B, entire, with portion of the rhizome attached. (Planchon and Collin.)

The plant produces a short, thick, fleshy rhizome and large, fleshy roots. Both rhizome and roots are collected when the plants are about three years old and dried, the larger being often sliced longitudinally.

Description.—The drug consists of both rhizome and roots. The former is usually cut longitudinally, and occurs in thin, irregularly rounded slices about 1½ or 2 inches in diameter.

The roots vary much in size, the smaller being the thickness of a pencil or even less, the larger sometimes exceeding an inch in diameter. They are nearly cylindrical (if entire), tapering very gradually towards the tip, but are seldom quite straight, usually curling irregularly as they dry, especially if they have been sliced.

Both rhizome and root are hard and horny, or, if slightly moist, tough, and are of a dark brownish-grey colour externally, whitish or pale-brownish internally. They break with a short fracture. The transverse section is more or less uniform in colour and exhibits a number of shining, brown oil-glands scattered over the whole of the surface, both in the bark and in the central portion (wood) which is separated from it by a dark and often very indistinct cambium line. In the wood small, radially elongated groups of vessels occur, but are difficult to discern with a lens. The root has an agreeable aromatic odour and an aromatic, slightly bitter taste.

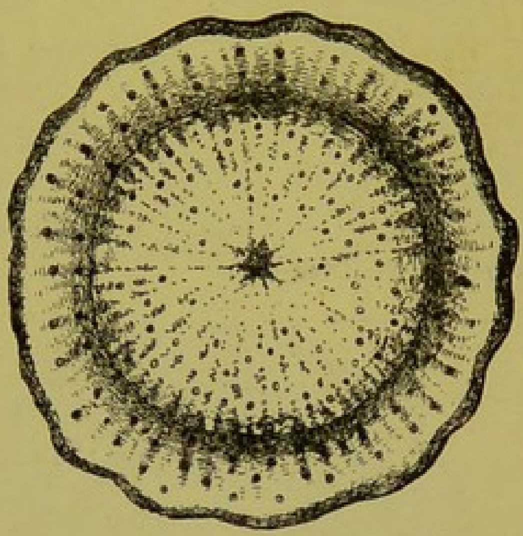


Fig. 172.—Elecampane root. Transverse section, showing the distribution of the oil-glands. Magnified. (Planchon and Collin.)

The student should observe

(*a*) The *horny* (*not starchy*) *nature of the drug*,
(*b*) The *presence of oil-glands*,
(*c*) The *absence of distinct radiate structure in the wood*;

and should compare the root with

(i) *Belladonna root*, which has no oil-glands, and which should possess a starchy fracture,
(ii) *Dandelion root*, which has no oil-glands, a small yellow wood, and thick ringed bark,
(iii) *Marshmallow root*, which has no oil-glands, a radiate structure, and a fibrous, easily separated bark,
(iv) *Pellitory root*, which has oil-glands, but is distinguished by its yellow, radiate wood, distinctive odour and taste.

Constituents.—Elecampane root yields by distillation about 1 per cent. of *volatile oil*, together with *helenin*, *alantolactone*, and *alantol*. Helenin and alantolactone are colourless crystalline bodies; alantol is a colourless liquid with an odour of peppermint. Elecampane root contains also in large quantity, as reserve material, *inulin*. The roots gathered in the autumn, when they are richest in *inulin*, contain as much as 45 per cent. of this substance, which can be obtained as a white crystalline powder, slightly soluble in cold water but easily soluble in hot water without gelatinising. It may be distinguished from starch by these characters as well as by the cooled decoction not assuming a blue colour with iodine. It takes the place of starch as reserve material in many plants belonging to the order *Compositæ* and in several belonging to *Campanulaceæ* &c.

PELLITORY ROOT

(Radix Pyrethri)

Source &c.—Pellitory root is obtained from *Anacyclus Pyrethrum*, DC. (N.O. *Compositæ*), a small plant with perennial root indigenous to *Algeria*. In habit and general appearance the plant resembles the chamomile. The root is collected in the autumn and dried.

Description.—Pellitory root is usually simple and unbranched; as seen in the commercial drug it is generally about 3 or 4 inches in length, but often attains 5 or 6, and is about $\frac{1}{2}$ inch thick. It is nearly cylindrical in shape, tapering slightly towards the tip, and often as well towards the crown where there is frequently to be found a tuft of grey hairs on the remains of leaves. The outer surface is brown and deeply and irregularly wrinkled.

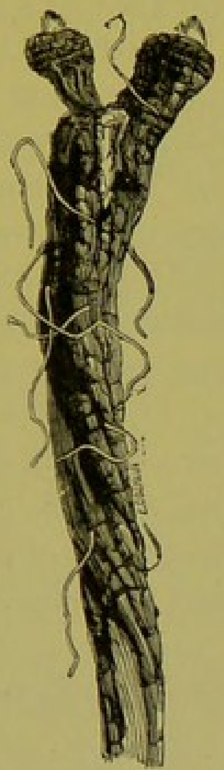
The root is tough and breaks with a short fracture. The bark is closely adherent to the wood, which exhibits a prominently radiate structure, narrow yellowish wedges of vascular tissue alternating with whitish medullary rays of equal or even greater breadth. In the latter, as well as in the bark, yellow or brown oil-glands are scattered. The drug when cut is of a horny, not starchy or fibrous nature. It has a characteristic though not strong odour, and, when chewed, a pungent taste, exciting a copious flow of saliva.

The student should observe

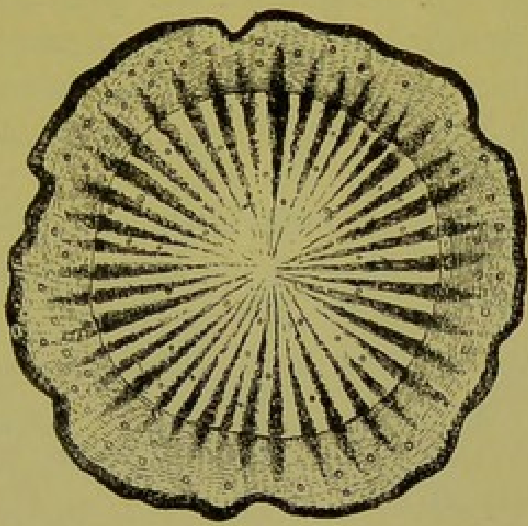
(*a*) The *distinctly radiate structure of the wood*,
(*b*) The *wide medullary rays*,
(*c*) The *presence of oil-glands*;

and should compare the root with

(*a*) *Belladonna root*, which has no oil-glands and should be starchy,
(*b*) *Dandelion root*, which has a small yellow wood and thick, ringed bark.
(*c*) *Liquorice root*, which has no oil-glands, is woody, and has much narrower medullary rays.



A



B

FIG. 173.—Pellitory root. A, root, natural size. B, transverse section, showing radiate structure of the wood and the distribution of the oleo-resin glands, magnified. (Planchon and Collin.)

Constituents.—Pellitory contains, as principal constituent, an alkaloid, *pyrethrine*, which can be obtained in colourless acicular crystals insoluble in water but soluble in alcohol and possessing an intensely pungent taste. It is apparently allied to piperine, which it resembles in some of its properties.

The drug contains also *inulin* to the extent of about 50 per cent., and traces of *volatile oil*. The sialogogue properties are due to the pyrethrine.

Uses.—Pellitory is used as a sialogogue in dryness of the throat and as an addition to dentifrices.

DANDELION ROOT

(Radix Taraxaci)

Source &c.—The common dandelion, *Taraxacum officinale*, Wiggers (N.O. *Compositæ*), is widely distributed over *Europe*, *Asia*, and *North America*, and is in many cultivated districts a troublesome weed. In this country it has long been used as a domestic medicine.

Both the fresh and the dried roots are official, the former for the preparation of the extract, the latter for the fluid extract.

For these purposes the root is directed to be gathered in the autumn, when, judging from analogy, it may be expected to be most active. This, however, has been denied, the assertion being made that the root is most active in the spring or summer. A method for the quantitative determination of the bitter principle not being at present known, this point cannot be definitely settled, but roots that can be accurately assayed, such as belladonna &c., have proved to be most rich in active constituent in the autumn.

The root collected in the spring or summer contains much sugar, which is more objectionable than inulin, so that, unless positive evidence can be adduced to the contrary, the autumn must be regarded as the proper season in which to collect dandelion root.

The roots are collected from wild plants, washed, and, if necessary, dried.

Description.—Dandelion root consists of a simple straight root, which, towards the upper part, passes imperceptibly into an erect rhizome; the latter sometimes remains simple, but often divides into several erect branches. It attains a length of a foot or more, and a thickness varying from ½ to 1 inch. Whilst fresh it is yellowish-brown externally, whitish and fleshy within. From the freshly cut surface, as indeed from all parts of the plant, an abundance of a very bitter, milky juice exudes, which on careful examination may be observed to rise from concentric rings of tissue. In the centre of the root is a small yellow wood.

The dried root has a dark brown colour and is much shrivelled and wrinkled longitudinally; it tapers but little below, and often divides in the upper part (rhizome) into several erect branches, the rhizome being distinguishable from the root only by its slightly varying structure. These branches (or the rhizome itself) are crowned with the short remains of the leaves which bear brownish hairs near the point of insertion.

It breaks when dry with a short fracture, the section exhibiting a very small, yellow, porous, central wood surrounded

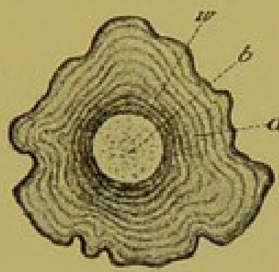


FIG. 174.—Dandelion root. Transverse section. *a*, bark; *b*, wood; *w*, cambium. Magnified 4 diam. (Berg.)

by an abnormally thick, whitish bark in which numerous brownish concentric rings (of laticiferous tissue) are visible. The root, which is rather hygroscopic, becomes tough when slightly moist. It has no odour, but a bitter taste, which, however, is often not nearly so pronounced as it is in the milky juice that exudes from the fresh root.

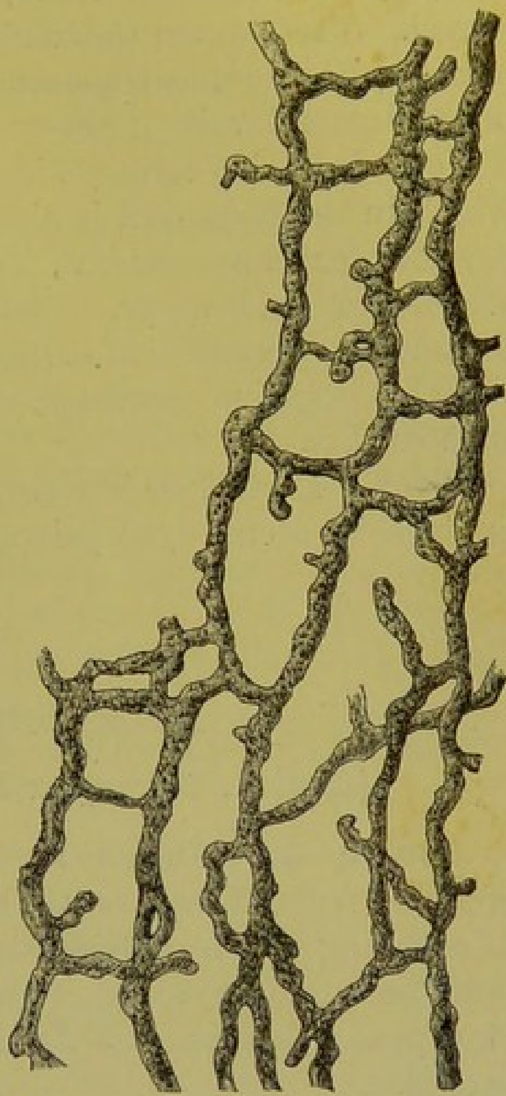


FIG. 175.—Anastomosing laticiferous vessels of Dandelion root. Magnified 140 diam. (Vogl.)

The student should observe

(*a*) The *small yellow wood,*
(*b*) The *thick, whitish bark* marked with *distinct, darker, concentric rings,*
(*c*) The *absence of starch* (see below);

and should compare the root with

(i) *Pellitory root,* which has oil-glands and a large radiate wood with conspicuous medullary rays,
(ii) *Liquorice root,* which also has a large radiate wood.

Constituents.—Dandelion root contains a small quantity of a crystalline, bitter substance *taraxacin*, and also an *acrid principle*, neither of which, however, has been closely examined. The former, taraxacin, appears to be very susceptible of decomposition, as the extract prepared from the fresh root is often almost devoid of bitterness.

The drug also contains in the autumn abundance of *inulin*, which in the fresh root is dissolved in the cell sap, but in the dry root forms amorphous, transparent lumps not again readily soluble in cold water. The absence of starch, which is so commonly present in roots, especially in the autumn, is a valuable negative character, and is often of service in detecting substitution.

Uses.—Dandelion is a simple bitter, and mild laxative, and is given in atonic dyspepsia attended by habitual constipation.

HEMIDESMUS ROOT

(Indian Sarsaparilla, Radix Hemidesmi)

Source &c.—Indian sarsaparilla or hemidesmus root is obtained from *Hemidesmus indicus*, R.Br. (N.O. *Asclepiadeæ*), a climbing shrub indigenous to *India* and *Ceylon*. It has long been employed in India, but was not introduced into European medicine till 1831, and is already practically discarded.

Description.—Hemidesmus root usually occurs in long, slender, rigid pieces, often more than a foot in length, but seldom exceeding $\frac{1}{4}$ inch in thickness, which branch occasionally and bear a few fibrous rootlets. Portions of the slender aerial stems are attached to the upper extremity, and the student should observe that these are marked with opposite leaf scars.

The root varies in colour from brick-red to dark-brown or nearly black; it is rather tortuous, nearly cylindrical in shape, and marked with longitudinal wrinkles, and, at rather distant intervals, with conspicuous transverse cracks. The thin cork with which the root is covered shows a disposition to separate from the cortex, and on one side may often be observed to be distinctly raised above it.

The root is hard and woody; the transverse section exhibits a large, porous, but not distinctly radiate yellowish wood surrounded by a thin greyish or sometimes dark-grey bark. It has an agreeable odour, distinctly recalling tonco beans; the taste is slightly aromatic and sweetish, but not otherwise characteristic.

The student should observe

(*a*) The *rigid, tortuous character* of the root,
(*b*) The *transverse cracks*,
(*c*) The *easily separable cork*,
(*d*) The *large yellowish wood*;

and should compare the root with sarsaparilla, which is destitute of transverse cracks, has a firmly adherent cork, and a small wood.

Constituents.—The constituents of hemidesmus root are quite unknown. The agreeable odour is probably due to coumarin or a similar substance, but no particular active constituent is known.

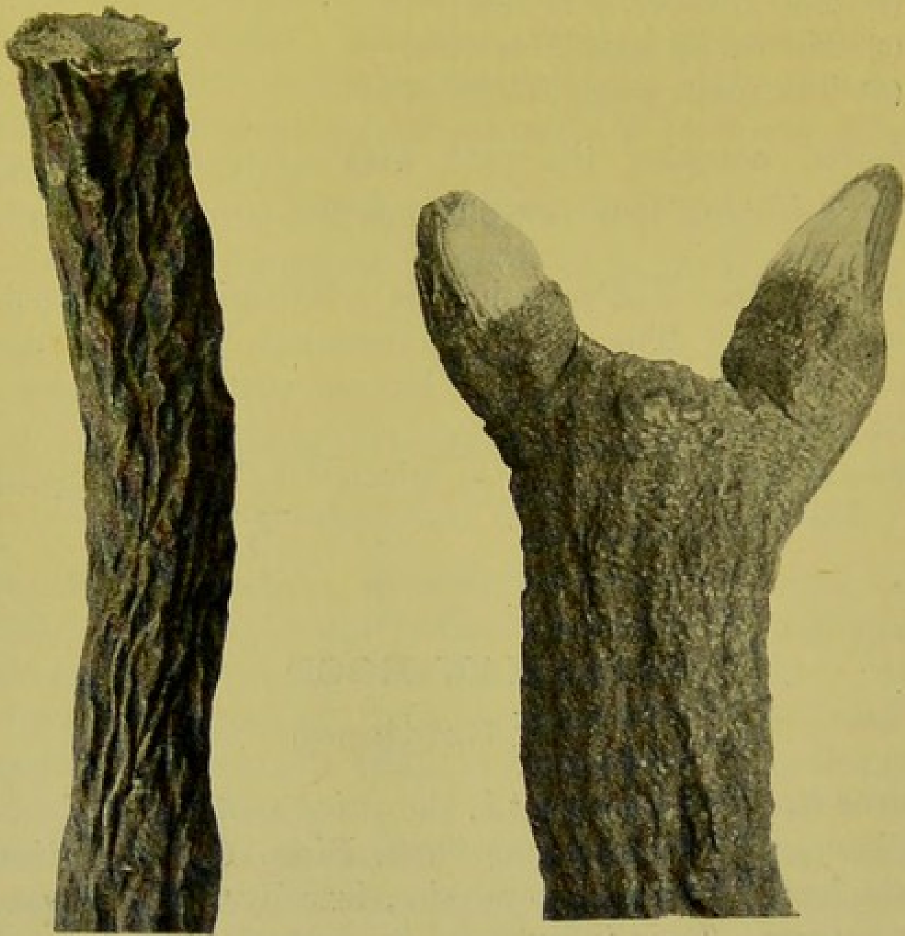
Use.—It has been used as an alterative, but is of doubtful value.

GENTIAN ROOT

(Radix Gentianæ)

Source &c.—Gentian root is the dried root and rhizome of the yellow gentian, *Gentiana lutea*, Linn. (N.O. *Gentianeæ*), a stately herb with large, opposite, broadly ovate leaves and yellow flowers. It is indigenous to *central Europe*, growing abundantly on the lower slopes in the Jura and Vosges mountains, in the Black Forest, and in the Pyrenees. The root has long been used as a medicine, and is also employed at the present day in Switzerland for the preparation of an alcoholic liquor, by fermenting an infusion of the fresh root, and distilling the fermented liquid.

The plant produces an erect rhizome, from which large fleshy roots are given off; the latter take a more or less horizontal course a few inches below the surface of the earth, and attain a considerable length. Both rhizome and roots are collected in the autumn and dried; they are occasionally, but not often, sliced longitudinally. When fresh they are whitish internally and almost odourless, but during the slow drying to which they are subjected the colour changes to a yellowish-brown, and a distinctive odour is developed. So much are the particular colour and odour required, that in some districts the practice is said to prevail of heaping the fresh root and allowing it to heat and ferment before drying it; by this treatment it darkens in colour and acquires the desired odour. Gentian root



A B

Fig. 176.—Gentian root. A, root, showing surface with longitudinal wrinkles. B, rhizome, showing fine transverse lines (leaf scars), and dividing into two branches, each terminating in a bud. Natural size.

that has been longitudinally sliced and quickly dried is paler, and has an odour less strong than that which has not been so treated. It is usually cut into pieces several inches in length, or into thin transverse slices, for pharmaceutical use.

Description.—Gentian root is accordingly usually seen in nearly cylindrical pieces of varying length and thickness, but seldom more than an inch in diameter. The roots, which differ in appearance from the rhizomes, are of a yellowish-brown colour, and much shrivelled and wrinkled longitudinally. They are tough and flexible when slightly moist, but when quite dry they are brittle. They break with a very short fracture, and internally are usually of a reddish-brown colour and spongy. The transverse section exhibits a dark line (cambium) separating a rather thick bark from a large central portion (wood) in which vascular tissue can with difficulty be discerned, as, like the bark, it consists almost entirely of parenchyma; neither bark nor wood exhibits any radiate structure.

The rhizome is easily distinguished from the root by the absence of conspicuous longitudinal wrinkles, and the presence of close, transverse annulations. It often exceeds the root in diameter, and may attain a length of a foot or more. Each transverse annulation represents a year's growth, and bears the scars of fallen leaves, the minute fibro-vascular bundles of which are evident under a lens. The rhizome, which occasionally branches, is usually crowned with a large bud protected by dry, scaly leaves.

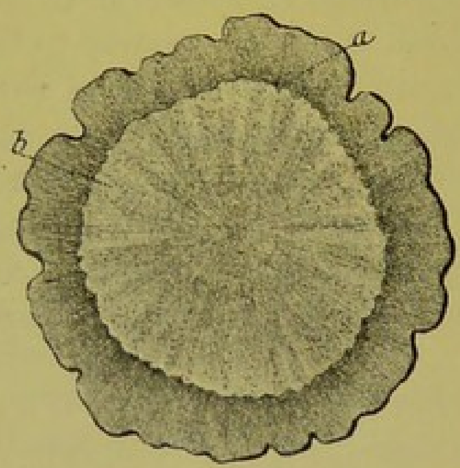


FIG. 177.—Gentian root. Transverse section. *a*, bark; *b*, wood. Magnified 2 diam. (Berg.)

Roots that have been longitudinally sliced before they were dried frequently exhibit transverse instead of longitudinal wrinkles, and are paler internally; otherwise they correspond to the description given.

Both roots and rhizome have the same distinct and characteristic odour, and a sweetish, afterwards agreeably bitter, taste.

The student should observe

(*a*) The *uniform yellowish-brown colour*,
(*b*) The *longitudinal wrinkles of the root*, the *transverse annulations and leaf scars on the rhizomes*,
(*c*) The *absence of any evident structure in the transverse section*,
(*d*) The *absence of starch* (see below).

Constituents.—Gentian root contains a crystalline, bitter glucoside, *gentiopicrin*, a pale yellow crystalline substance, *gentisin*, which in contact with alkalies strikes a yellow colour, *mucilage*, and a sugar, *gentianose*; the latter, however, is present only in the fresh root, being apparently changed to an uncrystallisable modification during the drying of the root.

Noticeable in this root is the absence of starch and of calcium oxalate. Whether the reactions that have been attributed to tannin are to be ascribed to the gentisin is a matter that has not yet been definitely decided.

Varieties, Substitutes, &c.—The roots of other species of gentian are often collected and dried; *Gentiana purpurea*, Linn. (Switzerland &c.), *G. pannonica*, Scop. (Austria), *G. punctata*, Linn. (Austria), all yield gentian roots. They are, however, all smaller than those of *G. lutea*. The roots of *G. purpurea*, which approach nearest to the official gentian, attain about half the size and are crowned with several (eight to ten) aerial stems clothed below with many scaly remains of leaves. The top of the root has thus a peculiar branched appearance never found in the root of *G. lutea* (Pharmacographia). All these species appear to possess similar properties.

Uses.—Gentian is a favourite bitter tonic.

ALKANET ROOT

(Alkanna Root, Radix Anchusæ)

Source &c.—Alkanet root is obtained from *Alkanna tinctoria*, Tausch. (N.O. *Boragineæ*), a small herbaceous plant with perennial root growing in sandy soil in southern Europe, Hungary, and Asiatic Turkey, our supplies being derived chiefly from *Hungary*.

Description.—The drug consists of deep reddish-purple, simple, tapering root averaging about 6 inches in length, and ½ inch in thickness near the crown, to which slender branches and the remains of leaves are attached; the latter have a purplish colour, and bear numerous bristly hairs.

The root has a very remarkable appearance. The outer layers, which are deeply coloured, easily exfoliate, separating from the wood in large papery flakes or strips; these are soon destroyed, and the exterior of the root is therefore the inner layers of cortical tissue. It is not smooth, but more or less deeply furrowed longitudinally, the furrows being often so deep as to divide the wood into separate woody strands. Cut transversely in the upper part the root exhibits a dark violet spot in the centre of the pith, and a woody ring containing several radiating strands of dense woody tissue separated by large wedge-shaped masses of parenchyma; the bark is yellowish near the wood, but becomes coloured and laminated towards the exterior. From near the crown of the root downwards the violet spot in the centre becomes larger, and the colouring matter in the bark penetrates deeper, until by their union the separation of the strands of wood is complete.

The root when handled stains the fingers red. It has no perceptible odour or taste.

The student should observe

(*a*) The *dark reddish-purple colour of the parenchymatous tissue* and *whitish colour of the wood*,

(*b*) The *hairy remains of the leaves*;

and should cut a root transversely at successive points, noting the gradual separation of the strands of wood.

Constituents.—Alkanet root contains about 5 or 6 per cent. of an amorphous resinous colouring matter, *alkannin*, which is insoluble in water but soluble in alcohol and fixed oils, imparting to them a deep reddish-purple colour, which is changed by alkalies to blue and acids to red. This substance is produced in the parenchymatous cells of the root, first in the bark and then in the medullary rays. As the formation of the resin proceeds the cells perish, and thus the cork is exfoliated, and the wood wedges in the root become separated from one another by the destruction of the medullary rays. Thus the remarkable appearance of the commercial drug is explained.

Varieties.—Many other plants furnish roots containing a similar red colouring matter, e.g. *Onosma echioides*, Linn. (S. Europe), *Macrotamia cephalotes*, DC. (Armenia and Syria), &c.; they are occasionally substituted for the root of *Alkanna tinctoria*, that of the latter being apparently more than half as rich again in colouring matter. Both of these substitutes are larger than alkanet root.

SCAMMONY ROOT

(Radix Scammoniæ)

Source &c.—Scammony root is obtained from *Convolvulus Scammonia*, Linn. (N.O. *Convolvulaceæ*), a twining plant indigenous to the *eastern Mediterranean*, and resembling the common bindweed but much larger. It produces a root, often of very considerable size, from which a number of slender aerial stems spring. The root, which yields by incision the gum-resin scammony, is collected and dried.

Description.—Scammony root is usually simple and often of large size. Small roots measure about 1 inch in diameter and 6 to 12 inches in length, but larger specimens attain as much as 3 or 4 inches in thickness and 2 or 3 feet in length; they are nearly cylindrical in shape, tapering gradually towards the tip but slightly enlarged at the crown, and there rugged from scars

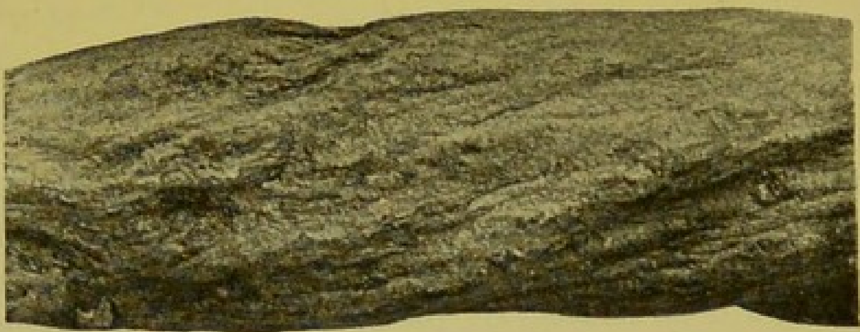


Fig. 178.—Portion of a small Scammony root. Natural size.

left by the aerial stems. The drug is of a greyish-brown colour, hard, heavy, and woody, rough and furrowed externally, and often spirally twisted. Lateral rootlets occasionally spring from it and commonly split into fibrous strands. It breaks with an irregular fracture, from which short fibres (strands of wood) project. Internally the root is whitish, and the transverse section, when smoothed, exhibits an abnormal and characteristic structure. There is no distinct central wood, but the root exhibits instead several not very well defined circles, in each of which a central portion containing groups of vessels can be distinguished from a surrounding parenchymatous portion; in the latter numerous dark points (resin cells) can be discerned with a lens. The root is invested with a thin bark, which however is not very conspicuous.[1] The whole of the parenchymatous tissue contains starch.

The root has a characteristic odour distinctly recalling that of jalap, and especially noticeable when the surface is freshly cut; the taste is sweetish and slightly acrid.

The student should observe

(*a*) The *large size and greyish-brown colour*,
(*b*) The *characteristic jalap-like odour*,
(*c*) The remarkable *structure of the transverse section*,
(*d*) The *presence of resin cells*;

and should compare the root with belladonna, which is usually smaller, darker externally, odourless, and has an entirely different structure.

Constituents.—Scammony root contains about 5 per cent. of a glucosidal *resin* which can be isolated by mixing a strong tincture with water, washing and drying the precipitated resin. The latter should be entirely, or almost entirely, soluble in ether, and in this respect differs from the resin obtained in a similar manner from jalap, which is only partially (not more than 10 per cent.) soluble in that menstruum. The purified resin, scammonin, can be obtained as a white powder which is converted by alkalies into scammonic acid, together with other organic acids. Scammonic acid yields by hydrolysis with mineral acid scammonolic acid and sugar (Kromer, 1895). It is identical with the resin from *Ipomœa orizabensis*, Leden., and probably with the ether-soluble resin of jalap, although the latter point is not yet definitely established.

The fact that from scammonic acid sugar can be obtained indicates the glucosidal nature of the resin. Scammonin itself boiled with mineral acids yields scammonol (the anhydride of scammonolic acid), valerianic acid, and a sugar (Kromer 1892).

Scammony contains also *sugar* and *starch*; the latter is in grains of characteristic appearance, an important fact, as it is sometimes necessary in examining scammony to distinguish the starch of the scammony root from other starches that may possibly have been fraudulently added.

Uses.—Scammony root is employed only as a source of scammony resin, which can be more economically prepared from the root than from the expensive gum-resin.

[1] For further anatomical details see Planchon and Collin, *Les Drogues Simples*, i. 623.

JALAP

(Radix Jalapæ)

Source &c.—Jalap is obtained from *Ipomœa Purga*, Hayne (N.O. *Convolvulaceæ*), a plant with climbing, twining stems indigenous to the *eastern slopes of the Mexican Andes.* It sends out slender runners which are provided at intervals with scaly, cataphyllary leaves in the axils of which are buds; below the buds roots are produced which sometimes remain fibrous, but often thicken rapidly and form tuberous, fusiform or napiform organs that taper gradually below and finally divide into slender ramifications.

These tuberous roots (tubercules) are collected and dried in nets over fires, the smaller entire, but the larger longitudinally incised to allow of the free escape of moisture. When fresh they are fleshy and white internally, but by drying, especially n the manner indicated, they darken in colour. The jalap plant has been cultivated with success in India and Jamaica. Although these colonies do not at present compete with Mexico in the supply of the drug, there is no reason why they should not do so; the plant grows freely, and has been found to yield, with suitable manuring, roots with a high percentage of resin. At present the drug is imported from the east coast of Mexico, and distinguished as 'Mexican' or 'Vera Cruz' jalap.

The Spaniards became acquainted with this and similar purgative convolvulaceous plants early in the sixteenth century, and exported considerable quantities of them to Europe.

Description.—Jalap occurs in pieces of very varying size, most commonly about that of an egg, although sometimes they attain several inches in diameter. They vary also much in shape, being sometimes napiform, sometimes fusiform or irregularly oblong. The small are usually entire, but the larger bear gashes that have been made to facilitate the drying. Towards the lower extremity they taper off and show a fractured end where the slender part of the root has been broken off. The surface is dark-brown, furrowed and wrinkled (but not prominently convoluted), and marked with numerous, paler, elongated transverse scars (lenticels). They are heavy and compact, and so hard as to be broken with difficulty. Internally they have a yellowish-grey or dingy-grey colour, and are very tough or horny, the section exhibiting irregular dark lines often concentrically arranged. These concentric lines should not be confused with annual rings; they are due to the formation of secondary cambiums, in more or less regular concentric rings, an abnormal development that is occasionally, although not often, met with. Under the lens numerous dark resin cells are visible, especially in the cortical portion, but woody tissue is not easily discerned.

FIG. 179.—True Jalap root. Small specimen, natural size, showing the transverse lenticels.

It has a distinct and characteristic odour which is often ascribed to the smoke from the fire over which the roots have been dried, but which is, partly at least, inherent in the drug. The taste is at first sweetish, but afterwards disagreeably acrid.

The heat to which the drug is subjected during the drying is generally sufficiently high to gelatinise the starch, especially in the interior of the roots where the moisture is retained longer than in the outer portions; hence the horny and not starchy appearance of the drug. Roots obtained from cultivated plants in India and Jamaica are usually more carefully dried, and present a mealy, not horny, appearance in the interior.

Constituents.—Jalap contains as principal constituent a *resin* which can be isolated by extracting the root with alcohol, adding water, evaporating, and washing the residual resin with water (*Resina Jalapæ*, B.P.)

Other constituents of jalap are *sugar* and *starch*. Oxalate of calcium is present in the form of cluster crystals, a character that is useful in distinguishing jalap from other undetermined convolvulaceous roots that are occasionally mixed with it, in which the calcium oxalate is present in the form of acicular needles.

The resin separated as above described is not a homogeneous substance, but a mixture of two distinct resins, one of which, constituting not more than 10 per cent. of the total, is soluble in ether, the remainder (about 90 per cent.) being insoluble. The composition of the resin and properties of the constituents are important points, as they form a valuable means of distinguishing the resin from other resins, such as scammony resin, which are soluble in ether, and of indicating the absence of such ether-soluble resins.

The resin insoluble in ether has been termed convolvulin; it has been obtained as a white powder soluble in alcohol but insoluble in ether. Alkalies convert it into convolvulinic acid, together with other organic acids; convolvulinic acid is hydrolysed by mineral acids yielding convolvulinolic acid and a sugar.

Whether the resin soluble in ether is identical with scammony resin or not has not yet been definitely proved.

Good jalap should yield not less than 10 per cent. of resin when treated by such a process as that outlined above. Much of the drug that at present reaches the market contains considerably less, and its exclusion from use in making the official preparations of jalap is ensured by the minimum requirement of 10 per cent. adopted by the Pharmacopœia. On the other hand there seems to be little doubt that the quality of the drug has deteriorated during the last twenty-five years, from 12 to 18 per cent. being formerly the usual amount of resin contained in it. Under exceptional circumstances the quantity has risen in roots cultivated in India to upwards of 20 per cent.

Uses.—Jalap is a powerful stimulant of the intestinal secretion, producing in small doses a laxative effect, and in large doses active purgation. It is much used as a hydragogue cathartic.

Varieties.—*Tampico jalap* is afforded by *Ipomœa simulans*, Hanbury, a plant resembling *I. purga* and growing on the eastern slopes of the Mexican Andes. The roots are exported from Tampico, a town on the Gulf of Mexico, about 200 miles north of Vera Cruz, whence it derives its name. This root, which frequently appears on the London market, is distinguished by its irregular shape and remarkable, convoluted surface, which does not exhibit the small transverse scars characteristic of true (Vera Cruz) jalap. It yields about 10 per cent. of resin, which is distinguished from the resin of true jalap by its complete solubility in ether. This resin (tampicin) is probably identical with the ether-soluble resin of jalap and scammony (scammonin).

Orizaba jalap, also known as light, woody, or male jalap, is produced by *Ipomœa orizabensis*, Leden. The drug, which seldom appears on the English market, occurs in irregular rectangular or block-like pieces, evidently portions of a very large root divided longitudinally and transversely. Sometimes it is more like true jalap, being in entire roots of smaller size, spindle-shaped, not spherical. From jalap it is easily distinguished by its radiated transverse section and the numerous thick bundles of vessels which project as woody fibres from the fractured surface (Pharmacographia.)

FIG. 180.—Tampico Jalap root. Natural size.

The root yielded 11·8 per cent. of resin, which Kromer has recently proved to be identical with the ether-soluble resin of scammony (scammonin).

BELLADONNA ROOT

(Radix Belladonnæ)

Source &c.—The deadly nightshade, or belladonna, *Atropa Belladonna*, Linn. (N.O. *Solanaceæ*), is a tall branching herb, attaining a height of 5 feet or more. It is widely distributed over central and southern Europe; in England it is confined chiefly to the southern counties, but is cultivated in Bedfordshire, Hertfordshire, and elsewhere, and it is grown for medicinal use in Germany also.

Belladonna possesses a stout, branching, tap root which for medicinal use should be collected in the autumn when about three or four years old, cut into pieces, and carefully dried. The commercial drug, much of which is imported from Germany, is often of inferior quality.

Description.—Good root, as found in commerce, occurs in pieces varying from 6 to 12 inches in length, and from $\frac{3}{8}$ to $\frac{3}{4}$ inch in diameter. It is of a pale greyish-brown colour, and finely wrinkled longitudinally, usually cylindrical or gradually tapering, and often crowned with the remains of hollow aerial stems. Sometimes the roots are cut longitudinally to facilitate drying. They break with a short fracture, and should be whitish and starchy internally. The smooth section exhibits

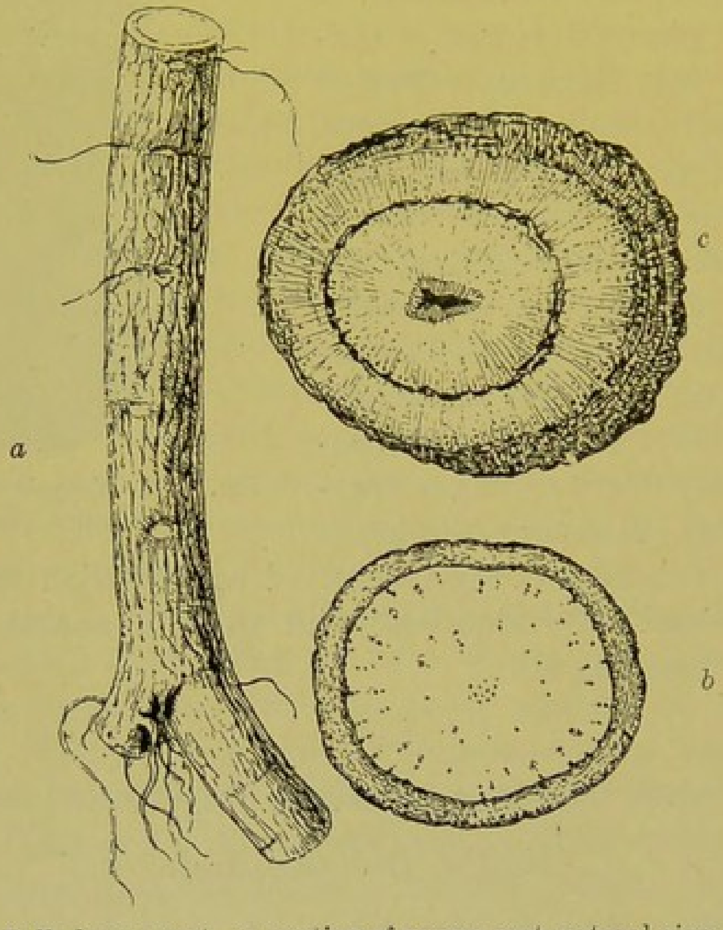


FIG. 181.—Belladonna root. *a*, portion of young root, natural size; *b*, transverse section of the same, magnified; *c*, transverse section of the upper part of the root, magnified. (Holmes.)

a greyish bark separated by a dark line (cambium) from a whitish central portion (wood) in which, especially near the cambium ring, dark groups of vessels and fibres are scattered; these groups, however, seldom exhibit more than an indistinctly radiate arrangement except close to the crown of the root, where one or more rings of radiate yellowish wood may be found, the root passing imperceptibly into rhizome. The bark is not fibrous, and adheres closely to the wood. Most of the parenchymatous cells of both bark and wood contain small compound starch-grains, and some of them are filled with numerous very minute crystals of calcium oxalate; these characters, visible only under the microscope, serve as additional means of identifying belladonna root.

Old roots become woody, and may then exhibit a prominently radiate structure, whilst roots gathered in spring contain sugar and but little starch, and hence show a shrunken outer surface and a dark-coloured, spongy interior. In both cases the drug contains less alkaloid than the young root collected in the autumn and possessing the characters given.

Notwithstanding the fact that the preparations of belladonna root are standardised, the official description is framed so as to exclude such old or partially exhausted roots.

The root has an odour recalling liquorice root, and a slightly bitter taste.

The student should carefully observe

(*a*) The *firm, plump appearance* of typical belladonna root,
(*b*) The *short, mealy fracture*,
(*c*) The *dark cambium line*, and *distribution of the groups of vessels and fibres*;

and should compare the root with

(i) *Elecampane root*, in which oil glands are present, and the groups of vessels inconspicuous,
(ii) *Scammony root* (small pieces), which have a very characteristic structure,
(iii) *Marshmallow root*, which has a radiate wood, in which scattered groups of vessels are not visible, and a fibrous bark.

Constituents.—The principal constituents of belladonna root are the alkaloids that it contains. The chief of these are *hyoscyamine* and *atropine*, the former constituting the majority; indeed it appears doubtful whether atropine is contained pre-formed in the root at all. Hyoscyamine changes so readily into its isomer atropine as to render it quite possible, if not probable, that the small proportion of atropine found has been produced in this way during the process of extraction. Traces of *scopolamine* appear also to be present, but belladonnine and apoatropine, which are found in the mother liquors from which the other alkaloids have been crystallised, probably do not exist as such in the root, but are formed during the various manipulations in the course of their isolation.

The root also contains β methyl-æsculetin, a crystalline fluorescent principle widely distributed throughout the natural order *Solanaceæ*, and found also in gelsemium rhizome.

The total amount of alkaloid that the root contains varies as a rule between 0·4 and 0·6 per cent., but may occasionally rise to 1·0 per cent. (Cripps). Gerrard has shown that the plant is more active when about four years old than when younger, and that the wild plant is rather richer in alkaloid than the cultivated, while Schmidt's experiments prove that the roots of young plants contain more alkaloid than those of old plants. The Pharmacopœia therefore directs the root to be collected in the autumn, and excludes old roots by the limitation of the size and by the description of the transverse section.

Uses.—Belladonna acts as a local anæsthetic and anodyne, and is often applied as such externally. Internally it is given to check the sweating in phthisis, as a sedative to the respiratory nerves, to relieve spasmodic cough, and in numerous other cases.

SASSAFRAS ROOT

(Radix Sassafras)

Source &c.—The sassafras, *Sassafras officinale*, T. Nees and Eberm. (N.O. *Laurineæ*), is a tree of medium size, widely distributed over the *eastern United States*, extending from Canada southwards to Florida. All parts of the plant secrete in special cells an aromatic volatile oil, but this is especially the case with the bark of the root, which is therefore to be regarded as medicinally the most active, although the entire root is official in the British Pharmacopœia.

Description.—The tree produces large, woody, branching roots covered with a dark reddish or greyish-brown spongy bark, from which, however, they are often partially freed, the bark constituting in America a separate article of trade, and realising, on account of its greater fragrance, a higher price than the wood. The latter is greyish-yellow or greyish-red in colour, soft, and easily cut; it exhibits in transverse section distinct annual rings traversed by fine, dark, medullary rays and containing large vessels. Both bark and wood, but especially the former, have an agreeable, fragrant odour, and an aromatic, slightly astringent taste.

Constituents.—The root contains about 2 per cent. of *volatile oil*, which is obtained from it by distillation, and employed in large quantities as a perfume and flavouring agent. The bark yields from 6 to 9 per cent.

Uses.—Sassafras is supposed to increase the action of the skin in syphilis and rheumatism, and thus to be an alterative, but its physiological action is not definitely known.

SARSAPARILLA

(Radix Sarzæ, Radix Sarsaparillæ)

Source &c.—Several varieties of sarsaparilla are imported more or less regularly into this country, but only one, that known as Jamaica sarsaparilla, is official in the British Pharmacopœia. This drug is obtained from *Smilax ornata*, Hook. f. (N.O. *Smilaceæ*), a climbing plant with woody stem springing from a stout, knotty rhizome and ascending lofty trees. From the rhizome slender cylindrical roots are thrown off horizontally and creep for many feet a few inches below the surface of the earth. In collecting the roots they are first laid bare and then cut off near the rhizome. After they have been dried they are made into bundles.

The plant is a native of *Central America* (Costa Rica), not, as would appear from the name of the drug, of Jamaica. The root was formerly exported viâ Jamaica, hence the designation 'Jamaica' sarsaparilla, but it is now sent chiefly to New York, and thence to England.

Description.—Jamaica sarsaparilla occurs in bundles about 18 inches long and 4½ inches in diameter, weighing about two pounds. Each bundle consists of numerous long, slender roots about ⅛ inch in thickness, doubled up and bound loosely with one of the same roots. These usually have a dark reddish-brown colour, are much shrunken and furrowed longitudinally, and bear tolerably numerous branching rootlets. They are tough and flexible, not breaking easily even when bent double. The transverse section exhibits a narrow, dark reddish-brown bark surrounding a central stele, which consists of a ring of yellowish wood with large radially arranged vessels and a white starchy pith.

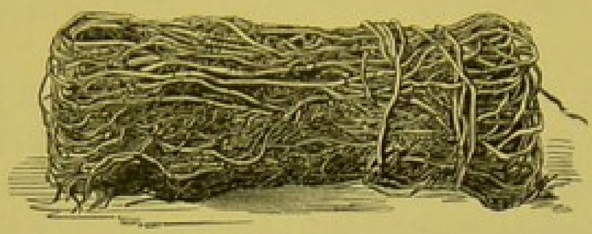


FIG. 182.—Bundle of Jamaica Sarsaparilla. Reduced. (Pereira.)

The characters of the root are, however, somewhat variable, and it is not difficult to find roots that are paler in colour, less shrunken and more starchy than those described; even the same root may vary at different points. But the dark reddish-brown colour, the shrunken bark, the presence of fibrous rootlets (technically known as 'beard') are regarded as important characters of good Jamaica sarsaparilla. The bundles are always free from the rhizome ('chump').

The drug has no odour, and only a slightly bitter taste.

The student should observe

(*a*) The *dark red shrunken bark, which does not exhibit transverse cracks,*
(*b*) The *numerous wiry rootlets,*
(*c*) The *transverse section,*

and should compare the drug with Indian sarsaparilla (*Hemidesmus indicus*, R.Br.), which is marked with transverse cracks, is rigid and tortuous, and has a distinctive aroma.

Constituents.—Three substances, all belonging to the sapotoxin group, have been isolated from sarsaparilla, viz. *parillin* (formerly called smilacin), *smilasaponin* (recently also called smilacin), and *sarsasaponin*. Of these three parillin and sarsasaponin have been obtained in a pure crystalline form, smilasaponin being amorphous. They are all glucosidal, and all produce salivation, vomiting, and diarrhœa, but sarsasaponin is the most active (Schulz, 1896). The drug contains also varying quantities of starch.

Uses.—Sarsaparilla has been administered as an alterative in syphilis, chronic skin diseases, and rheumatism, but great diversity of opinion exists as to its therapeutic value.

Varieties.—Several other varieties of sarsaparilla are imported into the English market; the following are the most important:

1. *Honduras Sarsaparilla*, the botanical origin of which is unknown. The drug is imported from British Honduras in bundles about 30 inches long and 2 or 2½ inches wide, much longer and narrower therefore than the bundles of the Jamaica variety; they are sometimes closely whipped round or sometimes loosely bound with a long root. The roots are distinguished from those of the Jamaica variety by their pale yellowish or brownish colour, and by their less shrunken, more plump

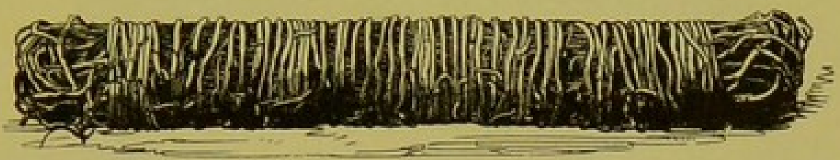


FIG. 183.—Bundle of Honduras Sarsaparilla. Reduced. (Pereira.

and starchy appearance; they have generally fewer rootlets attached and are always free from rhizome. The section exhibits a pale, starchy bark, usually thicker than that of Jamaica sarsaparilla, but a similar stele.

This variety is largely used on the continent, where it is generally preferred. Sarsaparillas rich in starch, as Honduras sarsaparilla, are sometimes termed 'mealy' or 'gouty,' whilst those that, like Jamaica sarsaparilla, contain little starch are termed 'lean.'

2. *Lima Sarsaparilla* is imported in bundles about 2 feet long and 5 or 5½ inches in diameter, loosely folded and bound with a root. This drug shows a close resemblance to Jamaica sarsaparilla, and indeed can only be distinguished with certainty by the different packing and by the anatomical characters of the cells of the endodermis and exodermis, which in certain cases constitute a most valuable means of identifying and distinguishing these drugs.

3. *Guayaquil Sarsaparilla* is imported in flattish bundles about 21 inches long and 6 inches wide, containing the knotty rhizome and portions of the stout, round aerial stems. Sometimes the root is imported loose in bales.

Guayaquil sarsaparilla has a mahogany brown colour, and is usually larger than Jamaica; it is not so much furrowed nor has it such numerous rootlets.

4. *Vera Cruz* or *Mexican Sarsaparilla* is obtained from *S. medica*, Schl. et Cham. Both rhizome and roots are collected

and dried, the drug not being made up into bales. It consists of a number of rhizomes to each of which are attached numerous straight roots laid together. The latter have a dull greyish-brown colour and are much shrunken. Like Lima sarsaparilla the variety is well characterised by the form of the cells of the endodermis and exodermis.

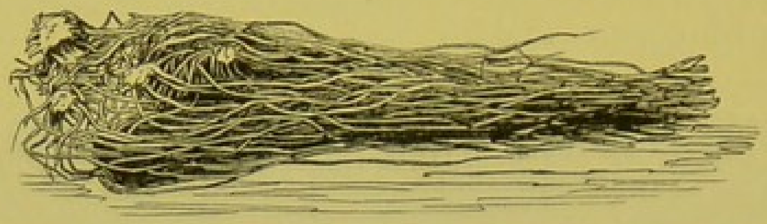


FIG. 184.—Bundle of Vera Cruz Sarsaparilla. (Pereira.)

5. *Native Jamaica Sarsaparilla* is obtained from plants presumably of *S. officinalis*, H.B. & K., cultivated on the island of Jamaica. This truly Jamaica sarsaparilla, commercially known as 'native' Jamaica, must be carefully distinguished from the ordinary Jamaica (or, better, Costa Rica) sarsaparilla. It arrives packed loose in bales, and is of a pale reddish or greyish-brown colour. The root bears scattered, rather stout rootlets, and exhibits in transverse section a pale bark separated by a distinct line from a rather darker stele. These characters sufficiently distinguish 'native' Jamaica sarsaparilla from the Costa Rica drug.

There is at present no evidence to show which of these numerous varieties is the most active, and the determination, even if only approximate, of the relative amounts of sarsa-saponin (the most active constituent) contained in each would afford a much-needed indication of the variety that should be medicinally preferred

SECTION X

HAIRS, GLANDS &c.

STARCH

Source.—The official varieties of starch (Amylum, B.P.) are those obtained from wheat, *Triticum sativum*, Lam., from maize, *Zea Mays*, Linn., and from rice, *Oryza sativa*, Linn. (N.O. *Gramineæ*). Wheat is largely cultivated in temperate climates, whilst maize and rice are grown chiefly in warmer or subtropical countries.

In preparing the starch from the fruits, it is essential in the first place that the cells containing it should be ruptured in order to liberate the starch-grains, and in the second place that the starch-grains thus liberated should be separated from other matters, both soluble and insoluble, that accompany them, especially from the nitrogenous gluten which often clings to them pertinaciously. The cells are ruptured by grinding the softened grain to a pulp, and the gluten is removed by one of these processes, viz.:

(*a*) A mixture of crushed grain and water is allowed to undergo putrefactive decomposition; the gluten is destroyed, lactic, acetic, and other acids being simultaneously formed; these can be removed by washing.

(*b*) The crushed grain is mixed with a dilute solution of caustic soda by which the gluten is dissolved.

(*c*) The grain is crushed and mixed with water to a dough from which the starch-grains are washed by kneading it in a stream of water, leaving a mass of gluten behind.

The starch is purified by washing, straining, and allowing the milky liquid containing starch-grains in suspension to settle, by which a more or less complete separation into pure starch and starch mixed with varying amounts of cell-débris is effected. It is finally dried, during which the moist mass gradually splits up into angular fragments. These are then ground to form starch powder

From whatever source starch is obtained it forms either a fine white powder, or angular or columnar masses easily reducible to powder. It is inodorous and quite insoluble in water, to which it should impart neither acid nor alkaline reaction. It leaves, when incinerated, only traces of ash. Boiled with water and cooled it gives a cloudy, more or less gelatinous mixture, which is coloured deep blue by solution of iodine.

Although the different varieties of starch show certain differences in the temperature at which they gelatinise, the chief means of distinguishing them and ascertaining their freedom from admixture lies in the examination with the microscope.

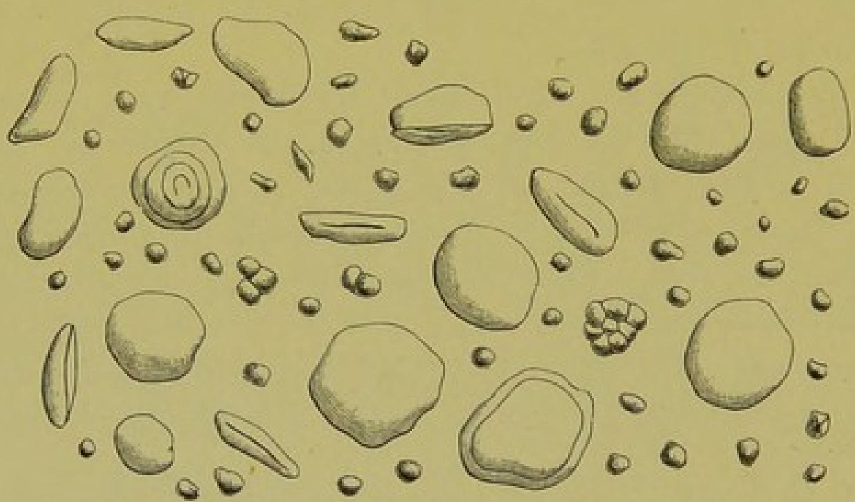


FIG. 185.—Wheat Starch. Magnified 300 diam. (Tschirch.)

Wheat Starch consists of large and small grains mixed together, with few intermediate in size; the former are lenticular in shape and sometimes marked with faint concentric rings. The hilum is central but not conspicuous. The larger of the large grains average about 30 to 38 micromillimetres [1] in diameter, the smaller of the large grains 15 to 25, whilst the small grains average 6 to 7.

Maize Starch consists of grains that are nearly uniform in size and rather smaller than the large grains of wheat starch (10 to 25 micromillimetres); they are polygonal, with blunt

[1] A micromillimetre is the one-thousandth part of a millimetre.

angles or more or less rounded. In the centre there is often a small cleft, or two or three radiating from a centre (the hilum).

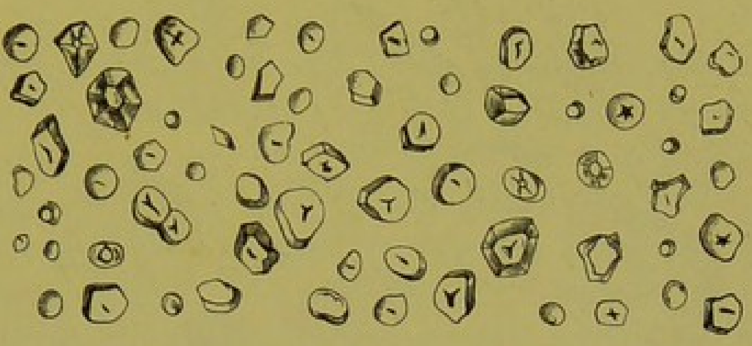


FIG. 186.—Maize Starch. Magnified 300 diam. (Tschirch.)

Rice Starch consists of extremely minute grains, averaging about 4 to 6 micromillimetres in diameter. They are poly-

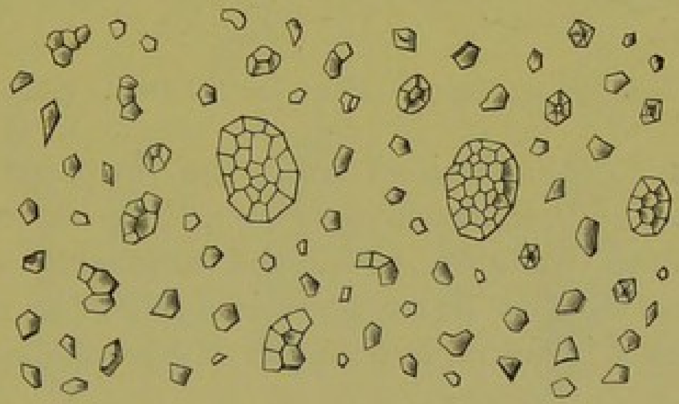


FIG. 187.—Rice Starch. Magnified 300 diam. (Tschirch.)

gonal, with sharp angles, and without evident concentric striæ, hilum, or cleft.

Varieties.—The following varieties of starch, although not official, are sufficiently important to call for remark.

Potato Starch, obtained from the tubers of *Solanum tuberosum*, Linn. (N.O. *Solanaceæ*), is extensively employed for various technical purposes and has been frequently used to adulterate maranta starch and other drugs.

The grains are much larger than those of any of the official starches, varying mostly from 45 to 75 micromillimetres in length and from 45 to 60 in breadth; larger grains may occasionally be found and smaller ones are by no means uncommon. They have usually a flattened ovoid shape and possess a small hilum that is often situated near the *narrow* extremity of the grain, whilst the broad end frequently exhibits a sinuate outline; the concentric striæ are well marked.

FIG. 188.—Potato Starch. Magnified 300 diam. (Tschirch.)

Maranta Starch, obtained from the rhizomes of *Maranta arundinacea*, Linn. (N.O *Marantaceæ*), is known in commerce as St. Vincent, Bermuda, and Natal arrowroot, or simply as arrowroot, but as the latter term is applied to a number of other starches it is desirable that this, the arrowroot of English

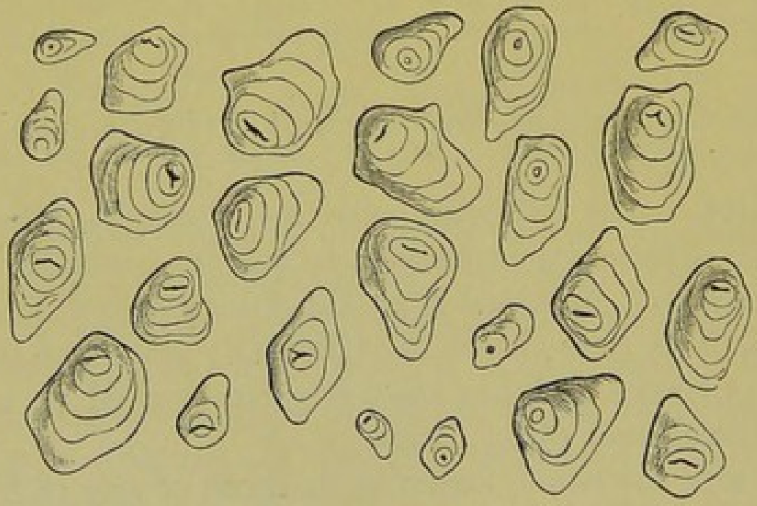


FIG. 189.—Maranta Starch. Magnified 300 diam. (Tschirch.)

commerce, should be specified as maranta starch. Thus the starch of *Curcuma angustifolia*, Roxb., and *C. leucorhiza*, Roxb. (N.O. *Scitamineæ*), is known as East Indian arrowroot; that of

Manihot utilissima, Pohl (N.O. *Euphorbiaceæ*), and that of *Ipomœa Batatas*, Chois. (N.O. *Convolvulaceæ*), as Brazilian arrowroot; that of *Canna edulis*, Edw., and other species of *Canna* (N.O. *Scitamineæ*) as Queensland arrowroot, &c.

The grains of maranta starch resemble in general appearance those of potato starch, but they are as a rule decidedly smaller, measuring only 30 to 45 millimetres in length and 24 to 30 in breadth. They are rather irregularly ovoid in shape and exhibit distinct concentric striæ. The position of the hilum is usually indicated by a cleft or by three or four radiating fissures, and in the majority of grains is near the broad end. The size of the grain, the character and position of the hilum sufficiently distinguish this starch from potato starch, which it otherwise resembles.

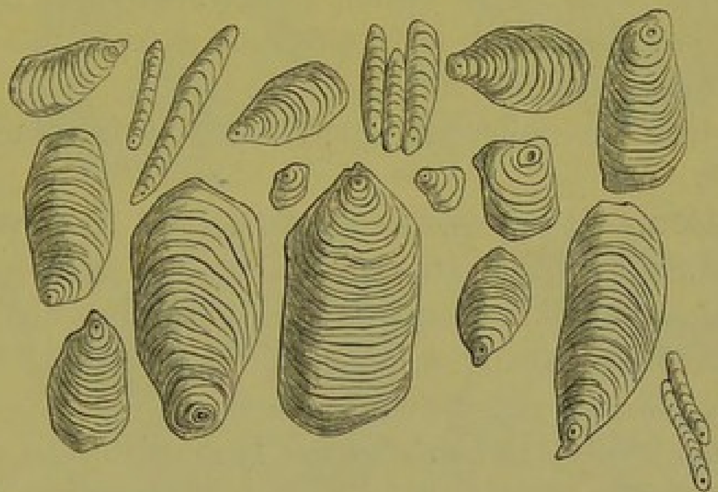


FIG. 190.—Curcuma Starch. Magnified 300 diam. (Tschirch.)

Curcuma starch from the rhizomes of *C. angustifolia*, Roxb., and *C. leucorhiza*, Roxb. (N.O. *Scitamineæ*), is known as East Indian arrowroot and is largely used in India, although it does not find its way, to any great extent, to this country.

The grains average about 36 to 60 micromillimetres in length, although both larger and smaller ones may be found. They vary considerably in shape, but typical ones are of an elongated ovate outline. The hilum is situated in a little projection from the narrow end of the grain and is therefore remarkably eccentric; it is often indistinct, but its position can be found by following the concentric striæ which are usually discernible. The grains are nearly flat, appearing as rods when viewed from the edge.

LYCOPODIUM

Source &c.—Lycopodium consists of the spores of the common clubmoss, *Lycopodium clavatum* Linn. (N.O. *Lycopodiaceæ*), and probably other species. The clubmoss, with its long creeping stems and ascending branches covered with narrow moss-like leaves, is distributed over *Great Britain* and *Europe* generally. It produces fruiting branches covered with small scaly leaves and resembling a slender elongated cone. On the upper surface of these leaves (sporophylls) near the base are small receptacles (sporangia) filled with minute spores. These spores form the drug; they are collected by shaking the fruiting branches over a cloth in which the lycopodium collects as a fine yellow powder which is freed from extraneous matter by passing it through a fine sieve.

Lycopodium is collected chiefly in Russia, Germany, and Switzerland.

Description.—It appears as a pale yellow, fine, very mobile powder that floats when thrown on to the surface of water. Blown into a flame it burns instantly with a brilliant flash, but when incinerated in a crucible it is slowly consumed, leaving only about 4 per cent. of ash.

Examined under the microscope lycopodium is seen to be composed entirely of minute spores, each of which is about 25 micromillimetres in diameter and has the shape of a triangular pyramid with a convex base. The entire surface of the spore is covered by a delicate network of projecting ridges. When crushed the spores burst and a drop of yellowish oil exudes from each.

Constituents.—The spores contain about half their weight of *fixed oil*, which, however, does not make itself evident until the cellular membrane in which it is enclosed is either broken or destroyed. The oil consists principally of oleic, arachic, stearic, and palmitic acids combined with glycerine. *Phytosterin*, *sugar*, and traces of an alkaloid are also present in the drug.

Adulteration.—Lycopodium is frequently adulterated with starch, inorganic substances, sulphur, and with pollen of various kinds, especially that of coniferous trees, which has been

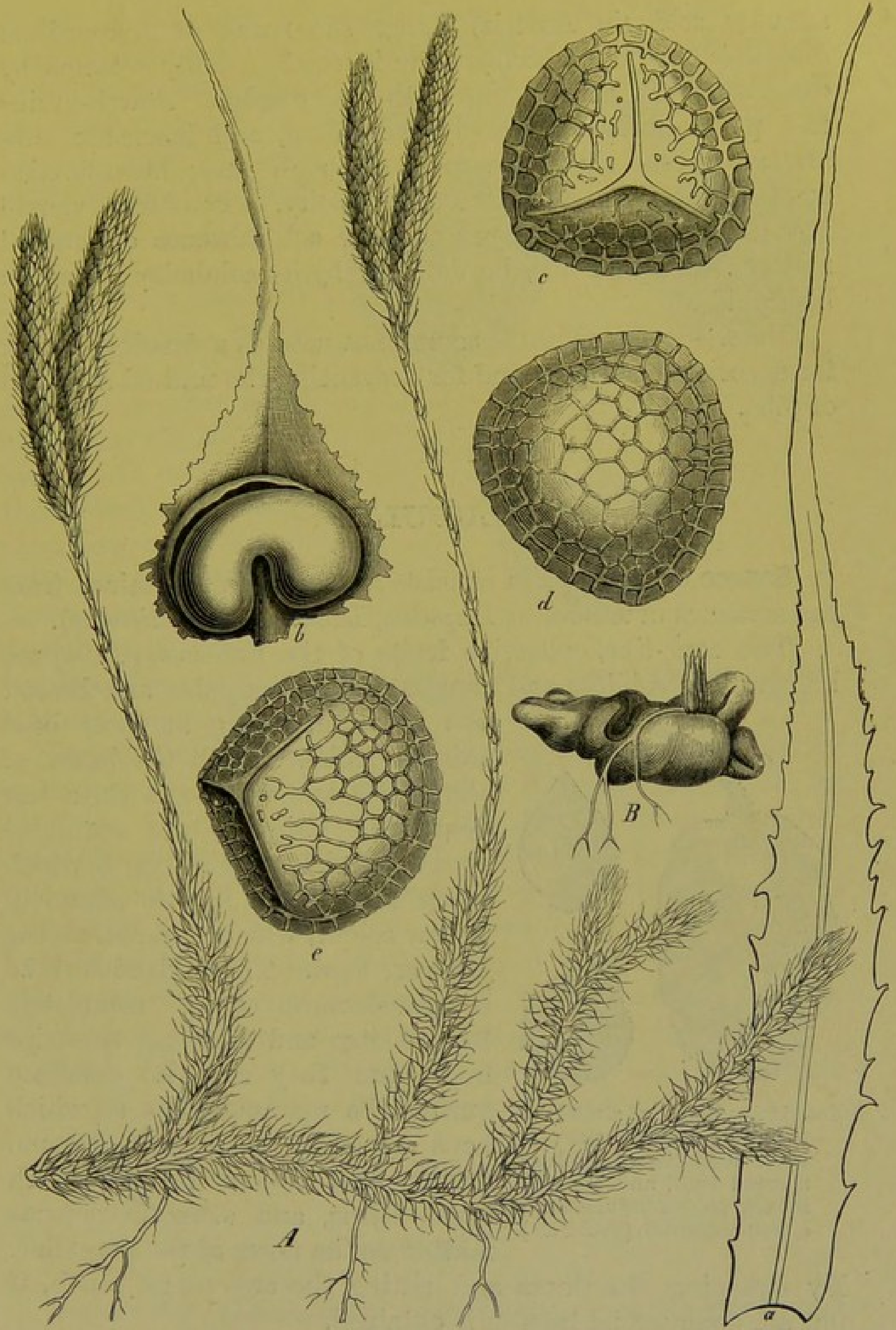


FIG. 191.—Lycopodium. *A*, portion of *Lycopodium clavatum*, natural size: *a*, foliage leaf; *b*, sporophyll with sporangium, magnified; *c*, *d*, *e*, spores, highly magnified. *B*, Prothallium of an allied species. (Luerssen.)

actually sold (in Austria) under the name of *Lycopodium hungaricum*. Such adulteration is usually readily detected by examining the sample under the microscope. Starch-grains and pollen-grains are easily recognised, and inorganic substances reveal their presence, although their identification by this means is a matter of difficulty. The drug should not yield more than 4 per cent. of ash (absence of mineral matter). Sulphur may be detected by its solubility in carbon bisulphide.

Uses.—Lycopodium is sometimes used as a dusting powder for excoriated surfaces and for preventing the mutual adhesion of pills.

LUPULIN

Source &c.—Lupulin consists of the glands obtained from the strobiles of *Humulus Lupulus*, Linn. (N.O. *Urticaceæ*).

The cone-like, collective fruits of the hop (see p. 108) are known as strobiles, and consist of leafy stipules and bracts, the latter enfolding at their base minute fruits. Both the bases of the bracts and the fruits (to a less degree the stipules) are sprinkled over with bright shining glands which when fresh have a pale greenish-yellow colour, which darkens as the hops are kept. These glands can be separated more or less completely by shaking and beating the ripe hops, and they are also detached during the manipulations to which hops are subjected in gathering and drying, and collect together with sand, debris, and other extraneous matter, on the floors of the hop-kilns. By sweeping the floors and sifting the sweepings, much, if not all, commercial lupulin is obtained.

FIG. 192.—Hop. *a*, strobile of the Hop, natural size; *b*, bract enfolding at its base a small fruit, and showing lupulin glands, natural size; *c*, fruit magnified. (Tschirch.)

Description.—Commercial lupulin is a granular, brownish-yellow powder with a strong, hop-like odour and bitter, aromatic taste. Examined under the microscope it is seen to be composed of a number of glands, each of which consists of a hemispherical layer of cells, the cuticle of the concave surface of which has been raised, dome-like, by the secretion of oil or oleo-resin between it and the cell-wall. When burst by pressure, which is very easily effected, the gland discharges a granular oily liquid.

Lupulin is generally very impure, as indeed it must be if it represents simply the sifted sweepings of the hop-floors, but the glands themselves are easily recognised under the microscope, and as easily distinguished from accidental (sand, debris of the strobiles &c.) or intentional impurities.

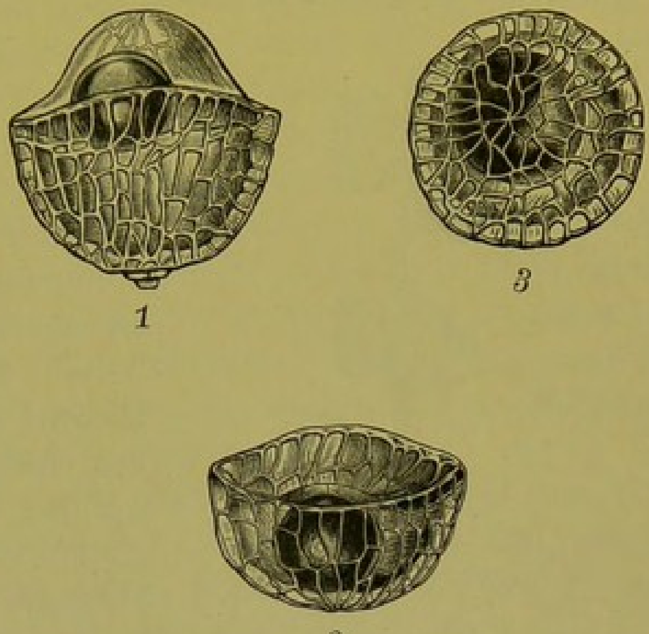


FIG. 193.—Lupulin. 1 and 2, side views; 3, seen from below. Magnified 100 diam. (Vogl.)

Constituents.—Lupulin contains *volatile oil*, *lupamaric acid* (a crystalline, bitter principle), *resin*, *wax*, and *traces of alkaloids*, *volatile acids*, &c. Pure lupulin yields to ether about 70 per cent. of its weight, and affords but little (2·37 per cent., Keller) ash. Commercial lupulin, however, often gives from 20 to 30 per cent. or even more ash, and yields from 39 to 54 per cent. to ether (Ward, 1886). The British Pharmacopœia fixes a maximum of 12 per cent. of ash and a minimum of 40 per cent. of substances soluble in ether.

Use.—Lupulin is occasionally employed as a stomachic tonic, and also as an hypnotic to promote sleep.

KAMALA

Source &c.—Kamala is a drug consisting of the glands and hairs that cover the fruits of *Mallotus philippinensis*, Müller Arg. (N.O. *Euphorbiaceæ*), a small tree widely distributed throughout *India*, Ceylon, the Malay Archipelago, Australia, &c.

The drug, which has probably been used in India for many centuries as a dye-stuff, was known to the Arabian physicians of the tenth century, and at the present time still retains in the Indian bazaars its Arabic name, *wars*. It was introduced into European medicine as a vermifuge about 1858. It is collected chiefly in north-west Provinces of India, in Concan (in the south-west), and Madras.

Fig. 194.—Fruits of *Mallotus philippinensis*. (Vogl.)

The tree produces three-celled capsular fruits about the size of a large pea, and more or less completely covered with a red powder. These fruits are gathered and thrown into a basket, where they are shaken and rubbed with the hands; the red powder covering them is detached, and, falling through the basket, is caught on a cloth placed beneath it. This powder constitutes the drug.

Description.—Kamala is a fine, granular, mobile powder of a dull red or madder colour, without odour and almost tasteless,

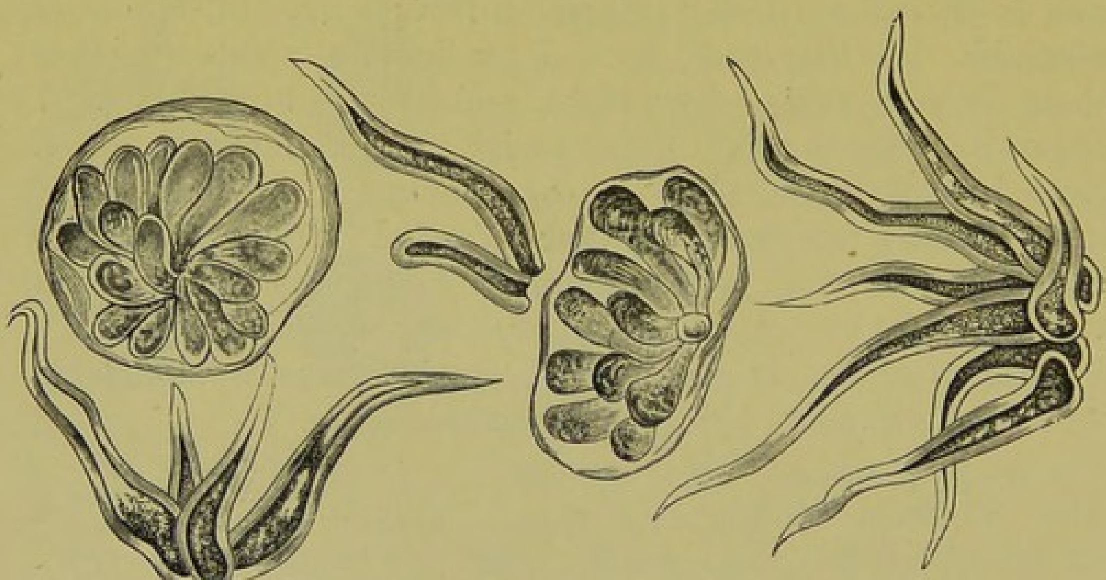


Fig. 195.—Kamala, showing glands with their secreting cells and grouped hairs. Magnified. (Moeller.)

floating when thrown on to the surface of water. Alcohol, ether, chloroform, and caustic alkalies are coloured deep red by it, but water has little action on it. That it is not a homogeneous powder can easily be seen by gently shaking it, when a greyish portion (hairs) will aggregate on the surface.

Examined with the microscope, kamala will, after suitable treatment, be seen to consist of glands and hairs. The former, which are much smaller than lupulin glands, are of a depressed globular shape; they are filled with a deep red resin, and contain a number of club-shaped secreting cells radiating from a common centre. The hairs are thick-walled, curved, and usually arranged in small groups.

Constituents.—Kamala yields to ether a dark brownish, resinous mass from which six different substances have been isolated, viz., *rottlerin* (crystallising in thin, salmon-coloured plates), *isorottlerin* (resembling rottlerin), *two resins*, one of which is red and the other pale yellow, *wax*, and a small quantity of a crystalline *yellow colouring matter*.

If quite pure, kamala yields about 1·5 per cent. of ash, but this amount is usually exceeded by the commercial drug, even when of good quality, from which from 3 to 5 or even 10 per cent. may be obtained.

Adulteration &c.—Kamala is often grossly adulterated with ferric oxide or with a ferruginous sand, inferior qualities of the drug yielding 50 per cent. or even more ash. Substitutes for kamala consisting of ground safflower (florets of *Carthamus tinctorius* Linn.), dyed starch, &c., have been observed, but are easily detected by the microscope.

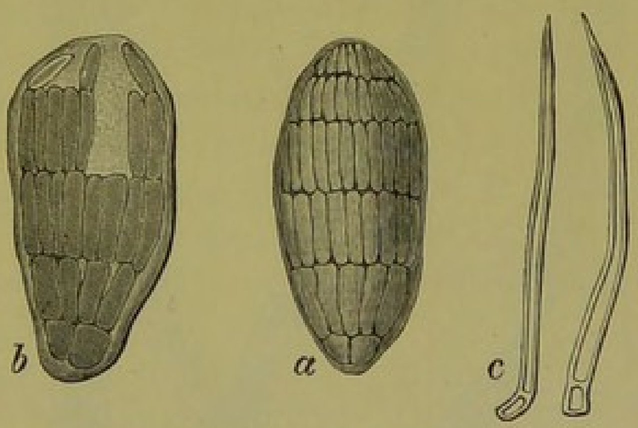


FIG. 196.—Glands (*a* and *b*) and hairs (*c*) of a species of *Flemingia*. Magnified 140 diam. (Vogl.)

True wars or *wurus*, a drug analogous to kamala, is obtained in southern Arabia and Africa from the fruits of a species of *Flemingia* (N.O. *Leguminosæ*). The drug has a dull purplish colour, and is seen under the microscope to consist of glands composed of several tiers of elongated cells (not radiating from a common centre), mixed with which are single (not grouped) hairs; it is therefore easily distinguished from kamala.

COTTON WOOL

ross.
rbaceum.

Source &c.—Cotton wool consists of the hairs of the seed of *Gossypium barbadense*, Linn. (N.O. *Malvaceæ*), and other species of Gossypium.

The cotton plants, of which many varieties exist, are either herbs, shrubs, or small trees. They produce three- to five-celled capsular fruits containing numerous seeds covered with a woolly mass of long white or yellowish hairs. These are separated from the seeds and freed from impurities by machinery specially designed for that purpose.

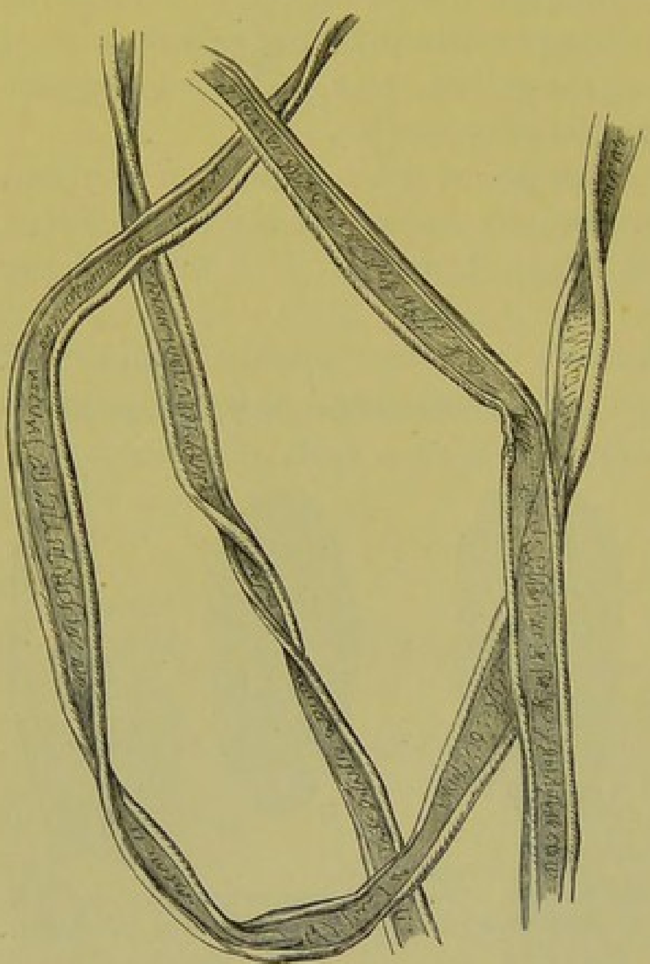


Fig. 197.—Cotton. Magnified. (Tschirch.)

Each of the hairs thus separated is covered with a thin cuticle by which certain waxy and fatty substances are secreted; the presence of these is objectionable, as they repel moisture, and consequently the wool will only slowly absorb watery fluids. To remove them, the cotton wool is usually boiled under pressure with a dilute caustic alkali, after which it is washed and bleached by the action of chlorinated lime and hydrochloric acid. It is again washed and then dried; finally the fibres are loosened by machinery, and separated by a current of air from which they are collected as a fleecy wool. The wool thus freed from the wax and fat naturally present in it possesses much better absorbent properties and is in most cases more suitable as a surgical dressing (absorbent wool).

Description.—Each of the soft white filaments of which cotton wool consists is a single hair from the surface of the seed. They attain as much as 2 inches in length, and appear, when examined under the microscope, as flattened, twisted bands with slightly thickened, rounded edges. Cotton wool should readily sink in water, showing that the waxy coating with which it is naturally provided has been removed, as directed by the Pharmacopœia; it should not, however, communicate to water either an acid or an alkaline reaction, as might be the case if it had not been completely freed from the acids and alkalies commonly used to remove the wax. It should further be inodorous and tasteless, insoluble in water but almost completely soluble in solution of ammonio-sulphate of copper. Solutions of iodine colour cotton wool yellow, which is changed to deep blue by sulphuric acid. It burns easily, leaving less than 1 per cent. of ash.

Constituents.—Cotton wool consists principally of *cellulose* $(C_6H_{10}O_5)_n$, associated with traces of inorganic matter, albuminoids &c. The fatty matter is partly a wax soluble in alcohol and ether, and melting at 86° C., partly a mixture (apparently) of stearic and palmitic acids.

Cotton wool is best identified by microscopic examination. It may be distinguished from animal fibres by being insoluble in hot 8 per cent. solution of potassium hydroxide, by not being stained permanently yellow by a solution of picric acid, and by containing only traces of nitrogenous substances. It differs from many other vegetable fibres by the blue colour it yields with iodine and sulphuric acid, but its ultimate identification can be effected only by the microscope.

GALLS

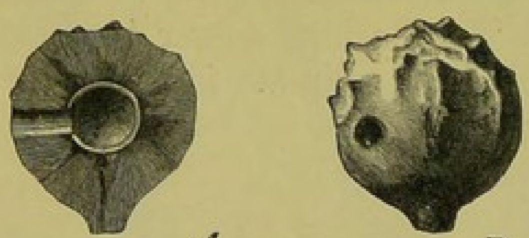
Source &c.—Galls are excrescences on the twigs of *Quercus infectoria*, Olivier (N.O. *Cupuliferæ*), resulting from the puncture and deposition of the eggs of *Cynips Gallæ tinctoriæ*, Olivier. Hymenoptera.

Under the generic term of galls a large variety of excrescences and other abnormal formations are included, that are produced not only upon plants, but also in a few instances upon animals, the exciting cause being either a plant or an animal.

The plants that induce the formation of galls are exclusively fungi, but a large number of animals are capable of producing them, the principal being species of *Cynips* and *Aphis*. Thus the true oak-apple, the bedeguar of the rose, the oak gall, oak spangles, &c., are all varieties of galls produced by various insects.

The British Pharmacopœia limits the term '*Galla*, galls,' to a particular variety of gall produced by a particular insect upon a particular plant. This variety of gall is known commercially as 'Aleppo' galls or 'Turkey' galls; they are collected in Asiatic Turkey, especially in the province of Aleppo.

The female gall-wasp (the male insect is not known) pierces the young twig of the oak nearly to the cambium with her ovipositor and deposits one or more eggs. These increase in size, and in all probability they secrete a particular fluid that provokes the formation of the gall. An abnormal development of tissue now takes place, completely enclosing the eggs or the larvæ hatched from them, lifting them out of the twig and at the same time furnishing them with a certain amount of nutritive material (starch &c.) After the larva has reached maturity it passes into a chrysalis from which the gall-wasp emerges; the latter bores with its mandibles a hole in the gall, and escapes into the air. It is only during the life of the egg or the larva that the gall continues to grow; if by any accident either the egg or the larva perishes, the growth of the gall is at once arrested.



A *B*

Fig. 198.—Galls. *A*, showing interior; *B*, exterior, both with hole bored by the insect. (Vogl.)

Galls should be collected preferably before the insect escapes; after that has happened they become lighter in weight and are less esteemed.

Description.—Aleppo galls are nearly spherical in shape and vary from $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter. They are hard and heavy, and bear, especially in the upper portion, short, bluntly pointed projections. They are of a bluish-green or olive-green colour externally, yellowish or brownish-white within. There is usually a small cavity in the centre, in which the remains of the larva or of the gall-wasp may be found. They have no odour, but an intensely astringent taste followed by a slight sweetness.

Constituents.—Galls contain as principal constituent from -80 ~~50 to 70~~ per cent. of *tannic acid,* which, to distinguish it from other varieties of tannic acid, is best termed gallotannic acid. They contain also a little *gallic acid* (2 to 4 per cent.) and *sugar.*

Uses.—Galls are used medicinally as a local astringent chiefly in the form of suppository or ointment. They find an extensive application technically in tanning and dyeing, in the manufacture of ink, &c.

Varieties.—*White galls* are the galls collected after the escape of the gall-wasp; they are rather larger than the 'blue' galls, rather lighter in weight, and yellowish in colour. They are less esteemed, and are considered to contain less gallotannic acid, which, however, does not from analyses appear always to be the case.

English galls or *oak galls* (sometimes, but erroneously, called 'oak-apples') are smooth, globular, brown in colour, and usually perforated. They are much less astringent than Aleppo galls, the gallotannic acid in them amounting to about 15 to 20 per cent.

Chinese galls are produced by species of *Aphis* on *Rhus semialata*, Murray (N.O. *Anacardiaceæ*); they are of a very irregularly lobed (not spherical) shape, reddish-brown in colour, and covered with a thick, grey, velvety down. They are largely used in the manufacture of gallotannic acid, of which they contain about 70 per cent.

SECTION XI

EXTRACTS AND DRIED JUICES

OPIUM

Source &c.—Opium consists of the dried latex of the opium poppy, *Papaver somniferum*, Linn. (N.O. *Papaveraceæ*). The drug was apparently known in very remote times, as both the Greeks and Romans were well acquainted with it, and with the manner in which it was collected then, as it is now, from the unripe capsule of the opium poppy. The physicians of the Arabian school probably introduced the drug into India as well as into Europe. It was originally used as a medicine, the practice of opium-eating having originated probably in Persia.

Opium is collected principally in *European and Asiatic Turkey*, in *Persia*, *India*, *China*, and in small quantities in Australia. The cultivation of the opium poppy has been experimentally carried on in France, Germany, and other countries, where, however, the expense of the necessary labour and land has been so great as to render it unprofitable, although opium of very high quality has been obtained. Indeed, the highest percentage of morphine ever observed in the drug (22·88) was found in a sample collected near Amiens, in France.

All parts of the plant yield on incision a white latex, but the unripe capsule is especially rich, and from it alone opium is obtained. The wall of the capsule contains an elaborate branching and anastomosing system of laticiferous vessels that accompany generally the fibrovascular bundles; these vessels are filled with a white milky secretion, and, being in open communication with one another, when incised at any particular point a considerable area of the system is drained of its latex.

Although the methods adopted in the different countries for collecting the opium vary in their minor details, the principal features remain the same; in India alone a particular method of treating the opium is adopted. Soon after the petals have fallen, and whilst the capsule is still unripe, being about 1½ inches in diameter, incisions are made in the wall, great care being taken that they do not penetrate to the interior of the fruit, for by that both opium would be lost and the seeds prevented from ripening; the latter have a commercial value, for they contain a fixed oil which they yield when submitted to pressure.

The incisions are sometimes limited to a single transverse one extending round the capsule (Asia Minor); sometimes they

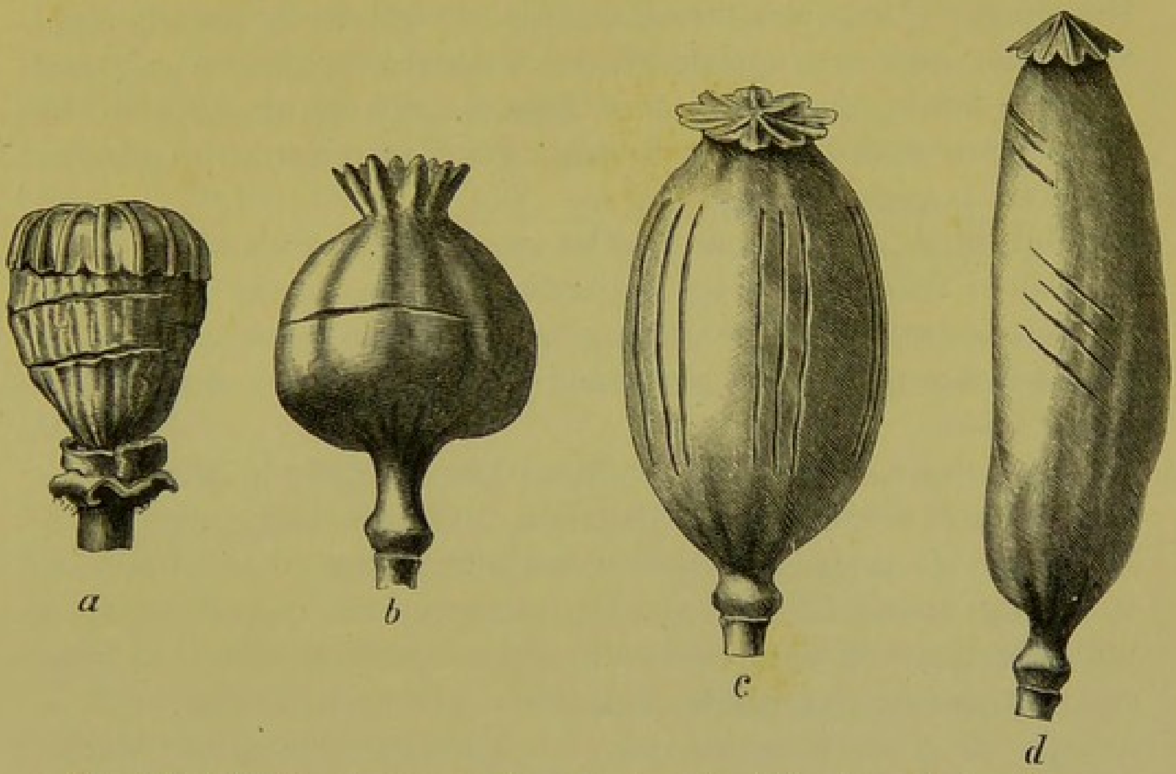


FIG. 199.—Opium. Poppy capsules, showing the different methods of incising. (Vogl, from specimens in the Museum of the Pharmacological Institute, Vienna.)

are oblique or vertical and two or three together (India), or the method adopted varies in different districts of the same country. Sometimes the capsules are cut once only, sometimes they are subjected after a short lapse of time to a second and third cutting. This is usually done in the afternoon, and on the following morning the latex that has exuded and partially dried is scraped off with a knife. The scrapings are united, and as soon as sufficient has been collected it is formed into a cake which is partially dried by exposure to the sun.

These cakes are wrapped in poppy leaves (Asia Minor) or paper (Persia, India), and are then ready for exportation.

Varieties of Opium.—1. *Turkey.*—This variety of opium is obtained in both European and Asiatic Turkey. In the former, Macedonia produces increasing quantities of opium which are exported from Salonica, and the cultivation is being pushed forward in Bulgaria; in the latter, the central and north-western districts yield the bulk of the drug, which is sent chiefly from Constantinople and Smyrna.

Turkey opium occurs in flattened cakes varying commonly from ½ to 2 lbs. in weight, although they may be larger as well as smaller. They are covered with a greyish-green leaf of the poppy plant, the broad midrib of which is usually conspicuous, and are sprinkled over with the brown, triangular, winged fruits of a species of *Rumex*. These are said to be thrown amongst the cakes by the opium merchants to prevent them from sticking together.

Bulgarian opium is said to be enveloped in a vine-leaf.

When fresh the drug is plastic; internally, it has a rich reddish-brown colour of varying depth, and is coarsely granular. It has a strong characteristic and nót unpleasant odour and a bitter taste.

2. *Persian Opium* is produced most largely in the south-western and north-western districts, the bulk being sent from Ispahan. It is usually made into short, bluntly conical masses weighing about 12 ounces each, wrapped in paper stamped with the name of the merchant. Occasionally it is formed into short sticks or flat cakes, but these are seldom seen. It is usually of a dark-brown colour internally and quite homogeneous, not exhibiting the granular appearance that characterises Turkey opium; this is possibly due to the fact that a number of batches of the opium are manipulated by expert workmen into a homogeneous mass which is then divided into cakes.

The bulk of the opium imported into England consists of the Turkey and Persian drugs, but the major part of the opium produced in Persia is exported to China.

3. *Indian Opium.*—The chief opium-producing districts in India are the central districts of the Ganges, including Behar, Benares, and Patna, and the tablelands of Malwa which lie to the north-east of Bombay, most of the drug being produced by licensed cultivators and purchased by the Government. That which is destined for use in India is dried in the sun until the moisture in it is reduced to 10 per cent., and then made into flat

cakes (Bengal abkari opium) or round balls (Malwa opium) and wrapped in oiled paper. But for the Chinese market, which takes nearly all the opium produced in India, it is formed into round balls which are enveloped in cases made of dried poppy petals, opium, and water, each cake with its shell resembling a Dutch cheese in size and shape.[1]

4. *Chinese Opium.*—China produces large and increasing quantities of opium, which, however, are entirely consumed in the country and not exported.

Constituents.—Among the numerous constituents of opium the most important are the alkaloids it contains. Of these no less than twenty-one have been reported, but the existence of some of these in the drug is open to considerable doubt. Chief of them, both in its medicinal importance and in the quantity in which it exists, is *morphine*; *narcotine* and *codeine* are of secondary importance, and next to these come *thebaine*, *narceine*, and *papaverine*.[2]

All these are well-defined, crystalline alkaloids, and together constitute in good dry opium about one-fifth of the weight of the drug.

Amongst the other constituents attention must be directed to *meconic acid*, a crystalline organic acid that exists to the extent of about 5 per cent. combined with morphine; this well characterised and easily identified acid is important as corroborative of the presence of opium in toxicological investigations.

Meconin and *meconoiosin* are two indifferent substances and exist in small quantity only.

Mucilage, *sugar*, *wax*, *caoutchouc*, and *salts of calcium* and *magnesium* are also contained in opium, but starch, tannin, oxalic acid, and fat, all of which are common constituents of plants, are not, and their presence therefore indicates adulteration of the drug.

The quality of opium is, however, determined almost exclusively by the proportion of morphine it contains. Good Turkey opium yields from about 12 to 18 per cent. of morphine (calculated upon the dry drug), but is subject, of course, to considerable variation. Persian opium is less rich in morphine,

[1] Details of the interesting but irrational process will be found in the Pharmacographia Indica.

[2] For a complete list and a table of the reactions by which they may be distinguished, Allen's *Commercial Organic Analysis*, vol. iii. part ii., may be consulted.

and contains, when of good quality, from 8 to 12 per cent. or in exceptional cases as much as 14, 15, or even 16 per cent. Indian opium is invariably poorer, and has not been found to exceed 8·5 per cent., varying usually from 4 to 7 per cent. Chinese opium has been shown to contain from 4·3 to 11·2 per cent.

The largest proportion ever found was 22·88 per cent. in a sample of French opium; in a German opium 21·75 per cent. has been recorded, but these are exceptional cases. The alkaloid certainly exists in combination with acids (probably partly with meconic, partly with sulphuric acid), and is easily and completely extracted by water.

Narcotine varies from about 2 to 10 per cent. It appears to occur in larger proportion in Indian and Persian opium than it does in Turkey, and to exist in the free state, it being a weak base.

The other alkaloids exist in small proportion, not often exceeding 1 per cent.

The necessarily high price of the drug and its nature invite adulteration, which is accordingly frequently practised. Stones, small shot, pieces of lead, and such substances are frequently found in opium. Gum, grape must, sugary fruits &c. are said to be frequently added to it. The percentage of morphine, the ash, moisture, and residue insoluble in water all give valuable indications, the last-named excluding the sugary pulp of apricots and other fruits. Good opium yields, when incinerated, from 4 to 8 per cent. of ash, contains about 12·5 per cent. of moisture, and yields to water about 64 per cent. of its weight. The residue (insoluble in water) will contain portions of the outer epidermis of the poppy capsule, but not of the inner (absence of powdered capsules); these are more frequent in Turkey than in Indian opium, the former, obtained usually from a horizontal incision, requiring more scraping than the latter, in which the opium collects at the bottom of a vertical incision. Starch should not be present in appreciable quantity; it is, however, regularly found in Persian opium (Mjoen, 1895), and traces are said to be frequently present in Turkey opium (Cæsar and Loretz, 1898), but in the latter case not in quantity sufficient to constitute an adulteration.

Uses.—Opium is one of the most valuable of drugs. It is unexcelled as an hypnotic and sedative, and is frequently administered to relieve pain and calm excitement. It is also used as an astringent in diarrhœa and dysentery, and as a sedative in certain forms of cough, dyspnœa, &c.

LACTUCARIUM

Source &c.—Lactucarium consists of the dried latex of *Lactuca virosa*, Linn. (N.O. *Compositæ*), and other species of *Lactuca*. *Lactuca virosa* is a native of central and southern Europe, but is cultivated in *England*.

All the plants belonging to the sub-order *Liguliforæ*, in which the genus *Lactuca* is included, contain a system of laticiferous vessels forming an anastomosing network penetrating to all parts of the plant (compare fig. 175). They are especially numerous in the bast of the stem, but are present also in the pith. Hence when the stem of *L. virosa* is wounded a free exudation of latex takes place, in the form of a white milky fluid of intensely bitter taste. This latex when dried constitutes the drug. It is collected by cutting the stem off about a foot below the summit; the latex exudes, and by the following day has partially hardened; it is then removed and a slice cut off the stem, which results in a further exudation of latex. The cutting is repeated throughout the summer, the collected latex being finally dried in small earthen dishes, and broken into irregular pieces.

Lactucarium is collected to some extent in this country (Market Deeping), in Germany (near Zell on the Mosel), and in France (Clermont-Ferrand). The collection of the drug in the same way as that in which opium is collected from the opium poppy was first suggested in 1799; although the sedative properties of the plant have been long known, lactucarium is not now much used.

Description.—Lactucarium occurs in hard, opaque, irregular, angular pieces, sometimes flat or curved on one or two of their sides, of a dingy brown or reddish-brown colour. In the interior they are paler, if quite fresh creamy white and of the consistence of wax; but the colour changes by exposure to a dull brown, the drug becoming at the same time hard. They possess a strong characteristic odour, different from but recalling that of opium, and a bitter taste.

Lactucarium is tough and difficult to powder. Boiled in water it softens to a plastic mass, but only very little of it is soluble. The cooled and filtered liquid should not be coloured blue by iodine, indicating the absence of starch, which has been found in factitious lactucarium, but, as composite plants contain no starch, should not be present in the genuine drug. Lactucarium is only partially soluble in alcohol and ether.

Constituents.—It appears doubtful whether lactucarium possesses any particular therapeutic action, although it has been used as a sedative. *Lactucin*, *lactucic acid* (crystalline), and *lactucopicrin* (amorphous) are three bitter principles, the re-examination of which is to be desired. *Lactucerin* (lactucone), constituting about one-half of the drug, and extracted from it by boiling alcohol, is a crystalline, tasteless, inert, waxy substance (yielding by saponification acetic acid and α- and β-lactucerol).

In addition to these constituents, that are apparently peculiar to lactucarium, various other substances commonly found in the latex of plants have been detected, such as caoutchouc, albumen, mannite, certain inorganic substances &c.

The alkaloid hyoscyamine, which Dymond detected in both wild and cultivated lettuce, especially when the flowering stage is reached, and to which possibly any sedative action of the fresh plant might be due, could not be found in lactucarium.

Uses.—Lactucarium has been used as a sedative, but is now not much employed.

ELATERIUM

Source &c.—Elaterium is the feculence that is deposited, on standing, by the juice of the nearly ripe fruit of the Squirting Cucumber, collected and dried. This plant, *Ecballium Elaterium*, Rich. (N.O. *Cucurbitaceæ*), is a rough, prostrate, trailing plant common in southern Europe, particularly in the countries bordering on the Mediterranean. It is cultivated to a limited extent in England (Hitchin, Ampthill), the majority of the commercial drug being imported from Malta. The plant and the drug under notice have long been known, the process described by Dioscorides for making elaterium being almost identical with the method now adopted.

When the fruit is ripe it is forcibly separated from the peduncle, and at the same time its seeds and juice are ejected. The fruits, which resemble small hairy gherkins about $1\frac{1}{2}$ to 2 inches long, are therefore collected before they are quite ripe, sliced, and pressed; the slightly turbid juice is allowed to stand, during which it becomes more turbid, and throws down a deposit which is collected, drained, and dried. This forms the elaterium of commerce.

Description.—Elaterium occurs in thin, opaque, curved pieces about $\frac{1}{10}$ inch thick, pale green in colour if fresh, from the presence presumably of a little chlorophyll, but becoming greyish-green and finally yellowish-grey by keeping. It is light and friable, breaking readily with a short, very finely granular fracture exhibiting minute crystals when examined with a lens. It has a slight odour, and bitter, acrid taste. It should not effervesce when moistened with dilute acid, nor should it give a blue colour when iodine is added to a cooled decoction, these tests indicating respectively the absence of chalk or other carbonates, and starch, such substances having been used to adulterate elaterium. It should not yield more than 10 per cent. of ash (indicating the absence of an undue proportion of inorganic matter).

Constituents.—The principal constituent of elaterium is a crystalline substance, *elaterin*, of which it contains when pure about 30 per cent., commercial elaterium of good quality yielding not less than 25 per cent. The commercial English drug has been found to yield from 19·7 to 27·1, whilst the Maltese, which generally contains chalk and starch, yielded from 13·8 to 17·2 per cent. This variation in the proportion of active constituent has led to the substitution of elaterin for elaterium in the British Pharmacopœia, and it remains to be seen whether this principle could not be more economically produced from the entire plant than from the juice of the fruits.

Elaterin has been obtained in the form of small, colourless, scaly crystals with a bitter taste; it is sparingly soluble in alcohol, but readily in chloroform. It contains no nitrogen, and is therefore not an alkaloid, nor does it possess the properties of an acid or exhibit those of glucoside.

In addition to elaterin the drug contains about 12 per cent. of moisture and 8 per cent. of mineral matter (Pharmacographia), the other constituents being at present unknown.

Uses.—Elaterin, the active constituent of elaterium, is the most powerful hydragogue cathartic known, producing in doses of even $\frac{1}{12}$ to $\frac{1}{6}$ grain numerous very watery motions. Like elaterium it is almost entirely used as a hydragogue purgative in dropsies and uræmia.

GUTTAPERCHA

Source &c.—Guttapercha is the dried, purified latex of several species of *Palaquium* (N.O. *Sapotaceæ*) and certain allied plants. Not only members of the genus *Palaquium*, but species belonging to other genera of the same order, and even to other natural orders (e.g. *Apocynaceæ*), yield products of allied nature.

The principal species from which guttapercha is obtained are *P. oblongifolium*, Burck, *P. borneense*, Burck, *P. Leerii*, Burck, and *P. Treubii*, Burck, all of which are stately trees indigenous to the Malay Archipelago. They contain in the bast, as well as in the cortical parenchyma of the stem, extending into the mesophyll of the leaves, numerous superposed, elongated, laticiferous cells which are filled with a granular latex. It is this latex that forms, when properly prepared, guttapercha. To that end the trees with a trunk about a foot in diameter are felled, the branches stripped off, and transverse or oblique channels are cut in the bark. Into these the latex is discharged, and in them it coagulates. This coagulation is apparently due to the coagulation of an albumin in the latex by which the separate particles of guttapercha are entangled and retained. The coagulated latex is then scraped from the incision, kneaded under hot water to free it from accidental impurities, beaten with mallets, and finally made into cakes which are bought up by Chinese merchants.

At present Sumatra yields the bulk of commercial guttapercha, but the destructive and wasteful method of collection has led to numerous endeavours to cultivate the trees and obtain from them the guttapercha by a more rational method. These endeavours have met with some success. It has been found that the leaves contain more guttapercha than the stem-bark, and that it can be extracted by boiling the dried and crushed leaves with a suitable solvent, such as toluol or hot petroleum spirit; from the latter solution the pure guttapercha is deposited on cooling (Obach's process). Not only are the trees preserved by this means, but the stools of trees that have already been felled send up shoots, the leaves of which can be utilised although the stems are too young to fell.

The yield by incision has been variously computed at about 10 to 20 ounces from each tree, whilst the leaves are said to yield 10 per cent. of their weight.

Description.—Crude guttapercha occurs in commerce in lumps or blocks of very variable, often large size, of a brown or greyish-brown colour externally, reddish-yellow or reddish-grey internally, and of laminated or fibrous nature. It has an odour that is not disagreeable (especially when rubbed), and it is flexible though scarcely elastic. It often contains mechanical impurities, from which it is freed by slicing and washing it and pressing it whilst plastic through wire gauze, or by softening in hot water and rolling into strips; these are then torn by machinery into shreds and the shreds kneaded into dark-brown lumps (purified guttapercha).

White guttapercha is prepared by dissolving purified guttapercha in chloroform, decolorising the solution with charcoal, filtering, and precipitating with alcohol.

Purified guttapercha is firm, tough, and flexible, but scarcely elastic; it can be cut easily with a knife, and at a temperature of 45°–60° C. it softens and can be rolled or drawn. It is soluble in chloroform and carbon disulphide in the cold; turpentine and benzol dissolve it when warmed, alcohol and ether only partially, whilst caustic alkalies and dilute acids have no action upon it. It is a very bad conductor of heat and electricity, and upon the latter fact depends its extensive use as an insulator.

Constituents.—Guttapercha consists principally of a hydrocarbon, *gutta*, having the formula $(C_{10}H_{16})_n$, and two resinous substances, *fluavil* and *alban*; fluavil $(C_{10}H_{16}O)$ can be dissolved from guttapercha by cold alcohol, and from the residue hot alcohol removes alban $(C_{40}H_{64}O_2)$.

Uses.—Apart from the varied technical uses of guttapercha a solution of that substance in chloroform is used to form a protective covering on the skin or as a means of applying various remedies.

CAOUTCHOUC

Source &c.—Caoutchouc is a substance contained in the latex of a large number of plants, especially of those belonging to the natural orders *Urticaceæ*, *Euphorbiaceæ*, and *Apocynaceæ*, but by no means confined to these. Indeed it is so widely distributed that in all cases the latex of plants appears to contain caoutchouc or some similar substance as a constant constituent. Many secrete it in such quantity as to form suitable sources for its commercial production. Commercial caoutchouc is, however, not quite pure, as the caoutchouc is associated with fat, resin &c. Such commercial impure caoutchouc is commonly, and perhaps better, termed 'rubber' or 'indiarubber.'

All the plants from which indiarubber is commercially obtained are natives of tropical climates. Chief amongst them are *Hevea brasiliensis*, Müll. Arg. (N.O. *Euphorbiaceæ*), and other species (Brazil), *Castilloa elastica*, Cerv. (N.O. *Urticaceæ*), and other species of *Castilloa* (Central America, Ecuador, Peru), *Ficus elastica*, Roxb. (N.O. *Urticaceæ*), and other species (India and Australia), *Vahea* and *Landolphia* species (N.O. *Apocynaceæ*, Africa). The latex is obtained by incision and coagulated. The means by which this coagulation is effected is not the same in all cases, but varies with the nature of the latex; thus the alkaline latex of *Hevea* requires an acid to coagulate it, and this is obtained by burning wood and palm nuts, and allowing the smoke, which contains acetic acid, to impinge upon the latex. The latex of *Castilloa*, which is acid, is coagulated by an extract of certain plants (*Ipomœa Bona-nox*, Linn.)

The coagulation consists in the coagulation of certain albumins, by which the particles of caoutchouc suspended in the latex are collected into a curdy mass which on drying becomes tough and elastic.

Description.—Pará rubber, which is the only official variety, is obtained from species of *Hevea* (N.O. *Euphorbiaceæ*), and occurs in commerce in elastic masses of varying form and size, which are of a brownish-black colour externally, paler within, and are usually composed of a number of thin layers separated by dark lines; these are produced by the coagulation of successive coats of latex. The drug is insoluble in water, alkalies, or dilute acids, but chloroform, oil of turpentine, carbon bisulphide, and benzol make it swell and become soft and gelatinous, one constituent of the rubber apparently dissolving, leaving the other undissolved, but in a more or less disintegrated condition. Digestion with alcohol removes from Pará rubber about 1·5 per cent. of resin, but inferior qualities may yield much more.

Constituents.—Pará rubber consists principally of caoutchouc, which when quite pure is white and corresponds to the empirical formula $(C_{10}H_{16})_n$; various foreign substances, such as resin, fat, colouring and mineral matter, are, however, always associated with caoutchouc in the commercial drug.

ALOES

Source &c.—Aloes is officially described as the juice that flows from the transversely cut leaves of certain species of *Aloe* (N.O. *Liliaceæ*) evaporated to dryness.

The aloe plants are indigenous to eastern and southern Africa, but have been introduced into other tropical countries, as for instance the West Indies, and will flourish even in southern Europe. They produce spikes of yellow or red flowers and large fleshy leaves resembling those of the American agave, an ornamental plant commonly grown in this country and often erroneously called an aloe.

The leaf, which is fleshy and mucilaginous in its interior, contains near the epidermis a row of isolated, fibrovascular bundles each of which is surrounded by an endodermis. The cells of the pericycle (within the endodermis) are unusually large, and filled with a yellow liquid, the aloetic juice. When the leaves are cut from the plant this juice drains from the cells containing it. Probably the transverse walls of the cells, which are much elongated and arranged in axial rows, give way under the pressure exerted upon them by the surrounding tissue, and thus the aloetic juice is drained from cells situated at a considerable distance from the incision.

Little or nothing flows from the mucilaginous tissue in the centre of the leaf, and as it contains no aloetic juice no effort is or should be made to obtain it; in fact its presence would lower the quality of the aloes.

The drug is obtained chiefly from *eastern* and *southern Africa* and from the *West Indies*. The means by which it is obtained are probably practically identical in all three countries, but it is much to be regretted that we are lamentably ignorant of the exact localities in which aloes is obtained, the plants that yield it, or the methods adopted in its preparation. The leaves are cut from the plant and placed so that the juice that drains from the aloetic cells may be received in any convenient vessel. This juice is then concentrated, either (probably) by allowing it to evaporate spontaneously (Socotrine aloes) or by boiling it until it has reached the desired consistence, when it is poured into boxes or gourds and allowed to solidify (West Indian and South African aloes).

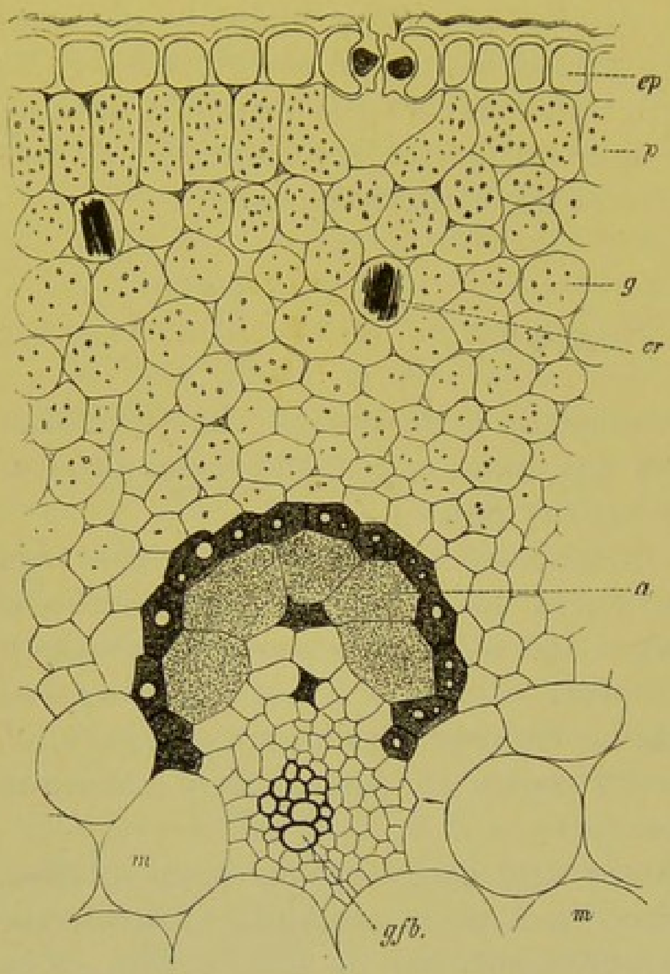


FIG. 200.—Transverse section near the margin of an Aloe leaf. *ep*, epidermis; *gfb*, vascular bundle, the pericyclic cells, *a*, of which are much enlarged and contain a granular secretion (aloes); *cr*, calcium oxalate crystals; *m*, mucilaginous parenchyma. Magnified. (Tschirch.)

The manner in which this operation is performed has a remarkable influence on the physical characters of the aloes. If the juice is rapidly concentrated, the concentration carried as far as practicable, and the resulting aloes quickly cooled, a drug is obtained that breaks with a vitreous or glassy fracture, and in small splinters is quite homogeneous and transparent even when examined under the microscope. Such an aloes is termed a 'vitreous,' 'lucid,' or 'glassy' aloes. But if the evaporation be carried on slowly and not quite so far as in the preceding case, a drug is obtained that is opaque and exhibits when examined under the microscope minute prismatic crystals embedded in a transparent resinous mass. Such an aloes is termed 'hepatic' or 'livery.' The crystals that it contains are aloin, and the reason why in this case the aloin crystallises, whilst in the vitreous aloes it does not, is probably to be found in the fact that the conditions under which evaporation takes place are more favourable to crystallisation; this is also influenced by the facility with which the particular variety of aloin crystallises. Hence Natal aloes, which contains an aloin that crystallises with extreme facility, is opaque, whilst Cape aloes, which contains an aloin that is difficult to crystallise, is vitreous. Nevertheless every variety of aloes not only may, but actually does, occur in both the vitreous and the opaque modification.

Varieties of Aloes.—The chief commercial varieties of aloes may be conveniently considered under three heads, viz.: *east African, south African,* and *West Indian.*

East African Aloes

1. *Socotrine Aloes.*—This variety is stated in the British Pharmacopœia to be derived from *Aloe Perryi,* Baker, and probably other species. It is brought by Arab traders from the east coast of Africa, the island of Socotra (600 miles west of Aden), and possibly also from the coast of Arabia, to Bombay, whence it is exported to Europe. It arrives usually in kegs or tins, and commonly has a pasty, semi-liquid, or even treacly consistence. It is then of a brownish-yellow colour and quite opaque, but if not too viscid it separates on standing into a clear, dark-brown, supernatant liquid and a dark-yellow sediment which under the microscope is seen to consist of minute prismatic crystals (aloin). The odour of the fresh aloes is remarkably unpleasant, but this changes when the aloes is kept under certain (not at present precisely known) conditions to a rather agreeable fragrance that has been compared to myrrh and saffron.

As this variety of aloes contains a varying amount of water, and is not, as imported, in a suitable condition for use in pharmacy, it must be dried at a gentle heat. It then forms hard, dark-brown or sometimes nearly black masses, breaking with a dull, waxy, uneven, often porous fracture, and possessing a strong characteristic odour and an extremely bitter, nauseous taste. It should be almost entirely soluble in alcohol, and yield about half its weight to cold water. Small splinters are opaque, but mounted in a drop of almond oil and examined under the microscope they exhibit numerous minute prismatic crystals (of aloin) embedded in a transparent, dark yellowish-brown mass. This aloes therefore belongs to the class of aloes known as livery or hepatic aloes. From other aloes it may be distinguished by moistening a little of the powder with nitric acid, when a reddish or yellowish-brown colour is produced.

2. *Zanzibar Aloes*, which is sometimes regarded as a variety of Socotrine, is imported in hard dark masses often packed in monkey (or goat) skins. It has a liver-brown colour, and a dull waxy, but nearly smooth and even fracture. In this respect it differs from the foregoing, which breaks with an uneven fracture, as it does also in its odour, which is characteristic and strong but not disagreeable.

Both the foregoing varieties of aloes are usually hepatic, a fact that points to a slow concentration of the aloe juice, possibly by spontaneous evaporation. Both occur also in the vitreous variety, but east African aloes is seldom imported in this condition.

South African Aloes

3. *Cape Aloes*.—Large quantities of aloes of excellent quality are exported from Mossel Bay and Cape Town in Cape Colony, but the botanical source of it is at present unknown. This variety of aloes, which is preferred in Austria and Germany, occurs in masses of a dark reddish-brown or nearly black colour, often with a greenish tinge, and breaking with a clean, glassy fracture. Thin splinters are perfectly transparent, of a reddish-brown or amber-yellow colour, and exhibit no trace of crystals when examined under the microscope. It belongs therefore to the class of glassy, lucid, or vitreous aloes, and may be easily distinguished from all other glassy aloes by its very distinctive sour odour and by the pale yellow colour of its powder.

Cape aloes seldom occurs in the hepatic modification, as the aloin it contains shows little disposition to crystallise.

Natal Aloes.—This variety of aloes is not now much used. Like Cape aloes its botanical source is obscure; *Aloe ferox*, Mill., appears to yield part of the aloes exported from Natal (Wood), but this statement has been doubted (Holmes).

It is almost always opaque, and has a characteristic, dull greenish-black or dull brown colour. In odour it closely resembles Cape aloes, and it may therefore be easily distinguished from all other opaque aloes by this character alone. It yields when scraped a pale greyish-green or sometimes pale yellowish powder, and when this is mixed with a little sulphuric acid and the vapour of nitric acid blown over it, a deep blue coloration is produced.

These last three characters are so distinctive that Natal aloes is one of the easiest to identify.

West Indian Aloes

5. *Barbados Aloes.*—But very little aloes is now produced in the island of Barbados, and that which bears this name is in reality prepared in the Dutch islands of Curaçao, Aruba, and Bonaire; it is therefore, often and more, appropriately termed Curaçao aloes. The plant which yields it appears to be *Aloe chinensis*, Baker, a species closely allied to but not identical with *Aloe vulgaris*, Lam., to which this variety of aloes is often referred.

Curaçao or Barbados aloes arrives usually in boxes, sometimes in gourds. It occurs in both the glassy as well as in the opaque variety; the former commercially known as 'Capey' Barbados, becomes opaque and 'hepatic' on keeping, a change to be ascribed to the slow crystallisation of the aloin. It is also by no means uncommon to find packages that are partly filled with glassy, partly with opaque, aloes; such differences in the appearance are probably due to slight differences in the mode of evaporating the juice.

Hepatic Curaçao aloes varies in colour from yellowish or reddish-brown to chocolate-brown or nearly black. It breaks with a dull, waxy, even fracture, small splinters exhibiting under the microscope numerous minute crystals of aloin. It closely resembles Zanzibar aloes, and, in fact, can be distinguished (apart from chemical tests) only by its distinctive odour. The powder imparts a crimson colour to nitric acid, whereas that of Zanzibar aloes imparts a reddish or yellowish-brown colour.

Vitreous Curaçao aloes is distinguished from the hepatic by its transparency. It has usually, in small fragments, a garnet-red colour; in other respects it resembles the foregoing.

The following chemical tests may be of service to the student in distinguishing the varieties of aloes (Bainbridge and Morrow).

	Nitric acid	Sulphuric and vapour of nitric acid
Socotrine aloes	reddish-brown	—
Zanzibar ,,	,, ,,	—
Cape ,,	permanent green after standing a few minutes	—
Natal ,,	permanent crimson	deep blue
Curaçao ,,	evanescent crimson	—

The student should have little difficulty in identifying the five foregoing varieties of aloes. Two only (Cape and Curaçao) are commonly met with in the vitreous form, and they are easily distinguished both by their colour and by their very different odour. Four (Socotrine, Zanzibar, Natal, and Curaçao) are hepatic. Of these the odour of Natal distinctly recalls that of Cape, whilst the greyish-green or pale yellowish-brown powder is characteristic. Socotrine aloes is remarkable for its unpleasant odour and uneven, porous fracture. Zanzibar and hepatic Curaçao are very similar in appearance, but differ in odour; these are the only two likely to be confused, and if necessary the chemical test must be applied.

Constituents.—All the aloes alluded to contain a crystalline, bitter, purgative principle, *aloin*, which, however, in most cases varies with the variety of the drug. Socotrine and Zanzibar aloes contain *socaloin*, Barbados (Curaçao) aloes contains *barbaloin*, Cape aloes *capaloin*, and Natal aloes *nataloin*. These aloins vary not only in composition but also in physiological effect, capaloin being the most powerful, whilst nataloin has but little purgative action on human beings. They are all anthracene derivatives, and are the sources of the characteristic colour-reactions that have been already alluded to. They are slightly soluble in cold water, more soluble in hot water and in alcohol. The official aloin may be obtained from either Socotrine or Barbados aloes, and may therefore be either socaloin or barbaloin, but the latter is the one usually found in commerce.

The proportion in which these aloins are present in the respective aloes is not accurately known.

Treumann (1880) actually obtained, on the larger scale, 23 per cent. of aloin from a sample of Barbados aloes, and estimated the total quantity present at about 60 per cent., as great loss in its separation is unavoidable.

Tilden (1872) also obtained 20 to 25 per cent. of aloin from Barbados aloes; and as there appears to be considerable loss in the extraction, it may be assumed that this variety of aloes may contain up to half its weight of crystalline aloin.

The same is probably true of Socotrine and Natal aloes. From Cape aloes Treumann obtained upwards of 9 per cent. of capaloin.

The attempts that have been made to assay aloes for aloin have yielded rather lower figures (*e.g.* Schäfer 15 to 30 per cent.), but it is doubtful whether they can be relied upon as being accurate. Pedersen (1898) ascribes the following composition to Barbados aloes :—

Resin	12·65
Barbaloin	12·25
Emodin	0·15
Ash	1·75
Water	10·50
Amorphous substances soluble in water	62·70
	100·00

The resin proved to be a compound of aloresinotannol with cinnamic acid, the resin from Cape aloes yielding paracumaric acid.

The presence of emodin is interesting, as it furnishes an explanation of Bornträger's reaction for aloes. This consists in shaking a solution of aloes with benzene, which extracts from it a yellow substance. The benzene solution is separated and shaken with ammonia, by which the yellow colour is changed to reddish-violet and taken up by the ammonia. Emodin appears to be easily formed from aloin by oxidation.

Uses.—All the species of aloes have more or less powerful purgative action, Cape aloes being the strongest and Natal aloes the weakest, all of them acting with remarkable slowness. Aloes is one of the most valuable purgatives in certain forms of constipation, as it improves the digestion and does not lose in activity by repetition.

KINO

Source &c.—The drug officially known as kino is the juice obtained from incisions in the trunk of *Pterocarpus Marsupium*, Roxb. (N.O. *Leguminosæ*), evaporated to dryness. The bast of the tree, which grows in *southern India* and *Ceylon*, contains, according to v. Höhnel, numerous comparatively wide and short tubular cells arranged in axial rows; these cells are filled with a red astringent liquid, which flows from them when they are wounded. Vertical incisions, with oblique lateral ones running into them, are accordingly made in the bark; the juice that flows is collected, and soon dries in the sun to a dark mass that readily breaks up into small angular grains. It is occasionally imported as a treacly liquid which can easily be dried.

This, the official kino, is frequently termed Malabar kino to distinguish it from other similar drugs to which the same generic name has been applied (see below).

Description.—Kino occurs in small, glistening, angular grains that appear quite black and are remarkably free from dust. When thin laminæ or the edges of the grains are examined they are seen to be transparent and of a dark ruby-red colour. They are hard and brittle, breaking with a vitreous fracture and yielding a brownish-red powder. The drug is odourless, but has, when chewed, an astringent taste, and adheres to the teeth, colouring the saliva red.

In cold water kino is only partially (from 80 to 90 per cent.) soluble; it dissolves to a greater extent in hot water, and is almost entirely soluble in alcohol. The aqueous solution turns green on the addition of a ferrous salt, violet with an alkali, and throws down a precipitate (kinotannic acid) when acidified with a mineral acid.

The student should particularly observe

(*a*) *The brilliant, apparently black, colour,*
(*b*) *The absence of any dust;*

and should compare the drug with red gum.

inoic acid.

Constituents.—Kino contains as principal constituents *kinoin* (1·5 per cent.), *kinotannic acid* (about 75 per cent.), and *kino-red*. Kinoin is colourless, crystalline, and sparingly soluble in water; it yields, when heated to 130° C., kino-red; the same substance is also produced when kinotannic acid is boiled with a dilute mineral acid, and probably therefore these three substances stand in a simple relation to one another.

Kino yields about 6 per cent. of ash (Flückiger). The other constituents of the drug are at present unknown.

Uses.—Kino is employed as an astringent, and is said to be largely used in the manufacture of wines.

Varieties.—Towards the middle of the eighteenth century a red astringent gum was imported from western Africa, with the information that it was there called 'kano;' this was the original drug, and was obtained from *Pterocarpus erinaceus*, Lam. (N.O. *Leguminosæ*). This drug was, however, soon replaced by other similar astringent gums to which the name kino was applied, as for instance Jamaica kino, from *Coccoloba uvifera*, Linn. (N.O. *Polygonaceæ*), Malabar kino, from *Pterocarpus Marsupium*, Roxb. (N.O. *Leguminosæ*), and Botany Bay kino, from *Eucalyptus resinifera*, Sm. (N.O. *Myrtaceæ*). Of these Malabar kino soon took the lead, to the gradual exclusion of the others.

Kinos have also been obtained from *Myristica sp.* (N.O. *Myristicaceæ*) and *Ceratopetalum sp.* (N.O. *Saxifragaceæ*); indeed such astringent substances appear to be widely distributed throughout the vegetable kingdom.

The official Malabar kino is distinguished by its black colour, glistening surface, and freedom from dust.

RED GUM

(Eucalyptus Gum, Gummi Eucalypti)

Source &c.—Eucalyptus gum, or as it is commonly termed 'red gum,' or sometimes Australian kino, is obtained from *Eucalyptus rostrata*, Schlecht. (N.O. *Myrtaceæ*), and other species (*E. marginata*, Sm., *E. amygdalina*, Labill., &c.). They are all Australian trees, *E. rostrata* forming large forests on the banks of the Murray River in New South Wales and yielding a valuable timber. This species is usually preferred as the source of red gum for medicinal use, because the tree is gregarious, cannot easily be mistaken for others, and yields freely a drug of good quality. The gum, which is secreted in cavities in the wood, or sometimes between the bark and the trunk of the tree, forming carbuncles, is obtained by making an incision and inserting a trough-shaped piece of tin by which the treacly liquid as it drains from the cut is carried into buckets or tins. In a few days it dries into a solid mass which soon becomes friable; occasionally it is found in the dry state in cavities in the trunk. The yield of each tree is very variable, the average being about a quart, some yielding none, others as much as 4 gallons (Maiden, 1897).

Description.—Red gum is seen in commerce in small pieces, about the size of a pea or less. They are of a dark reddish-brown colour, opaque, and more or less dusty, but thin laminæ are transparent and ruby-red, the powder being pale-reddish in colour. It is somewhat tough, and has when chewed an astringent taste, colouring the saliva red and adhering to the teeth. Cold water should dissolve from 80 to 90 per cent. According to Brownscombe (1899) good qualities should yield not less than the latter percentage.

The student should observe

(*a*) The *reddish colour*,
(*b*) The *dusty appearance*

of the drug.

Constituents.—Red gum contains about 47 per cent. of *kinotannic acid* (Maiden, 1897), which is undoubtedly its principal constituent. There is also present *kino-red*, and about 15 per cent. of *moisture*, the remainder consisting of *gum* and other substances not at present exactly known.

Uses.—Red gum has been much praised as an astringent, and is said to be superior in this respect to Malabar kino.

GAMBIER

(Pale Catechu, Terra Japonica)

Source &c.—Pale catechu is an extract prepared from the leaves and young shoots of *Uncaria Gambier*, Roxb. (N.O. *Rubiaceæ*).

This plant is a climbing shrub indigenous to the *Malay Archipelago* and largely cultivated on the small islands between

Singapore and Sumatra, as well as in British North Borneo, and on other islands of the Archipelago. The drug was introduced into Europe towards the end of the eighteenth century, but was probably used in India at much earlier times for chewing with betel leaf (the leaf of *Piper Betle*, Linn.).

The leaves and young shoots of the shrub are collected and boiled with water; the decoction is evaporated to a syrup in copper pans (iron pans would discolour it) and cooled; during the cooling the workman works a stick up and down in an oblique direction in the liquor, by which crystallisation is induced and a mass of the consistence of soft clay is obtained. This is usually conveyed in a moist state, often dripping with the mother liquor that drains from the crystalline mass, to Singapore, where it is cut into cubes about an inch in diameter and dried. Occasionally it is formed into strips, plates, or small round discs, or sometimes it is imported in large blocks, but cube gambier is the form in which it is usually employed in pharmacy.

Description.—Gambier, as observed, is usually seen in the form of tolerably regular cubes, measuring about an inch each way; it is light in weight, and of a dull, dark reddish-brown colour externally, which, however, varies slightly, even on different sides of the same piece. The cubes break easily, and internally are of a pale cinnamon-brown colour, porous and friable. The drug has no odour; the taste is at first bitter and astringent but afterwards sweetish.

Gambier of good quality is almost entirely soluble in boiling water, and yields not less than 70 per cent. to alcohol.

When a little is mixed with a drop of oil and examined under the microscope it is seen to consist chiefly of minute acicular crystals.

Constituents.—Gambier consists principally of *catechin* and *catechutannic acid*, these two substances in varying proportions constituting together in good specimens over 60 per cent. of the drug; the percentage of catechin varies from 7 to 33 per cent., that of catechutannic acid from 22 to 50. These figures, however, vary with the care with which the drug has been prepared.

Catechin forms white, silky, acicular crystals with an astringent taste; it is sparingly soluble in cold but freely in boiling water, the solution giving an intense green colour with ferric salts.

Catechutannic acid has been obtained as a reddish, amorphous substance easily soluble in cold water and in alcohol, the former being used to extract it from the drug. It is apparently produced from catechin by loss of a molecule of water, and itself yields an insoluble red substance, catechu-red, when boiled with water or with dilute mineral acids. These three substances, catechin, catechutannic acid, and catechu-red, appear therefore to stand in close relation to one another, and the relative proportion in which they occur in the drug depends largely upon the care with which it is manufactured, well prepared gambier containing most catechin. Hence commercial gambier may contain as much as 50 per cent. of catechutannic acid, and as little as 7 per cent. of catechin.

Trimble (1888) found in three samples of gambier the following composition :

Catechin	7 to 19 per cent.
Catechutannic acid	33 to 47 ,, ,,
Gum	10 to 16 ,, ,,
Ash	3 to 4 ,, ,,
Moisture	9 to 11 ,, ,,
Colouring matter &c.	4 to 28 ,, ,,

Other investigators have obtained larger proportions both of catechin (up to 33 per cent.) and catechutannic acid (up to 50 per cent.).

Other constituents of the drug are *catechu-red*, a decomposition product of catechutannic acid, to which the reddish colour of the drug is due, *quercetin*, and a *fluorescent substance* which can be removed from an alkaline solution of gambier by agitation with petroleum spirit. This fluorescent substance is not present in black catechu or in many similar extracts, and forms therefore a valuable means of identifying gambier (Dieterich, 1897).

Uses.—Gambier is employed medicinally as a local astringent in the form of a lozenge or as a general astringent in diarrhœa ; its use for these purposes is, however, insignificant compared with the quantities consumed in the dyeing and tanning industries.

Impurities.—Gambier may be adulterated with starch or with inorganic matter, possibly also with extracts prepared from other plants.

It should be almost entirely soluble in boiling water, depositing a crystalline sediment (catechin) on cooling, and should yield not less than 70 per cent. to alcohol. Starch is best detected by exhausting the drug with cold water and submitting the residue to microscopical examination, and the amount of inorganic substances present by determining the ash, which should not exceed 5 per cent. The valuation of gambier is effected by the determination of the catechin and catechutannic acid present.

CUTCH

(Catechu, Black Catechu)

Source &c.—Black catechu is an extract prepared from the heartwood of *Acacia Catechu*, Willd. (N.O. *Leguminosæ*), a tree of medium size common in *India* and *Burmah*. It yields a valued timber, and also an astringent bark that is used for tanning.

This drug must be carefully distinguished from the foregoing (gambier), which is official under the name of catechu. The two substances are quite distinct, and that obtained from *Acacia Catechu* is to be regarded as true catechu. To avoid confusion it would be well to adhere to the terms gambier and cutch for the two drugs, thus avoiding the use of the term catechu, which has been applied to both.

Cutch has long been used in India as a masticatory, but it was not introduced into Europe till the latter half of the seventeenth century.

To obtain the drug the tree is felled, the bark and sapwood stripped from the trunk, the dark red heartwood cut into chips and boiled in water in earthen pots. The decoction is then strained and boiled down in iron pots with continual stirring until it attains the consistency of syrup. When sufficiently cool to handle, the extract is spread upon leaves arranged within a wooden frame or mould and left for the night. In the morning the cutch is dry, and appears in brick-like masses weighing from 36 to 44 lbs., which are broken up for the market.

Description.—Cutch occurs in nearly black masses, the outer portions of which are hard and brittle, but the interior often still soft. It breaks easily, the fractured surface having a dull gloss, and containing a number of small cavities that give the drug a bubbly appearance. It yields a dull brown powder and has no odour, but an astringent and subsequently sweetish taste.

When macerated with cold water it forms a brown magma, which exhibits under the microscope numerous minute crystals similar to those found in gambier. Boiling water dissolves it almost entirely, but on cooling deposits a crystalline sediment.

Constituents.—Cutch closely resembles gambier in chemical composition. It contains as principal constituents *catechu-tannic acid* and *catechin*, but the former is usually present in much larger quantity than the latter. The drug contains in addition *catechu-red* and small quantities of *quercetin*, but is free from the fluorescent substance that is present in gambier. Although the two drugs, gambier and cutch, as usually found on the market have little resemblance to one another, this is due solely to the manner of preparation, the syrupy liquor being in the case of gambier allowed to crystallise. This method is sometimes pursued in India with cutch, and the resulting drug then closely resembles gambier, but can always be distinguished from it by the absence of the fluorescent substance extracted by shaking an alkaline solution with petroleum spirit.

40°/o

Trimble (1888) found three samples of cutch to have the following composition.

Catechin	2 to 10 per cent.
Catechutannic acid	25 to 33 ,, ,,
Gum	20 to 29 ,, ,,
Ash	2 to 3 ,, ,,
Moisture	12 to 15 ,, ,,
Colouring matter &c.	21 to 25 ,, ,,

Uses.—Cutch is employed chiefly in the dyeing and tanning industries, especially the former, the amount of colouring matter it contains often rendering it more suitable for dyeing than gambier.

CURARE

Source &c.—Under the name of curare several (at least three) varieties of a dark, extract-like mass appear in commerce. They are all arrow poisons prepared by tribes of Indians in the valleys of the *Amazon* and *Orinoco* and their tributaries. With the manner in which these extracts are prepared, or the ingredients, vegetable or animal, that enter into them we are only imperfectly acquainted. The bark of various species of *Strychnos* (*S. toxifera*, Benth., *S. Castelnæi*, Wedd., *S. Gubleri*, G. Planchon, *S. Crevauxii*, G. Planchon, &c.) appear to be essential constituents. In the bark of these plants considerable quantities of poisonous alkaloids are present.

Curare has been imported in gourds, in small earthen pots, and in bamboo tubes, but gourd curare is now no longer a commercial article. It has the appearance of a very dark brown or nearly black extract resembling black catechu, often containing small cavities. That imported in bamboo is dark-brown and granular, the broken fragments frequently exhibiting crystals sufficiently large to be visible to the naked eye. It has little or no odour, but a very bitter taste.

All these varieties of curare are poisonous when injected subcutaneously, but when administered by the mouth they are harmless, producing, it is said, the effect of a stomachic tonic. The degree of toxicity varies not only in the different varieties but in the different specimens of the same variety, and the strength, therefore, of each parcel must be determined before it can be used medicinally. Bamboo curare yields to water about 84 to 88 per cent., gourd curare 34 to 75 per cent., pot curare 50 to 87 per cent. (Böhm, 1898). These figures suffice to show the extreme variability of the drug.

Constituents.—Gourd curare contains the poisonous alkaloid *curarine*, whilst bamboo curare appears to contain a different alkaloid that has been termed *tubocurarine*, and pot curare a third, viz. *protocurarine*.

Uses.—Curare has been employed as a remedy for hydrophobia and chorea; it has also been found useful for tetanus, but it would appear desirable to abandon the use of the crude drug in favour of that of its active alkaloids.

SECTION XII

GUMS

ACACIA GUM

Source &c.—Acacia gum is a dried exudation from the stem and branches of various species of *Acacia* (N.O. *Leguminosæ*), especially of *Acacia Senegal*, Willd., a small tree attaining a height of 15 or 20 feet, and growing freely both in western Africa (Senegambia) and in eastern Africa (the upper Nile districts), possibly also in central Africa, forming forests of considerable extent. In most cases the gum appears to be exuded spontaneously, but sometimes its formation is promoted by incision. It is produced, in the first instance at least, in the cells of the cortex and pericycle (Lutz, 1895), and is a result of the transformation of the cell-wall, but what the influences are that determine such transformation (gummosis) is at present unknown. Wiesner and Beijerinck ascribe the gummosis of the African acacias to a fungus.

The gum is collected and either conveyed down the Nile to Alexandria or is exported from St. Louis (Senegambia).

Description.—The gum exported from Alexandria as Kordofan gum is generally regarded as the best. It occurs in rounded or ovoid tears, varying in size from a pea to a hazel nut. They are often quite white, but sometimes show a yellowish tinge, and are opaque from the presence in the outer part of the tears of small fissures. In consequence of these they easily break up into a number of small angular fragments with glistening, vitreous surfaces, and quite transparent. The drug is practically inodorous, and has a bland, mucilaginous taste. Whilst the finest qualities are white, or have at most only a yellowish tinge, inferior grades have a decided yellow or reddish or brownish-red colour.

Acacia gum is insoluble in alcohol, but dissolves freely in water, forming a translucent, viscid, but not glairy or ropy liquid, that feebly reddens litmus paper. Solution of subacetate of lead throws down a copious white precipitate from a solution of acacia gum, whilst solution of borax forms with it a clear, translucent jelly. The gum loses about 14 per cent. of water when dried at 100° C., and yields from 2·7 to 4·0 per cent. of ash containing calcium, potassium, and magnesium.

Constituents.—Acacia gum is supposed to consist of *calcium*, *potassium*, and *magnesium* combined with *arabic acid*; the latter can be separated by acidifying a solution of gum with hydrochloric acid and precipitating with alcohol, and obtained nearly free from inorganic substances by repetition of this treatment. Pure arabic acid has been obtained as a colourless, amorphous, transparent substance that swells in contact with water, but does not dissolve until after the addition of an alkali. Dried at 100° C. its composition corresponds to the formula $C_{12}H_{22}O_{11}$, and when boiled with dilute mineral acids it is converted into galactose and arabinose.

There is, however, probably more than one such organic (acid) substance present in acacia gum.

Varieties, Impurities, &c.—Gum-yielding acacias are widely distributed over tropical and subtropical countries, and furnish large quantities of gums which, though unsuitable for medicinal use, are extensively employed for certain technical purposes. In the deserts of Scinde the flora much resembles that of the African deserts, and large forests of *A. arabica*, Willd., exist, from which the Amrad gum of Bombay is obtained; *A. modesta*, Wall., yields the gum sent from northern India (Amritsar gum), whilst an altogether different plant, *Anogeissus latifolia*, Wall. (N.O. *Combretaceæ*), furnishes the Ghatti gum of commerce; the latter may be distinguished from acacia gum by its giving a white, stringy precipitate with mercuric chloride, acacia yielding only a slight one; Ghatti gum yields also only a slight precipitate with basic acetate of lead, whereas acacia yields a copious one.

Northern Africa supplies a gum (Mogadore gum) probably obtained from *A. gummifera*, Willd., the finest pieces of which are indistinguishable from Kordofan gum.

Senegal gum has usually a yellowish or reddish tinge, is less fissured than Kordofan gum, and often forms long cylindrical or curved pieces.

Southern Africa also yields gum from *A. horrida*, Willd., and Australia from *A. dealbata*, Link, *A. pycnantha*, Benth., &c.

Many of these gums form glairy, ropy solutions with water, and when diluted throw down gelatinous deposits of gum that has swelled but not dissolved. A gum suitable for pharmaceutical use should be free from both those characters, and should further give no reaction for (i) starch (absence of commercial dextrin from which an artificial gum has been prepared, or which might be present as an adulterant of powdered gum); (ii) tannin, which is present in certain inferior varieties of gum (such as Australian); and (iii) from substances that reduce Fehling's solution (dextrin and certain sugars).

Uses.—Acacia gum is used medicinally as a demulcent and as a means of suspending oils, resins, &c. in aqueous fluids.

TRAGACANTH GUM

Source &c.—Tragacanth gum is a dried gummy exudation from the stem of *Astragalus gummifer*, Labill. (N.O. *Leguminosæ*), and other species of *Astragalus*.

These plants are small, branching, thorny shrubs, about 3 feet in height, and are natives of southern and eastern Europe and especially of *Asiatic Turkey* and *Persia*, where they form one of the most characteristic forms of vegetation. When the stem is incised a gum exudes and dries, the form that it assumes being dependent on the form of the incision, vertical slits yielding flat, ribbon-shaped pieces and punctures vermiform tears. It is produced by the transformation of the cell-walls of the medullary rays and pith into gum, which easily absorbs water, and, swelling, exerts considerable pressure on the surrounding tissue. When, therefore, the stem is wounded the gum is forcibly pressed out, a piece nearly an inch long being exuded in half an hour; it carries with it the starch grains present in the cells in a more or less unaltered condition, such starch grains being a natural constituent of the drug.

Of the influences that induce gummosis of the cell-wall, we have no definite knowledge.

In some districts accidental wounds by grazing cattle appear to suffice for the production of tragacanth. In Asiatic

Turkey it is collected chiefly in Anatolia and shipped from Smyrna; in Persia the Baktiari mountains, south of Ispahan, and the neighbouring districts yield much tragacanth, which is conveyed from the Persian Gulf ports to Bombay, and thence to Europe. The former variety is known as Smyrna, the latter, which alone is official, as Syrian or Persian.

Description.—*Syrian* or *Persian tragacanth* occurs in thin, flattened, curved, ribbon-shaped flakes of a translucent, horny appearance and nearly colourless or faintly yellowish. The flakes are often 1 inch long and ½ inch wide, and are marked with numerous concentric ridges, conveying the impression that the gum has been exuded in successive portions. The flakes break with a short fracture, are odourless and almost tasteless. Soaked in cold water they swell considerably, forming a gelatinous mass, but only a small proportion dissolves.

Smyrna tragacanth occurs in similar pieces in which, however, the ribbon-like character is less pronounced, and which are more opaque than the Persian, so that the two, when placed side by side, can easily be distinguished. Moreover, Smyrna tragacanth contains sufficient starch to give a decided reaction with the iodine test, whereas Persian responds only very faintly.

Constituents.—Tragacanth consists of about 8 or 10 per cent. of *arabin* (soluble in water) and 60 or 70 per cent. of *traganthin*, which swells in water but does not dissolve. It contains also water, traces of starch, cellulose, and nitrogenous substances, and yields about 3 per cent. of ash.

Varieties &c.—In addition to the tragacanth described (flake tragacanth), much is imported of a very inferior quality ('hog' gum); such gum is usually in tears or irregular vermiform pieces, and darker in colour. Sometimes it has been whitened with lead carbonate (Caramania gum) before being used to adulterate the finer qualities.

Uses.—Tragacanth is chiefly employed medicinally as a means of temporarily suspending insoluble powders in mixtures, and to give the requisite firmness to pill-masses.

SECTION XIII

RESINS

COLOPHONY

(Amber Resin, Resin, Resina)

Source &c.—Colophony is the residue left after the distillation of the oil of turpentine from the crude oleo-resin of various species of *Pinus* (N.O. *Coniferæ*).

Most coniferous trees contain in the wood a branching system of schizogenous secretion ducts filled with a viscid oleo-resin; when the ducts are punctured the oleo-resin is exuded, and this constitutes crude turpentine. All the species of the order do not yield oleo-resins of identical composition, and therefore several varieties of turpentine are known, as for instance American turpentine, Bordeaux turpentine, Venice turpentine, Strassburg turpentine, &c.

The term 'common' turpentine is practically restricted to the oleo-resin obtained in America, as the English market is almost exclusively supplied from that source. The bulk is obtained from *Pinus palustris*, Mill., the long-leaf pine, but *Pinus Tæda*, Linn., the loblolly pine, *P. echinata*, Mill., the short-leaf pine, and *P. cubensis*, Griseb., the Cuban pine, all yield a considerable quantity. These trees, especially the long-leaf pine, form extensive forests in the *southern* and *south-eastern United States*, extending from Texas to North Carolina.

The oleo-resin is collected in the following manner:

In the winter, when no oleo-resin flows, cavities are cut in the trunk of the tree near the base; they slope inwards and downwards, and are destined to receive the turpentine. In the spring triangular incisions are made above the cavity or 'box,' the bark and part of the young wood being removed. The turpentine now rapidly exudes and collects in the box, from which it is removed by a dipper. After eight or ten days the flow diminishes, and may be increased by cutting a strip of bark above the triangular incision; this process of hacking is repeated until the autumn, when the flow of turpentine gradually ceases. The last portions that are slowly exuded partially dry before they reach the box, and form a white incrustation on the hacked surface. This incrustation is removed and forms the drug known in America as 'scrape,' and in England as 'gum thus' or 'American' or 'common' frankincense.

The crude turpentine is removed by the dipper from the boxes to barrels for transportation to the stills. These are of

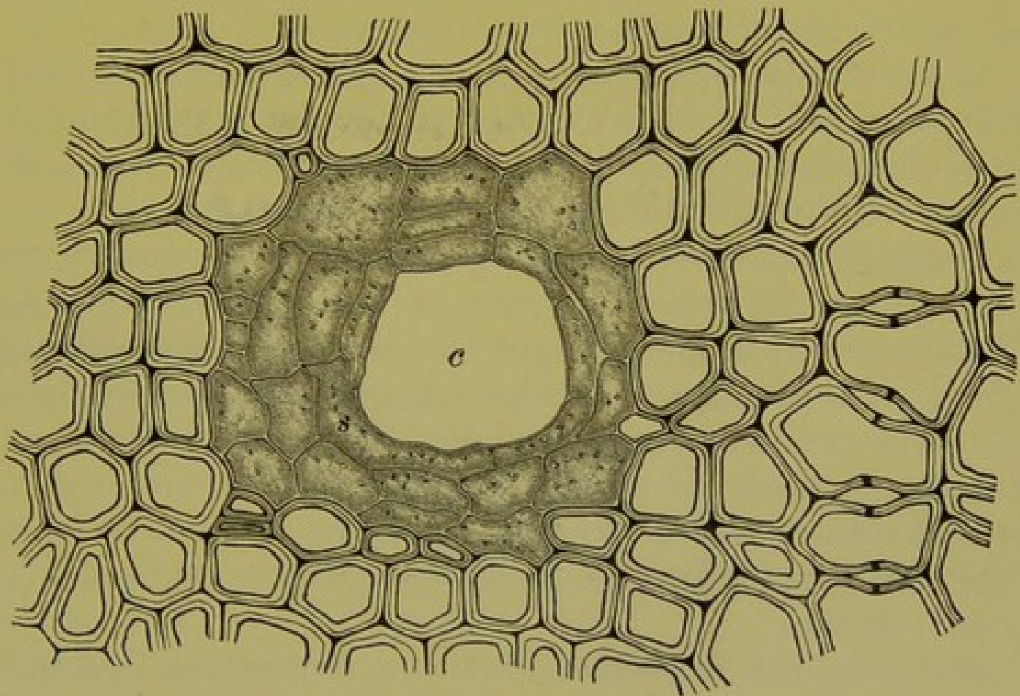


Fig. 201.—Transverse section through the wood of *Pinus maritima*, showing an oleo-resin duct, *c*. Magnified. (Tschirch.)

copper, and set in brick furnaces. Water is added and the whole warmed, any chips of wood &c. that float to the top being skimmed off. The head is then luted on, and the heat increased. At first, water and oil of turpentine distil over, subsequently oil of turpentine alone. Water is occasionally added to prevent the resin from charring. After the distillation has been stopped the melted resin is run through wire strainers into barrels.

The finest resin is that obtained from the tree in the first year, when the crude turpentine yields about 80 per cent. of it. After that the proportion of oil of turpentine in the oleo-resin gradually diminishes whilst that of the resin increases, but the latter becomes darker and darker in colour.

So enormous is this industry in the United States that it is computed that at least 800,000 acres of virgin forest are newly invaded annually to supply the turpentine stills in operation.

Description.—The resin thus obtained should form pale amber-coloured, transparent, glassy masses, very brittle and easily powdered. It is rather heavier than water, the specific gravity varying from 1·070 to 1·085 (Dieterich). It has a faint terebinthinate odour and taste. At about 80° C. it softens, but it does not completely melt until the temperature exceeds 100° C. It is soluble in alcohol, ether, and chloroform, and leaves when incinerated but little ash.

Constituents.—Colophony consists principally of the *anhydride of abietic acid.* Powdered colophony is gradually converted into crystalline abietic acid when allowed to stand in contact with warm dilute alcohol. resene.

Varieties &c.—*Bordeaux turpentine* is obtained chiefly from *P. maritima.* A vertical incision is made through the bark and about 1 centimetre deep into the wood, and an earthen pot is fixed at the bottom, in which the turpentine is collected. The cut is gradually lengthened until it is about 3 metres long, then the opposite side, and finally the edges of the cicatrix of the first cut are incised, the tree remaining productive for 100 years. A product similar to 'scrape' is also obtained; it is termed 'galipot.'

The principal turpentine-producing districts in France are the south-western departments of Landes and Gironde. The resin consists chiefly of the anhydride of pimaric acid.

Venice turpentine is obtained from the larch, *Larix europæa*, DC., in France and the southern Tyrol, by boring into the stem in the spring, and collecting the oleo-resin that exudes. It is a yellowish, slightly turbid, viscid liquid, with bitter, aromatic taste. A factitious mixture of resin and turpentine is commonly substituted for it in this country.

15-22% vol. oil, chiefly pinene, rest is resin.

BURGUNDY PITCH

Source &c.—Burgundy pitch is a resinous exudation obtained from the stem of *Picea excelsa*, Link (N.O. *Coniferæ*), melted and strained.

Burgundy pitch is collected chiefly in *Finland*, smaller quantities being obtained in the *Black Forest* and in the *Jura* mountains. Incisions are made through the bark into the outer layers of wood, and the oleo-resin that exudes is scraped out of the incisions in which it solidifies, melted under water, and strained.

Description.—True Burgundy pitch is an opaque, yellowish-brown or dull reddish-brown substance, hard and brittle, but gradually taking the form of the vessel in which it is kept. It is strongly adhesive, breaks with a clear, conchoidal fracture, and has a very agreeable aromatic odour, especially when heated. The taste is sweet and aromatic without bitterness.

It is soluble in twice its weight of glacial acetic acid, and readily soluble in alcohol.

Constituents.—Burgundy pitch contains a little *volatile oil* and *resin*. The latter appears to consist chiefly of the anhydride of pimaric acid. Sol. in C_2H_5OH.

Varieties &c.—Much of the Burgundy pitch of commerce is a factitious mixture of resin, turpentine, and palm oil; it may be distinguished from the genuine by its incomplete solubility in twice its weight of glacial acetic acid (Pharmacographia).

GUAIACUM RESIN

Source &c.—Guaiacum resin is the resin obtained from the stem of *Guaiacum officinale*, Linn., or *Guaiacum sanctum*, Linn. (N.O. *Zygophylleæ*). Both of these are large evergreen trees, the former a native of the *West Indian Islands* and the *north coast of South America*, the latter indigenous to *southern Florida* and the *Bahamas*. Both occur in *Cuba* and *Hayti*, where much of the resin of commerce is obtained. The Spaniards became acquainted with the tree when they conquered San Domingo; the wood was soon brought to Europe, where it acquired an immense reputation in the sixteenth century as a cure for syphilis and other diseases; the resin was introduced later.

The resin may be obtained either by spontaneous exudation from the bark of the trees or exudation after incision (tear guaiacum); in the latter case deep cuts are made into the stem or branches, and the exuded resin is scraped off. But the bulk of the resin of commerce is produced in a rather crude way from the trunk of the tree, the heartwood of which, as already stated (see 'Guaiacum Wood'), contains from 20 to 25 per cent. of resin.

A log of the wood is supported in a horizontal position above the ground by two upright bars. Each end of the log is then set on fire, and a large incision having been previously made in the middle, the melted resin runs out therefrom in considerable abundance (Pharmacographia); or one end of a log of wood is raised, and fire applied to it, when the melted resin will run out of a groove cut in the other end, and may be received in pot-sherds (block resin).

Description.—Guaiacum resin is usually seen in large masses of dark colour, often more or less covered with a greenish powder. The resin breaks easily with a clean, glassy fracture, thin splinters viewed by transmitted light being transparent, and varying in colour from yellowish-green to reddish-brown. The powder is greyish, but becomes green by exposure to light and air. It has a slightly acrid taste, and, especially when warmed, a somewhat balsamic odour. It is freely soluble in alcohol, chloroform, and solution of caustic potash, but is only slightly soluble in petroleum spirit, carbon bisulphide, or benzol.

The resin in tears forms rounded masses, attaining an inch in diameter, usually covered with a greenish powder, and exhibiting the characters already detailed.

The commercial drug is never completely soluble in alcohol. The residue, which in the case of tear resin is about 1·5 per cent., and in good samples of the lump averages about 7·5 per cent. (Evans, 1898), may in exceptional cases amount to as much as 25 per cent. It consists chiefly of fragments of vegetable débris, gummy matter, &c.

Guaiacum resin is easily identified by its remarkable reaction with oxidising agents. This is best seen by dissolving a little of the resin in alcohol and adding a drop of dilute solution of ferric chloride; the liquid instantly assumes a deep blue colour which is destroyed by reducing agents, but restored by oxidising agents.

The student should observe

(*a*) The *varying colour* that the resin exhibits when viewed by transmitted light, (*b*) The *greenish powder* with which it is often more or less covered,

(*c*) Its *characteristic*, though not powerful, *odour and taste*.

Constituents.—Guaiacum resin consists chiefly of three organic acids, viz. *guaiaretic*, *guaiaconic*, and *guaiacic acid*. Guaiaretic acid is alone crystalline, but guaiaconic acid is present guaiac- in the largest proportion, constituting rather more than one-half yellow of the resin. The latter constituent produces the remarkable blue colour with oxidising agents. Guaiac-beta resin.

Uses.—The action of guaiacum is that of a local stimulant or, in large doses, irritant, producing in the latter case vomiting and purging. It has been employed locally in the form of the lozenge, and has also been given in chronic gout and rheumatism.

ARAROBA

(Goa Powder)

Source &c.—Araroba, or, as it is often termed, Goa powder, is a substance found in cavities in the trunk of *Andira Araroba*, Aguiar (N.O. *Leguminosæ*), a large tree common in the damp forests of *Bahia* (Brazil).

This remarkable substance is found filling longitudinal fissures in the trunk of the tree. From careful microscopical examinations that have been made of the fragments of wood picked from the crude drug, it would appear that the walls of both parenchymatous and prosenchymatous cells, as well as those of the vessels, undergo a complete change, by which they are converted into a yellowish, powdery substance, araroba. This change is observable first in the secondary thickenings of the cell-wall, but afterwards the cell-walls themselves break down, thus forming cavities of considerable size which are filled with the araroba. Of the exact nature of the change, of the influences that induce it, and the manner in which it is effected, we have no knowledge. It appears to be a pathological product, the formation of which is induced by some external agency, and not a normal physiological product of the plant.

Araroba is collected by felling the tree, sawing the trunk into lengths, and splitting these longitudinally. The yellowish powder is then scraped out with the axe, by which means numerous splinters of wood and other débris are simultaneously removed. It is exported in that crude condition, and may be purified by sifting it as free as possible from fragments of wood, drying, and powdering it. The drug appears to have been long known to the natives of Brazil as a cure for certain skin diseases. In 1864 Kemp drew attention to the Goa

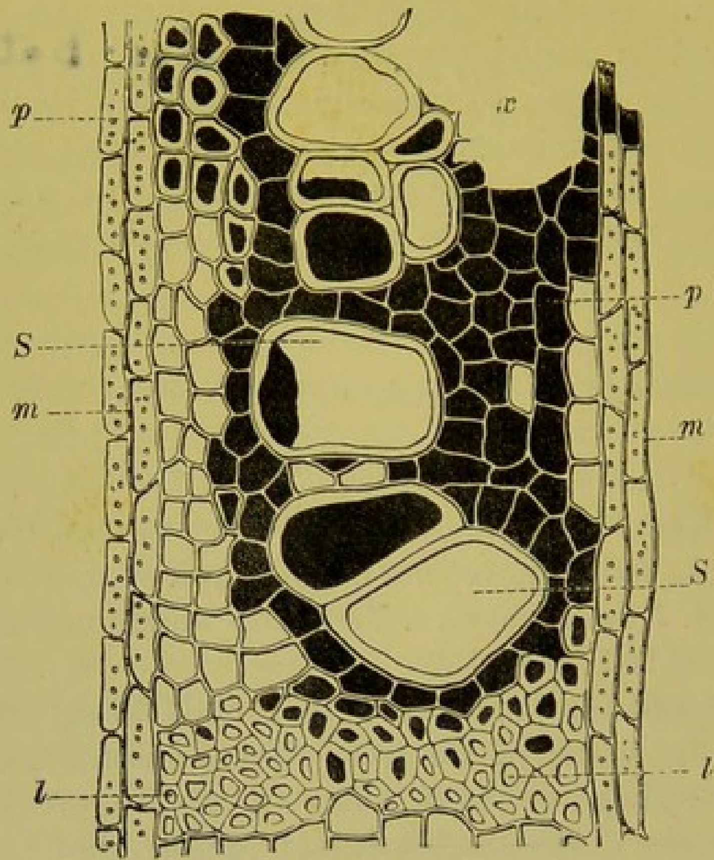


FIG. 202.—Araroba. Portion of a transverse section of the wood of *Andira Araroba*, near to a cavity filled with araroba. *S*, vessels; *l*, wood fibres; *p*, wood parenchyma; *m*, medullary rays. Nearly all the elements contain a dark substance, which in the upper part forms a dense mass, *x* (omitted from the illustration). Magnified. (Vogl.)

powder that was used in India for similar purposes, and this proved in 1875 to be identical with the araroba of the Brazilians.

Description.—The crude drug, as imported, consists of a brownish-yellow or umber-brown powder mixed with numerous small and large fragments of wood. Microscopical examination of the powder shows the presence of numerous minute prismatic crystals, and granular, amorphous matter accompanied by vegetable débris. The smoothed transverse surfaces of the larger fragments of wood show fine, yellow, medullary rays and vessels, and here and there yellow masses (of araroba). As already observed, it is sometimes purified by simply freeing it from the débris present, drying, and powdering ; but the purification is more generally effected by grinding the crude drug, exhausting it by boiling it with chloroform or benzol, evaporating the solution to dryness, and powdering the residue so obtained. But it is supposed that by this method an active constituent insoluble in chloroform or benzol is left in the drug.

The crude drug, after having been freed as much as possible from fragments of wood, dried, and powdered, should yield not less than 50 per cent. of its weight to hot chloroform.

Thus purified by solution in chloroform the drug yields the official chrysarobin. This is obtained as a yellow, crystalline, tasteless, and inodorous powder, soluble in hot chloroform, almost entirely soluble in hot alcohol, partially in petroleum spirit, but only slightly in water. In cold solution of caustic potash part of it dissolves readily, yielding a solution of a deep brownish-red colour, and leaving a yellowish sediment which requires repeated treatment with the alkali to effect its complete solution.

Much of the purified araroba of commerce is said to be obtained by exhausting the crude drug with an aqueous solution of a caustic alkali and precipitating the chrysarobin and chrysophanic acid by acidifying the filtered liquid.

When heated, araroba melts, gives off yellow fumes, and finally burns, leaving not more than 1 per cent. of ash.

Constituents.—The purified drug, which should properly be termed purified araroba, and not, as officially sanctioned, chrysarobin, much less, as commonly is the case, chrysophanic acid, consists largely of *chrysarobin* with which a varying quantity of *chrysophanic acid* is associated. Both of these substances are definite, crystalline bodies : chrysophanic acid dissolves with facility in dilute caustic alkalies, yielding deep red solutions ; chrysarobin is less easily soluble, and when dissolved by a strong alkali it is rapidly oxidised to chrysophanic acid, the solution turning from yellowish-brown to deep red ; this change may be hastened by passing a current of air through the solution.

In addition to these two substances there are unquestionably other bodies present. Microscopical examination shows colourless prismatic crystals and an amorphous resin, in addition to which there appears to be a substance present in the crude drug that is not removed by chloroform. These constituents of araroba have not yet been investigated.

Uses.—Chrysarobin has been used successfully in ringworm, psoriasis, and other skin diseases; it acts apparently by destroying low vegetable organisms.

BENZOIN

Source &c.—Benzoin is officially described as a balsamic resin obtained from *Styrax Benzoin*, Dryand. (N.O. *Styraceæ*), and probably other species of Styrax.

There are certainly three species at least of *Styrax* that yield commercial benzoin, of which only one, *Styrax Benzoin*, is known. This is a tree of moderate size, indigenous to *Java* and *Sumatra*, and it is in the latter island principally that benzoin is collected. The drug was not known in Europe till the middle of the fifteenth century, although it had presumably long been produced in Sumatra.

It is a remarkable fact that the benzoin tree does not contain at any period of its development special secreting cells or ducts for the formation of the benzoin. The drug appears to be a purely pathological product, the formation of which may be induced by injury to the bark of the tree.

At first the tannin contained in the parenchymatous cells of the medullary rays resinifies; this change extends to the bast parenchyma, and finally the wood, attacking the walls of the cells as well as their contents. The product is fluid when formed, but gradually hardens. Benzoin is sometimes placed in the artificial class of 'balsams,' as it appears at first to be an oleo-resinous fluid, and it contains either cinnamic or benzoic acid (or sometimes both). But the physical characters of the drug as seen in commerce are those of a resin, and it is best considered as such. The Pharmacopœia solves the difficulty by styling it a 'balsamic resin.'

The drug is obtained by hacking the bark of the tree with an axe. The liquid benzoin, which is gradually formed, either accumulates between the bark of the tree and the trunk or exudes from the incisions; it is allowed to get firm and is then collected, bought by Chinese traders, softened by heat or hot water, and packed in oblong boxes, being often, it is said, mixed with vegetable débris in the course of repacking.

Several commercial varieties are known, the chief of which are Siam, Sumatra, and Palembang; Penang benzoin is imported to a smaller extent.

Description.—1. *Siam Benzoin.*—This variety of benzoin is collected in the Siamese province of Luang Prabang, in the neighbourhood of the Mekong River, but from what species of *Styrax* is at present unknown, certainly not from *Styrax Benzoin*. It appears in commerce either as separate tears or in the form of masses composed of tears more or less firmly cemented together by a dark reddish-brown, transparent resin.

The tears vary considerably in size, but seldom exceed 2 inches in length, by ½ inch in thickness; usually they are much smaller. They are flattened, or sometimes, if large, concavo-convex, this shape being evidently caused by the resin accumulating between the trunk and bark of the tree. They are opaque, brittle, and milky-white internally, but are usually covered with a thin coating of brownish resin, which increases as the tears are kept, being produced from the opaque tear by a change that is not at present understood.

Block Siam benzoin consists of small tears cemented together by a glassy, reddish-brown, transparent or translucent resin, which gives them a peculiar varnishy appearance. In this case also the proportion of the red, transparent resin increases as the drug is kept until it becomes its most prominent feature.

Both varieties of Siam benzoin are characterised by their agreeable fragrant odour, recalling vanilla; they are almost entirely soluble in alcohol, yielding only about 2 per cent. of insoluble residue.

Constituents.—Siam benzoin consists mainly of two substances of alcoholic nature (*benzoresinol* and *siaresinotannol*), combined with *benzoic acid* and associated with *free benzoic acid*. The characteristic fragrant odour is due to *vanillin* (0·15 per cent.), and an oily, aromatic liquid (0·3 per cent.) that appears to be an ester of benzoic acid, but the exact composition of which is not known. It contains *no* cinnamic acid, a fact which assists in distinguishing this variety of benzoin from that exported from Sumatra. The benzoic acid constitutes as much as 38 per cent. of the drug, part existing in the free state, part combined with the benzoresinol and siaresinotannol.

2. *Sumatra Benzoin* is obtained on the island of Sumatra, and occurs only in masses consisting of opaque white tears embedded in a resin which in this case is of a dull reddish brown, and usually wanting in the transparent, varnishy appearance of the Siam drug. It differs also in its odour, which recalls storax rather than vanilla, and in the fact that it contains cinnamic acid, from which Siam benzoin is free. The presence of this acid is easily detected by boiling a fragment of the drug with solution of soda, filtering, and warming again with potassium permanganate, when the evolution of benzaldehyde indicates the presence of cinnamic acid.

Sumatra benzoin is usually less pure than Siam. Apparently during the repacking in Singapore much vegetable débris finds its way into the angles of the boxes into which it is packed. Good Sumatra benzoin should not contain more than 10 per cent. of substances insoluble in alcohol, whilst inferior qualities often yield up to 30 per cent.

Constituents.—Sumatra benzoin consists principally of two alcohols combined with *benzoic* and *cinnamic acids*, and associated with *free benzoic* and *cinnamic acids*. Of these two alcohols, one, benzoresinol, is identical with the benzoresinol of Siam benzoin; the other, resinotannol, is similar to, but not identical with, siaresinotannol. The drug contains, in addition, traces of benzaldehyde, benzene, vanillin (1 per cent.), phenylpropyl cinnamate, styrol, and styracin, all of which combine to produce its particular fragrance.

From Sumatra benzoin 18 per cent. or even more of benzoic acid has been obtained, and about 20 per cent. of cinnamic acid.

3. *Palembang Benzoin.*—This variety, which is not official, is produced in Sumatra, it is said from *S. Benzoin.* It differs markedly in appearance from both Siam and Sumatra benzoin, consisting principally of a translucent, greyish-brown or reddish resinous mass in which a few scattered, opaque, white tears are embedded. It breaks with an irregular fracture, the fractured surface being uneven and often exhibiting small cavities. The

odour, which is not strong, recalls that of Sumatra benzoin. Its constituents have not yet been accurately investigated; it appears to contain *benzoic* but *no cinnamic acid.* It is not official, and is used only for the preparation of benzoic acid.

These characters apply to the variety of benzoin known in this country as Palembang; it would appear that in Java this name is applied to a different variety of the drug.

DRAGON'S BLOOD

Source &c.—Dragon's blood is a resinous secretion produced on the fruits of *Calamus Draco*, Willd. (N.O. *Palmeæ*), a climbing palm with long, flexible stem, indigenous to *Sumatra* and *Borneo.* Very probably more than one species furnish the commercial drug, but what these are is at present unknown.

The plant produces numerous small fruits about the size of a cherry, covered with hard, yellowish, imbricated scales, which overlap one another from apex to base. From these scales a red resin exudes, more or less completely covering the fruit. The fruits are shaken together in a basket, and the separated resin mixed with water, pressed into moulds, and then melted. It is said to be nearly always mixed with the milky juice of *Garcinia parviflora*, Miq. (Treub, 1891).

Description.—Dragon's blood occurs in lumps of very varying size and shape. They are often rounded, flattened cakes several inches in diameter and 2 inches or more in thickness, that appear to have been moulded in an earthen dish; sometimes the cakes are smaller and thinner. Occasionally it is imported in sticks about 8 or 9 inches long and 1 inch thick, or 12 inches long and ½ inch thick, each carefully wrapped in a palm leaf. These varieties are known as 'lump,' 'saucer,' 'reed,' &c. dragon's blood.

Good samples of the drug usually have a dull, dark red colour, and are more or less covered, where the pieces have rubbed against one another, with a crimson powder. They are brittle and friable, breaking with a glossy but irregular, uneven, porous fracture, and although opaque in lump, minute fragments are translucent and of a deep garnet-red colour.

The drug yields when crushed a bright crimson powder, has no odour, and is practically tasteless, breaking up when chewed into a fine gritty powder.

Inferior qualities are duller in colour and tougher. They yield a duller crimson or even brick-red powder, and exhibit less powder on the surface of the lumps. Such specimens frequently contain numerous fragments of the fruit scales, which are easily seen when the drug is broken, or are left when it is exhausted with alcohol.

Tears, in which form the drug is now seldom seen, give a glassy, conchoidal fracture, thin flakes being of a clear garnet-red colour.

Constituents.—Dragon's blood has been carefully examined by Dieterich (1896), who found it to consist principally of a red
0-10% resin (56·8 per cent.) that proved to be a compound of *dracoresino-tannol* with *benzoic* and *benzoylacetic acids*. Other constituents are a white, amorphous body, *dracoalban* (2·5 per cent.), *dracoresen* (13·58 per cent.), vegetable débris (18·4 per cent.), and ash (8·3 per cent.).

It is frequently considerably adulterated both with earthy matter and with fragments of the scales of the fruits, the amount of residue insoluble in alcohol amounting sometimes to as much as 40 per cent. of the drug.

Uses.—Dragon's blood is chiefly used for colouring varnishes &c.

MASTICH

Source &c.—Mastich is a resin obtained from *Pistacia Lentiscus*, Linn. (N.O. *Anacardiaceæ*), a shrub or small tree indigenous to the countries bordering on the *Mediterranean*. The resin, which has been known from the earliest times, and was formerly much more highly prized than it is now, is collected on the island of Scio in the Grecian Archipelago, and also in Cyprus, and possibly on other islands, but is exported only from Scio.

he bark of the tree, which contains a circle of oleo-resin ducts in the bast, is punctured with a small instrument resembling a chisel ; the oleo-resin exudes in the form of small tears which in a few days become dry and hard. It is then collected, that taken from the tree itself forming the best qualities, whilst that which has dropped upon the ground is inferior.

Description.—Mastich occurs in small hard tears about the size of peppercorns. The majority are pear-shaped, ovoid, or nearly globular; sometimes, but not often, they are elongated and resemble small stalactites. They are pale yellow in colour, and have a dull, dusty surface; they are brittle, breaking with a clear, glassy, conchoidal fracture, the interior of the tears being quite transparent. When chewed the tears break up at first into a sandy powder, which subsequently agglomerates into a plastic mass. The drug has an agreeable, rather aromatic odour, and a slight agreeable taste, both of which, though not pronounced, are characteristic.

The student should observe

(*a*) The preponderance of *rounded or pear-shaped tears*,
(*b*) The *characteristic odour*,
(*c*) The formation of a *plastic mass when the resin is chewed*;

and should compare the drug with

Sandarac resin (see below).

Constituents.—Mastich consists of *resin* associated with 2 or 3 per cent. of *volatile oil*. About 90 per cent. of the resin is soluble in alcohol (masticic acid); the residue (masticin) is insoluble even in boiling alcohol but soluble in ether. Of the nature of these resins nothing further is known.

Mastic masticu & mastico acids

Uses.—Mastic was formerly employed as a stimulant, and was also used in the manufacture of varnishes. For the latter purpose it has been superseded by other cheaper resins, whilst as a medicine it is obsolete.

SANDARAC

Source &c.—Sandarac is a resin obtained from *Callitris quadrivalvis*, Ventenat (N.O. *Coniferæ*), a small tree about 15 or 20 feet high, growing on the mountains in the *north-west of Africa*. It is usually obtained by incision, the tears when sufficiently hard being collected and exported, chiefly from Mogadore.

Description.—Sandarac occurs in small tears about the same size as mastich, but usually of an elongated, more or less cylindrical or stalactitic form, several of which are sometimes united into a small flattened mass. Globular or pear-shaped tears are comparatively rare in it, and by this means it can be distinguished at sight from mastich.

The tears have a dull dusty surface and a pale yellowish colour; they are brittle, breaking with a glassy, conchoidal fracture, and displaying a clear, transparent interior, in which, as in amber, small insects are occasionally embedded. The resin has a slight terebinthinate odour and a terebinthinate, slightly bitter taste; when chewed it breaks up between the teeth into a sandy powder which, unlike mastich, shows no disposition to agglomerate into a plastic mass.

It is completely soluble in alcohol and ether, partially only in chloroform, carbon bisulphide, and turpentine.

The student should observe

(*a*) The *preponderating stalactitic form*,
(*b*) The *terebinthinate odour*,
(*c*) The *indisposition to form a plastic mass between the teeth*;

and should compare this drug with

(i) *Mastich* (see p. 425),
(ii) *Olibanum* (see below).

Sandaracinic, san-aracinolic & sandar-opimaric acids.

Sand-acon

Constituents.—Sandarac consists principally, according to a recent research (Balzer, 1896), of *sandaracolic acid* (85 per cent.) and *callitrolic acid* (10 per cent.). It contains in addition traces of volatile oil, bitter principle, water, and ash.

Uses.—Sandarac is chiefly used in the manufacture of varnishes; it is paler in colour than shellac, and is therefore more suitable for light woods.

AMBER

(Succinum)

Source &c.—Amber is the fossil resin of certain extinct coniferous trees, chiefly of *Pinus succinifer*, Conwentz. Several varieties of amber have been distinguished, but that known as Succinite or Baltic amber is the only one of commercial importance.

The amber-yielding trees probably formed in the early part of the period geologically known as the oligocene, and belonging to the tertiary formations, extensive forests over the northern parts of Scandinavia. They contained oleo-resin ducts similar to those of coniferous trees of the present day, and in addition frequently produced abnormal quantities of oleo-resin as the result of injuries, to which they appear to have been especially liable. The oleo-resin, hardened by exposure and liberated by the gradual destruction of the trees, was carried, towards the latter end of the oligocene period, from the position occupied by the forest and deposited in a bed of blue earth of considerable extent near the eastern shores of the Baltic. From this bed of earth which lies below the sea-level the amber is now recovered chiefly by mining, but some little is washed by the sea from the exposed surface of the stratum and thrown up by the waves on the shore.

Succinite is also occasionally found on the east coast of England, whither it has been brought by the sea.

Description.—Amber occurs in pieces varying much in size and shape, usually with rounded edges and covered with a dark crust. Internally it is transparent, translucent, or quite opaque (cloudy amber), and of varying shades of yellow or brown. It exhales when warmed a slight but characteristic odour, and is almost tasteless. It is hard, breaking with a bright, conchoidal fracture that is sometimes glassy, sometimes opaque. It is partially soluble in alcohol, ether, and chloroform ; it melts at 280° to 290° C., at the same time decomposing and yielding water, succinic acid, and various tarry products amongst which the presence of sulphuretted hydrogen may be noticed.

Constituents.—Baltic amber or succinite yields about 25 per cent. to alcohol, consisting principally of free *succino-abietic acid*, a small portion of the acid being combined with *borneol*. The part insoluble in alcohol, *succinin*, was found to be a compound of succinic acid, with a resin-alcohol, succino-resinol.

Amber (succinite) contains in addition traces of sulphur and of inorganic substances.

By destructive distillation amber yields a dark tarry oil accompanied by water ; the former, separated from the watery fluid and redistilled, forms the genuine yellow oil of amber of commerce.

SHELLAC

Source &c.—Shellac is a resinous exudation that encrusts the bodies of *Coccus Lacca*, Kerr. Tacardia Lacca.

The female insects, after impregnation, resort in large numbers to the twigs of certain trees. They increase in size, become filled with a red colouring matter resembling that produced by the cochineal insects, and at the same time become surrounded and enclosed in a resinous exudation. In this way, encrusted with resin, they end their lives.

Whether the resin is secreted by the insects or produced by the plant as a result of the irritation caused by the insects is at present not definitely known. The resin shows, in its chemical composition, a variation from vegetable resins, and this seems to indicate that it owes its origin, in part at least, to a change effected by the insects in the constituents of the plant.

Numerous trees of different natural orders are thus visited. The principal ones are *Aleurites laccifera*, Willd. (N.O. *Euphorbiaceæ, India*), *Ficus religiosa*, Linn. (N.O. *Urticaceæ, India*), *Schleichera trijuga*, Willd. (N.O. *Sapindaceæ, India*), and *Butea frondosa*, Roxb. (N.O. *Leguminosæ, Ceylon &c.*).

After the secretion of the resin the twigs are broken off, and form without further preparation the stick lac of commerce. Stick lac therefore consists of the twigs of the trees coated with a granular brownish or reddish resin which is frequently ¼ inch thick. Enclosed in this resin are the bodies of the insects, which contain a valuable colouring matter. The latter is extracted by breaking the lac from the twigs, crushing it, and exhausting it with water or dilute soda solution. The aqueous solution contains a red colouring matter, laccaic acid, that resembles carminic acid, but is not identical with it. It can be obtained by precipitating the alkaline solution with alum, the precipitate when dried forming the lac dye of commerce. After the resin has been crushed and freed from colouring matter, it forms brownish grains which are known as seed lac. This still contains various débris of the insects &c., from which it can be purified by melting and straining, the melted resin being pressed through a cloth whilst hot. In this way commercial shellac is obtained.

Description.—Shellac is usually seen in thin, brownish-yellow, leafy flakes, more or less translucent in appearance, brittle, and easily pulverisable. When heated it melts, evolving a characteristic odour.

Shellac is completely soluble in hot alcohol, but not quite completely soluble (about 90 per cent.) in cold. Ether removes from it only about 5 per cent., but hot caustic alkalies and solution of borax dissolve it entirely.

Constituents.—A recent investigation of stick lac (Farner, 1899) resulted in the separation of the following constituents:

Wax	6·0	per cent.
Colouring matter (laccaic acid)	6·5	,,
Resin	74·5	,,
Residue (sand, vegetable and animal débris) . .	9·5	,,
Moisture and loss	3·5	,,

Of the resin 35 per cent., composed principally of fatty acids, was soluble in ether. The part insoluble in ether (65 per cent.) consisted of a resinotannol combined with aleuritic acid, a crystalline acid belonging to the fat acid series.

Shellac consists principally of the resin (90 per cent.) and wax and other substances (10 per cent.).

SECTION XIV

GUM-RESINS

GAMBOGE

Source &c.—Gamboge is a gum-resin obtained from *Garcinia Hanburii*, Hook. f. (N.O. *Guttiferæ*), a tree of moderate size found in *Cambodia*, *Siam*, and the southern parts of *Cochin China*.

The bark of the tree contains in the cortex, as well as in the bast, secretory ducts filled with a yellow, milky gum-resin, the two systems being connected by transverse canals at the nodes.

The gamboge is obtained by making in the rainy season a spiral cut in the bark from a height of about 10 feet down to the ground. The gum-resin wells out and trickles down the incision into a hollow bamboo placed to receive it. From this it is transferred to smaller bamboos; these are set aside until, in about a month, the gamboge has solidified. It is removed from the bamboo by drying over a fire until the bamboo cracks and can be stripped off. The drug is sold to local collectors, who convey it to Bangkok or Saigon, whence it is exported to Europe, usually viâ Singapore.

It is occasionally formed whilst soft into cakes of various shapes or into thick sausage-like masses, which are wrapped in leaves, the impression of which they bear on their surface (Saigon gamboge).

Description.—The finest qualities of gamboge occur in rolls, 1 or 2 inches in thickness, and from 4 to 8 inches in length, nearly cylindrical, solid or hollow in the centre, and marked externally with longitudinal furrows derived from the inner surface of the bamboos in which they have been dried. The drug breaks easily, with a smooth, uniform, conchoidal fracture, the freshly fractured surface having a dull gloss and being of a rich reddish-yellow or brownish-orange colour. It is easily reduced to a bright yellow powder, with little odour, but with an acrid taste.

Rubbed with the wet finger gamboge instantly forms a yellow emulsion. It is almost completely dissolved by the successive action of alcohol and water. The yellow emulsion yielded with water becomes nearly clear and deep orange red on the addition of ammonia.

Sometimes the rolls of gamboge are agglomerated into masses, or the drug occurs in irregular lumps frequently soft in the interior and often containing much visible impurity.

Inferior gamboge breaks with a dull, rough, granular fracture, and the fractured surface, which often exhibits small cavities, is of a dark brownish colour.

Gamboge is occasionally imported (from Saigon) in thick, short, cylindrical cakes wrapped in leaves.

Constituents.—Gamboge consists principally of *gum* and *resin*. The former varies in amount from about 15 to 25 per cent., and is not identical with gum acacia. The resin, which has been termed cambogic acid, is soluble in alkaline solutions and in alcohol. The drug, if of good quality, yields not more than 1 per cent. of ash.

Hurst (1889) found a sample of gamboge to have the following composition:

Moisture	2·50 per cent.
Ash	1·05 ,,
Resin	66·05 ,,
Wax	4·31 ,,
Gum	26·03 ,,

Eberhardt found the resin to vary from 76 to 82 per cent.

Adulterants.—The chief adulterants are starch, inorganic matter (such as sand &c.), and vegetable débris. These are all easily detected by their insolubility in alcohol and water used successively, or in dilute ammonia. Starch is officially tested for by adding iodine to a cooled decoction, which should not then assume a distinct green colour (*traces* of starch are usually present in gamboge). Inorganic substances would also be detected by the ash, which should not exceed 3 per cent.

Uses.—Gamboge in large doses produces both purging and vomiting. It has been employed as a hydragogue cathartic, but is now seldom used as a medicine.

SCAMMONY

Source &c.—Scammony is a gum resin obtained by incision from the living root of *Convolvulus Scammonia*, Linn. (N.O. *Convolvulaceæ*).

The scammony plant is a twining plant indigenous to the *eastern Mediterranean* and resembling the common bindweed but much larger. It produces a root, often of very considerable size, as much as 3 feet in length and 4 inches in thickness, from which a number of slender aerial stems spring. The gum resin is collected in Asiatic Turkey, chiefly near Smyrna and Aleppo.

The abnormal structure of the root has been already alluded to (see Scammony Root). In the cortex as well as in the parenchyma surrounding each of the columns of wood are cells containing a liquid gum-resin. These cells are arranged in vertical rows, and when an incision is made the contents drain from a series of cells by the breaking of the transverse walls. In collecting the gum-resin the workman clears away the earth surrounding the upper part of the root so as to leave 4 or 5 inches of the root exposed. This is then cut off in a slanting direction 2 to 4 inches below the crown, and a mussel shell is stuck into it just beneath its lowest edge so as to receive the milky sap which instantly flows out. The shells are usually left till the evening, when they are collected and the cut parts of the roots scraped with a knife so as to remove any partially dried drops of juice (Pharmacographia). If the gum-resin were then dried at once a drug of fine golden-brown colour and translucent appearance would be produced; but as a rule the contents of the shells are collected, and daily added to, until a sufficient quantity has accumulated; this is then softened, mixed into a homogeneous mass, and allowed to dry. During the long standing in a more or less moist condition the scammony undergoes a fermentative change, and the drug when dry has a darker colour and porous appearance when broken. It is also frequently adulterated whilst in the soft state.

Description.—Scammony is usually imported in flattened cakes about ½ inch thick and 4 or 5 inches in diameter. It varies in colour from dark-grey to brown or nearly black, the surface being often covered with a grey powder. It breaks very readily, and the freshly exposed surface is glossy, resinous, often more or less porous, and of a dark-brown or nearly black colour. Thin fragments, however, when viewed by transmitted light, are seen to be brown in colour and translucent. It is very easily reduced to an ash-grey powder, and readily yields a milky emulsion when rubbed with water. Scammony has a characteristic odour, commonly compared to that of cheese, and an acrid taste.

Very fine qualities of the drug which, however, are scarce, differ in being of a golden-brown colour, almost transparent in thin fragments, and less porous.

The student should observe its *brittle nature*, *translucent brown colour* in thin fragments, and *characteristic odour*; it yields a milky emulsion when rubbed with the wet finger, a character that distinguishes it from scammony resin, which does not emulsify when so treated.

Constituents.—Pure scammony contains about 88 or 90 per cent. of *resin* identical with that obtained from the root (see before) and entirely soluble in ether; the residue consists principally of gum. But scammony of such purity as this is seldom met with in commerce. Good qualities yield from 75 to 80 per cent. of resin to ether, and are known as 'Virgin' scammony. The official standard has been fixed at 70 per cent. 70%

Adulteration.—The high price of scammony and its plastic nature before it is dried invite and facilitate adulteration. Starch, chalk, and earthy matter are frequently used to increase its weight, and occasionally other resins are fraudulently mixed with it.

Adulteration with inorganic matter is readily detected by incineration. Good scammony should not yield more than 3 per cent. of ash. Starch is easily recognised by microscopical examination or by the iodine test, but traces of the starch of scammony root are often present in genuine scammony, and caution must be used in concluding that the drug has been adulterated. Guaiacum resin has been used to adulterate scammony, and a specific test for it has been introduced into the Pharmacopœia; the alcoholic solution of scammony should not be coloured blue by solution of ferric chloride (compare Guaiacum Resin).

Inferior scammony is usually tough and has a dull fracture, small splinters being opaque instead of translucent. Factitious scammony that was practically free from resin soluble in ether has even been offered for sale as genuine scammony.

Under the name of *skilleep* a drug occasionally comes into the market in large, nearly black, oval, flattened cakes or 'puddings,' the interior of which is moist, paler in colour, and possesses an odour resembling sour dough. Such a drug contains but little resin, and consists principally of starch (flour) mixed with (?) an extract of the root.

Uses.—Scammony is used as a brisk cathartic and vermifuge, especially for children.

EUPHORBIUM

Source &c.—Euphorbium is a gum-resin obtained from *Euphorbia resinifera*, Berg. (N.O. *Euphorbiaceæ*), a plant about 3 feet in height, resembling in appearance and habit a cactus, and common in the mountainous districts of *Morocco*, especially

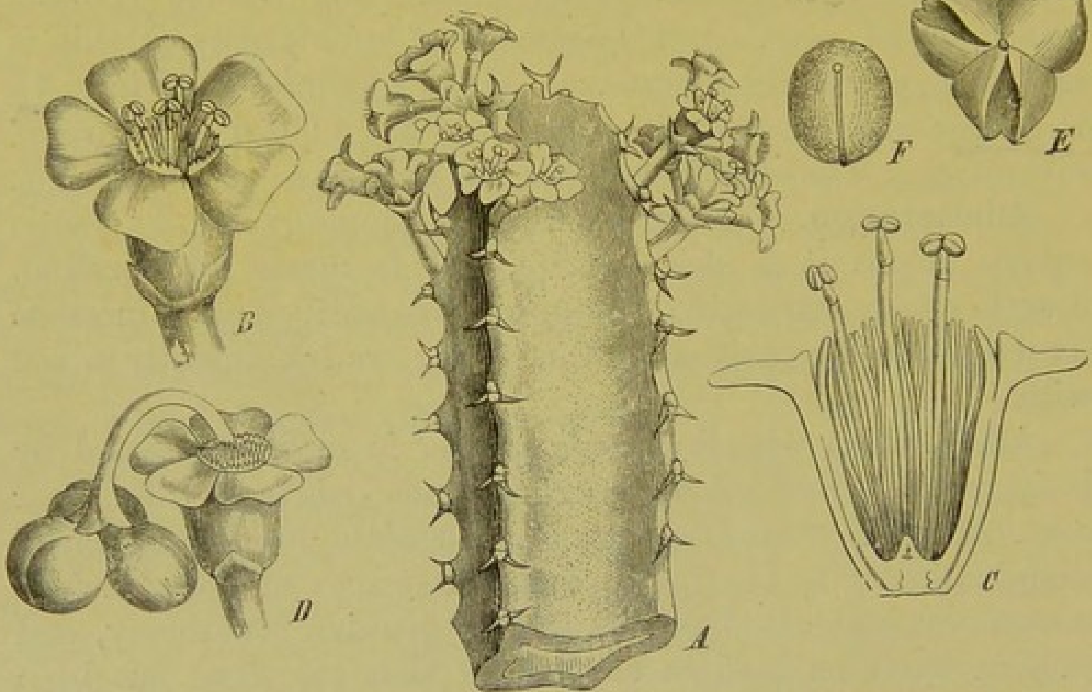


Fig. 203.—*Euphorbia resinifera.* *A*, flowering branch, natural size. *B* and *C*, staminate, *D*, pistillate flower, magnified. *E*, fruit, and *F*, seed, magnified (Luerssen, after Berg u. Schmidt).

on the spurs of the mountains in the neighbourhood of the town of Morocco, where the drug is principally collected.

The plant produces green, fleshy, quadrangular stems and branches which bear small scaly leaves supported by two persistent thorny stipules; the flowers are small and borne on short peduncles; the fruits consist of three carpels, and resemble typical Euphorbiaceous fruits.

The drug, which has long been known, for both Pliny and Dioscorides were well acquainted with it, is obtained by wounding the plant.

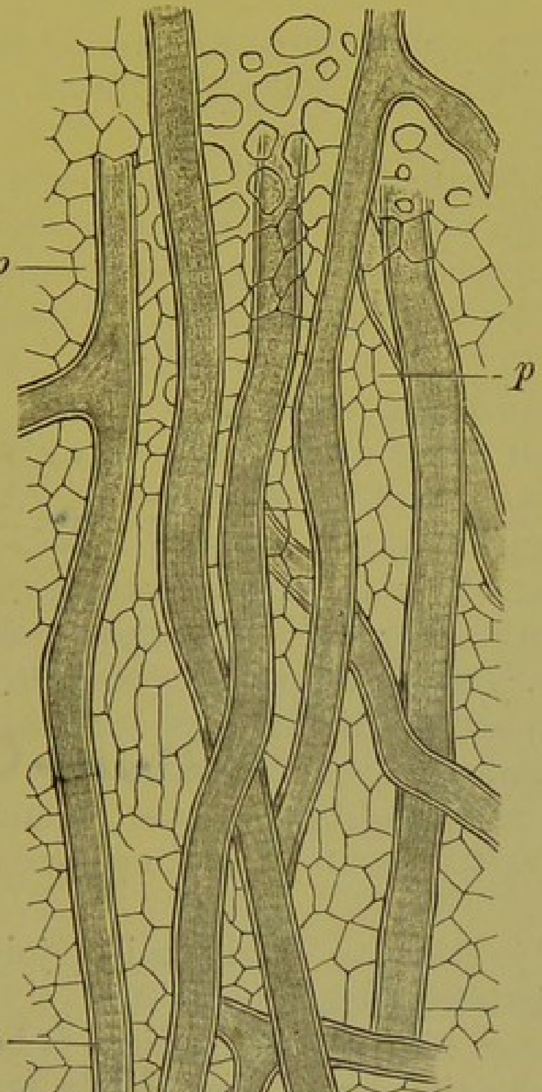


Fig. 204.—Laticiferous cells in the stem of *Euphorbia resinifera*. *p*, parenchyma; *m*, laticiferous cells. Magnified. (Tschirch.)

Both the cortex and the pith of the plant contain long, branching, laticiferous cells; these when wounded discharge their latex, which exudes in the form of milky drops, the exudation in rainy seasons being very copious.

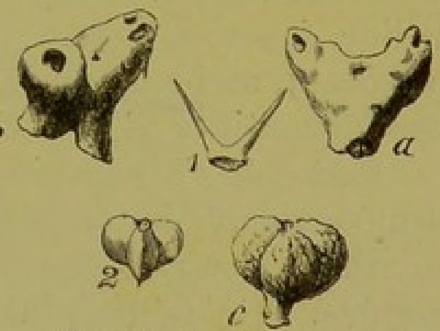


Fig. 205.—Euphorbium. 1, pair of stipules; *a* and *b*, stipules covered with gum-resin; 2, fruit; *c*, fruit covered with gum-resin. (Vogl.)

The milky juice dries to a resinous mass which is collected in the autumn by the poorer class of Arabs and brought to Morocco for sale. It is exported chiefly from Mogadore. So acrid is the drug that the faces of persons handling it have to be protected by cloths.

Description.—The drug occurs in dull yellow or brown, dusty-looking pieces seldom exceeding 1 inch wide, often mixed with fragments of the quadrangular, thorny stem and other débris. Many of the pieces have evidently solidified round a pair of stipules and are pierced by holes corresponding to them, or sometimes even include the stipules themselves; some are pierced with single holes and retain the fruits or flowers or portions of them. The former are characterised by their shape, each consisting of three nearly separate, one-celled, compressed, keeled carpels attached at the apex and base to a central axis.

The gum-resin itself is very brittle, breaking readily between the fingers; internally it is of a dull yellowish-brown colour.

It has no particular odour, but the powder if inhaled excites violent sneezing; the drug has, however, an extremely acrid taste. Although it contains a considerable proportion of gum it shows little disposition to yield an emulsion when triturated with water.

It is partially soluble in alcohol and in ether.

Constituents.—Euphorbium consists principally of a crystalline, inactive body, *euphorbone* (34·6 per cent.), *resin* (41·2 per cent.), and *gum* (about 20 per cent.), in addition to which small quantities of caoutchouc and various salts are present. Eup - ores

Part only of the resin (about 27 per cent. calculated on the drug) is soluble in ether, and it is that portion of the drug alone to which the sternutatory properties and intensely acrid taste are due. Its nature is at present unknown. Sodium + Ca Mal

Euphorbone corresponds in composition to the formula $C_{20}H_{36}O$; it is volatile, melts at 67° to 68° C., and appears to be quite inactive.

Many species of *Euphorbia* yield an acrid, milky juice analogous in composition to the above (Hencke, 1886).

Uses.—Euphorbium possesses very acrid properties. It has been employed as a drastic purgative, but is now chiefly used as a vesicant in veterinary practice.

MYRRH

Source &c.—Myrrh is a gum-resin obtained from the stem of an undetermined species of *Balsamodendron*, probably *B. Myrrha*, Nees (N.O. *Burseraceæ*). It is collected chiefly in *Somaliland*, in the north-east of Africa, and is brought down to the coast and sent to Aden, whence it is shipped to Europe, either direct or viâ Bombay. Some myrrh is said also to be collected in the south of Arabia. Although the Pharmacopœia specifies *B. Myrrha*, Nees, as the plant yielding the official drug, this point cannot be regarded as definitely settled. The exact botanical origin of the drug is still unknown, and its determination is accompanied by great difficulty, since several other species

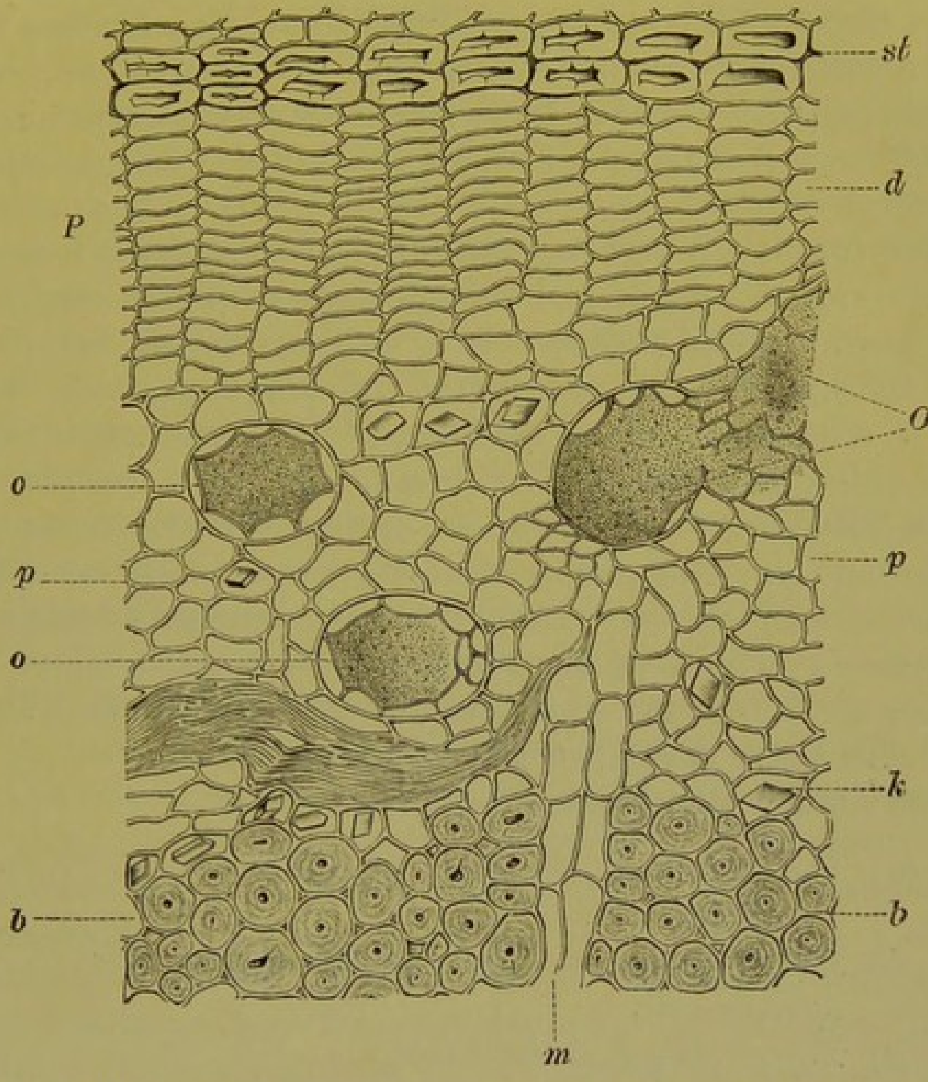


Fig. 206.—Myrrh. Section of a portion of bark, probably of *Balsamodendron Myrrha*. *P*, outer portion (bark) in which layers of sclerenchymatous cells, *st*, alternate with thin-walled cells, *d*; *p*, bast parenchyma; *b*, bast fibres; *m*, medullary ray; *o*, oleo-resin ducts containing a granular secretion (myrrh); *O*, tissue breaking down to form a cavity filled with the secretion. Magnified 280 diam. (Vogl.)

of *Balsamodendron* are found in Arabia and north-eastern Africa yielding gum-resins that more or less resemble the official myrrh in appearance and odour.

These plants are shrubs or small trees, and, like most other plants belonging to the same natural order, they contain numerous schizogenous ducts in the bark, in which an oleo-gum-resin is secreted. In the case of the species to which the official myrrh is ascribed the tissue intervening between the ducts frequently breaks down, and thus lysigenous cavities of considerable extent are produced which, together with the ducts that remain intact, are filled with a granular secretion. When the bark is wounded, therefore, the secretion is discharged in considerable quantity. It is at first yellowish-white and fluid, but soon hardens to a firm, reddish mass which constitutes the commercial drug. The secretion also exudes from fissures that are formed in the bark by natural causes; indeed the bulk of the drug is said to be naturally exuded.

Description.—Myrrh occurs in irregular rounded tears, or lumps composed of agglutinated tears, varying in size from small grains up to masses nearly as large as the fist, pieces about the size of a walnut being of common occurrence. They have a reddish-yellow or reddish-brown colour and a rather rough, dull, dusty surface. They break fairly easily, the fractured surface having a rich brown or reddish-brown colour and translucent, unctuous, granular appearance, often exhibiting whitish spots or veins; thin splinters are translucent or almost transparent. The drug has an agreeable aromatic odour and an aromatic, bitter and acrid, but not unpleasant taste. Triturated with water it yields a yellowish emulsion.

The student should observe

(*a*) The *unctuous, granular* (not uniform and vitreous) *fracture*,

(*b*) The *translucent* (not opaque) *appearance of thin fragments*,

(*c*) The *aromatic, bitter taste.*

The taste is, perhaps, the most characteristic feature of myrrh.

Constituents.—Myrrh consists of a mixture of *resin, gum*, and *volatile oil.* The latter can be obtained by distillation with water to the extent of 2·5 to 6·5 per cent. (Schimmel). The resin occurs in amounts varying from 25 to 40 per cent., the remainder of the drug consisting of gum. The resin is not a homogeneous substance, but contains at least three constituents that have not yet been sufficiently investigated.

Myrrh of good quality should yield not more than 10 per cent. of ash or less than 30 per cent. of resin (Dieterich, 1898). Myrr

Varieties and Substitutes.—As several[1] varieties of myrrh are known, and as commercial myrrh is almost invariably mixed with other gum-resins from which it has to be separated by picking, the following chemical test is useful in distinguishing the genuine. Digest one part of crushed myrrh with ten of ether for a few hours, filter into a test tube, which should be only partially filled, and allow the vapour of bromine to fill the upper part of the tube. The ethereal solution should assume a violet colour. A similar reaction is given by the volatile oil distilled from myrrh, and it is to the presence of the oil in the ethereal extract that the reaction is due. A purplish or violet colour is also produced when nitric acid is added to a tincture of myrrh or even to myrrh itself.

Parker (1879) has described a number of gums or gum-resins that have been found mixed with genuine myrrh and have been separated by picking. The following may be mentioned:

Opaque bdellium is a very hard, yellow ochre-coloured, opaque gum-resin with but a slight odour and a bitter taste. Portions of a papery bark are frequently found associated with it. The tincture (1 to 6) assumes an intense greenish-black colour with solution of ferric chloride.

African bdellium is in hard pieces, translucent in thin layers, and red when viewed by transmitted light. The fracture is dull and slaty, the margins possessing a powdery appearance; it has a bitter taste and an odour recalling pepper. The tincture gives no precipitate with ferric chloride.

Bissabol closely resembles myrrh. It breaks with a waxy fracture and yields to the nail, giving an oily exudation like soft myrrh. It has a yellowish colour, with white markings which, however, are traversed by angular interstices filled with a brown resin. It has an aromatic odour, quite distinct from that of myrrh.

Indian bdellium occurs in large irregular masses of a dark reddish-brown colour. The fractured surface resists the nail, and is covered with characteristic, minute, shiny points of resin

[1] Holmes (1897) distinguishes four varieties of myrrh—viz. *Somali myrrh*, which corresponds to the official description; *Arabian myrrh* (Hanbury), which resembles Somali myrrh but has no whitish markings; *Arabian myrrh* (Dymock), which resembles Somali myrrh, in having whitish marks, but is rather less fragrant and has a dark reddish colour and unctuous waxy fracture; *Yemen myrrh*, which does not yield the bromine reaction.

which also appear on the outer surface. The odour is feeble and cedar-like; it appears to be developed only on keeping. The taste is slightly acrid and devoid of bitterness.

In addition Parker describes several other gums that have been found in commercial myrrh. But as genuine myrrh can be distinguished from each and all of these impurities or substitutes by its characteristic odour and taste and by the chemical test above mentioned, the student is recommended to make himself acquainted with these, and content himself with the information here given concerning the substitutes.

Uses.—Myrrh has stimulant and disinfectant properties; it is used as a mouth-wash and as a uterine stimulant and emmenagogue.

OLIBANUM

Source &c.—Olibanum or, as it is sometimes termed, frankincense (to be carefully distinguished from American frankincense), is a gum-resin obtained from *Boswellia Carterii*, Birdw., and other species of *Boswellia* (N.O. *Burseraceæ*).

These plants are small trees that grow in *southern Arabia* and in *Somaliland* in north-eastern Africa. Like the trees that yield myrrh they contain schizogenous ducts in the bark, in which an oleo-resin is secreted. The Somalis obtain this by incising the bark and collecting the gum-resin as soon as it has sufficiently dried. The drug is conveyed to Aden and thence to Bombay, whence it is exported to Europe.

Description.—Olibanum occurs in small tears varying from ¼ inch to 1 inch in length and usually ovoid, pear-shaped, or club-shaped, but sometimes stalactitic in form, occasionally agglutinated into small masses. They are usually of a pale yellowish colour, frequently with a greenish, bluish, or reddish tinge, and covered with a dull white dust. They are brittle, breaking easily between the fingers; internally they are opalescent and translucent, the fractured surface being waxy.

The drug has a fragrant, balsamic odour and an aromatic, slightly bitter taste, softening when chewed to a plastic mass. Triturated with water it yields a whitish emulsion.

The student should observe

(*a*) The *fragrant odour*,

(*b*) The *opalescent, waxy interior of the tears.*

Constituents.—Olibanum consists principally of *resin* (60 to 70 per cent.), *gum* (27 to 35 per cent.), and *volatile oil* (5 to 7 per cent.). These constituents have been recently further investigated, with the following results (Halbey, 1898):

Soluble in alcohol, 72 per cent.	Boswellic acid, free	33·0 per cent.
	" " combined	1·5 "
	Olibanoresen	33·0 "
	Volatile oil	7·0 "
	Bitter principle	0·5 "
Insoluble in alcohol, 28 per cent.	Gum (arabic acid with Ca and Mg)	20·0 "
	Bassorin	6·0 "
	Vegetable débris	2·0 "

According to this analysis the resin consists principally of a resin acid (boswellic acid) and an indifferent resin (olibanoresen) in about equal proportions; the gum consists mainly of arabin, with which is associated a little bassorin.

Uses.—Olibanum is used chiefly in the manufacture of incense and as an ingredient in fumigating pastilles.

AMMONIACUM

Source &c.—Ammoniacum is a gum-resin exuded from the flowering and fruiting stem of *Dorema Ammoniacum*, D. Don (N.O. *Umbelliferæ*), and probably other species.

The plant or plants that yield ammoniacum are large umbelliferous plants widely distributed *throughout Persia* and extending into southern Siberia.

The drug is collected chiefly in central Persia.

The stems of the ammoniacum plants contain, especially in the bark, numerous, large, schizogenous ducts full of a milky secretion. In the summer, when the plant is fruiting, it is visited by numbers of beetles, which puncture the stem and cause an abundant exudation of the secretion in the form of milky drops, some of which harden on the stem, whilst others drop on to the ground. All of it is collected and sent in a very crude state, mixed with stones, stalks of the plant, and other impurities, from the ports on the Gulf of Persia to Bombay, where the drug is sorted, and whence it is exported to Europe.

Description.—Ammoniacum occurs in commerce in two forms—viz. *tear ammoniacum* and *lump ammoniacum*, the former being alone official.

The tears are small, rounded or nodular masses varying usually from $\frac{1}{4}$ inch to 1 inch in diameter. When fresh they are of a pale, dull yellow colour, which, however, darkens by keeping. They are hard and brittle when cold, but soften when warmed. Internally the tears are opaque, and vary in colour from milky white to pale brownish-yellow, the freshly fractured surface having a waxy lustre. The drug has a characteristic but not alliaceous odour, and a bitter, acrid taste. Triturated with water it forms a white emulsion, which is coloured deep orange-red by a solution of chlorinated lime, yellow by solution of potash, and transiently violet by ferric chloride. The latter reaction, although not strong, should be noted, as it depends upon the presence of a constituent (salicylic acid) that is absent from other similar gum-resins, and is characteristic therefore of ammoniacum.

Lump ammoniacum consists of agglutinated whitish tears mixed with varying quantities of extraneous substances, such as stones, dirt, stems and other débris of the plant, and occasionally the broad, flat mericarps of the fruit, the presence of which indicates the time at which the drug has been collected. The substance of the tears agrees with the description of the tears already given.

If a small fragment be strongly heated in a dry test-tube, the contents of the tube, after cooling, yield with boiling water a solution which, when largely diluted with water and made alkaline, does not exhibit a blue fluorescence, a reaction indicating the absence of umbelliferone, which is present in galbanum and asafetida.

The student should observe

(*a*) The *clean, hard tears,* which do not crumble between the fingers,

(*b*) The *characteristic odour,*

(*c*) The *positive result of the test for salicylic acid,*

(*d*) The *negative result of the test for umbelliferone*;

and should compare the drug with selected tears of galbanum, which are much softer, have a distinctive odour, and yield a positive result with test for umbelliferone.[1]

[1] This test may also be carried out as follows: Boil 5 grammes of the drug with 15 c.c. of hydrochloric acid for fifteen minutes, dilute with 15 c.c. water; filter through a double, wetted filter, and to the filtrate, which should be clear, add excess of ammonia.

Constituents.—Ammoniacum consists of *volatile oil* (1 to 2 per cent.) and *resin* (about 65 to 70 per cent.), the remainder being composed of *gum* (about 20 per cent.), moisture (2 to 12 per cent.), ash (1 per cent.), and insoluble residue (3·5 per cent.).

Luz (1893) found that the resin could be separated into two portions, one consisting of a resin-alcohol which is also found in galbanum, and hence called galbaresinotannol, combined with salicylic acid, the remainder being a resin alcohol peculiar to ammoniacum and designated ammoresinotannol. The gum is allied to gum acacia.

Yiel resor wher fused with

Luz was unable to detect sulphur in either the volatile oil or the resin, although that element had previously been reported present in ammoniacum.

The drug contains also traces of free *salicylic acid*, which is the source of the reddish colour produced when ferric chloride is added to an aqueous emulsion.

Varieties &c.—The official or Persian ammoniacum is distinguished from African ammoniacum, which is obtained in Africa from (it is said) *Ferula tingitana*, Linn., by the orange-red colour it yields with solution of chlorinated lime, as well as by not yielding a fluorescent solution when treated as above described. This indicates the absence of umbelliferone, which is present in African ammoniacum as well as in galbanum and asafetida.

Uses.—Ammoniacum is a stimulant, and being excreted by the bronchial mucous surfaces stimulates and disinfects the secretion. It is used as a disinfectant expectorant in chronic bronchitis with profuse discharge, and in plasters as a stimulant to the skin.

GALBANUM

Source &c.—Galbanum is a gum-resin obtained from *Ferula galbaniflua*, Boiss. and Buhse (N.O. *Umbelliferæ*), and probably from other species.

These plants are, like those yielding ammoniacum, large umbelliferous plants indigenous to and widely distributed over *Persia*. Two varieties at least are well recognised—viz. Persian, which is soft and contains fruit and stalks, and Levant, which is dried and contains slices of the root, seldom fruits or stalks. The latter is the variety at present usually met with.

How this drug is obtained is not exactly known.

Like the ammoniacum plants the galbanum plants contain, especially in the cortical portion of the stem (and root), numerous schizogenous ducts that secrete a milky gum-resinous fluid.

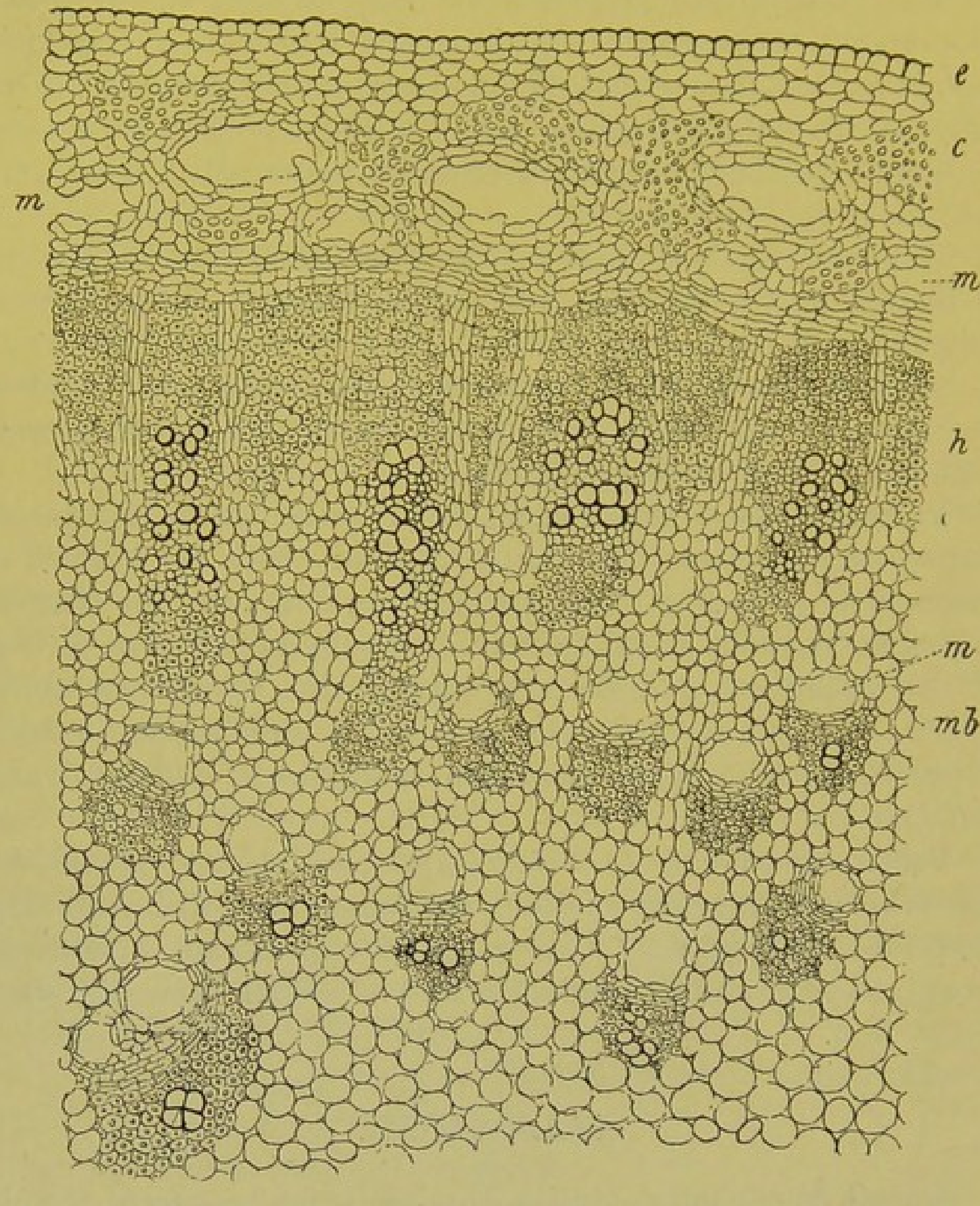


FIG. 207.—Transverse section through a portion of the stem of *Ferula galbaniflua*, showing the distribution and structure of the gum-resin ducts. *e*, epidermis; *c*, collenchyma; *m*, gum-resin ducts; *h*, wood; *m b*, bundles in pith; magnified. (Tschirch.)

Part of the drug is apparently obtained by natural exudation from the stem, but part is certainly produced by laying bare the root, cutting the stem off near the crown, and collecting the juice that exudes and hardens, successive slices of root being removed at intervals of several days. The former procedure would probably yield the tears that are found in commercial galbanum, whilst the slices of root found in the drug indicate the latter method as the one by which that part of the drug not in distinct tears is obtained.

Galbanum reaches Europe partly viâ Russia (especially Persian galbanum), partly viâ Bombay.

Description.—Galbanum occurs in distinct tears and small agglutinated masses. The tears are rounded or irregular in form, and, though they vary in size, are usually about as large as or rather larger than a pea. Externally they are yellowish-brown or orange-brown in colour, and often rough and dirty. They are not, like the tears of ammoniacum, hard, but are so soft that they can usually be squeezed flat between the finger and thumb, becoming ductile and sticky. They break easily with a granular, irregular fracture, and are opaque, yellowish, and soft internally. Sometimes the tears are more or less translucent and of a bluish-green colour.

Thin transverse slices of the root are commonly found mixed with commercial galbanum; they are usually about an inch in diameter and frequently bear on one side the dried secretion derived from the freshly cut surface.

The drug has a characteristic, not exactly unpleasant, aromatic odour, and a rather disagreeable, aromatic, and bitter taste.

Galbanum occurs also in lumps, corresponding to lump ammoniacum; these consist of yellowish or bluish-green or brownish tears embedded in a brownish mass and mixed with slices of root and various foreign substances.

The student should observe

(*a*) The *soft yellowish-brown tears*, occasionally *bluish-green*,
(*b*) The *characteristic odour*,
(*c*) The *positive result of the test for umbelliferone*;

and should compare the drug with ammoniacum.

Small fragments of galbanum may easily be distinguished from ammoniacum by their yielding umbelliferone when heated to redness in a dry test-tube; the presence of this body may be recognised by boiling the tube and its contents in water, filtering and saturating with ammonia, a fine blue fluorescence being produced.

Constituents.—Galbanum consists, apart from extraneous substances, of *volatile oil* (about 5 to 10 per cent.), *resin* (about 60 per cent.), and *gum* (about 20 per cent.), the residue being made up of inorganic matter (about 2 per cent., sometimes much more), and moisture (from 1 to 10 per cent.).

Conrady found (1894) in a good specimen of commercial galbanum

Volatile oil	9·5 per cent.
Resin	63·5 ,,
Gum and impurities	27·0 ,,
Ash	8·25 ,,

The resin is, according to Conrady, composed of an alcohol, galbaresinotannol, combined with umbelliferone; of the latter Conrady obtained no less than 20 per cent. Traces of free umbelliferone are also contained in the drug.

Good qualities should yield at least 50 per cent. to alcohol, contain not more than 10 per cent. of moisture, and give on incineration not more than 10 per cent. of ash (Dieterich, 1898).

Uses.—Galbanum is used chiefly as a stimulant in plasters.

ASAFETIDA

Source &c.—Asafetida is a gum-resin obtained from the root of *Ferula fœtida*, Regel (N.O. *Umbelliferæ*), and probably other species. These plants are, like those yielding ammoniacum and galbanum, large umbelliferous plants growing in *eastern Persia* and *western Afghanistan*, but, as in the case of galbanum, an exact knowledge of the plants themselves or of the mode of procuring the drug is still wanting. In the cortex of the stem, and especially in that of the root, there are numerous large, schizogenous ducts filled with a milky, gum-resinous emulsion; these when wounded discharge their contents, which then gradually acquire by evaporation a firmer consistence.

Part of the drug is certainly collected in a manner similar to that in which part at least of commercial galbanum is obtained—viz. by laying bare the root of the plant and cutting off the stem close to the crown; the emulsion that flows from the cut surface is allowed to harden, for which purpose the root is protected by a dome-like covering of sticks and leaves; the hardened gum-resin is then scraped off, a slice of the root cut off, and the juice again allowed to exude, and so the process is repeated. The scrapings are united and mixed with earthy matter &c., for the purpose, it is said, of facilitating the transport of the drug, which is still inconveniently soft.

It is, however, difficult to explain the production of the large tears of asafetida by this method of collection.

Herat and Kandahar are the centres of the asafetida trade. The drug is conveyed chiefly to Bombay, where it is sorted, and whence it is exported to Europe.

Description.—As in the case of ammoniacum and galbanum, two forms of the drug are known—viz. tear and lump; the former, which is as a rule much purer, is alone official.

The tears, some of which are separate, some more or less agglutinated together, are rounded or flattened, and vary from $\frac{1}{2}$ to 1 inch in diameter. They are of a dull yellow or sometimes dirty grey colour, which darkens on keeping, finally becoming reddish-brown. When fresh they are usually tough at ordinary temperatures, becoming harder when cooled and softer when warmed. Internally they may be yellowish or milky white, translucent or opaque; the freshly exposed surface passes gradually through a very characteristic change of colour, becoming first pink, then red, and finally reddish-brown. The drug has an intense, penetrating, persistent, alliaceous odour, and a bitter, acrid, alliaceous taste.

Lump asafetida consists of the tears agglutinated into a more or less uniform mass and mixed with varying quantities of extraneous substances such as stones, slices of the root, earthy matter, and so on. It is thus much inferior to the tears, and generally has a dark reddish colour.

Asafetida, when heated in a test tube, as described under Ammoniacum, yields a fluorescent solution, indicating the presence of umbelliferone or a substance yielding it, a reaction which it therefore shares with galbanum, but which serves to distinguish it from a variety of the drug met with in Bombay yielding no umbelliferone. From galbanum the tears of asafetida may be distinguished by the green colour the freshly fractured surface assumes when it is touched with nitric acid diluted with an equal volume of water.

The student should observe

(*a*) The *change in colour* of the fractured surface,
(*b*) The *nitric acid reaction*,
(*c*) The *intense, alliaceous odour*,
(*d*) The *positive result of the test for umbelliferone*.

Constituents.—Asafetida consists principally of volatile oil, resin, and gum.

The composition of typical asafetida can be well seen from the following analysis by Polasek (1897):

Resin	62·0 per cent.
Gum	25·1 ,,
Volatile oil	6·7 ,,
Ferulic acid	1·28 ,,
Moisture	2·36 ,,
Impurities	2·5 ,,

The resin consists of ferulic acid combined with asaresinotannol; although the drug easily yields umbelliferone by the action of sulphuric acid on the ferulic acid and on the resorcin produced simultaneously from the asaresinotannol, Polasek was unable to detect free umbelliferone in the drug.

Reso with KOH

The ash yielded by the commercial drug varies with the quality of the drug, fine tears yielding about 5 per cent., whilst lump asafetida may contain 50 or more per cent., according to the amount of admixture that has taken place. The Pharmacopœia places the limit at 10 per cent.

The volatile oil varies also from 3 to 9 per cent., and that of substances soluble in alcohol from about 70 per cent. to less than 30 per cent., the official limit for substances dissolved by alcohol being 65 per cent., a limit which, according to Dieterich (1898), is rather too high for the average of good commercial qualities of the drug.

Uses.—Asafetida is a powerful nervine stimulant, and is used in the nervous disorders of hysteria. It has also a well-marked stimulant action on the bowel, and is employed to expel flatulence and relieve constipation.

SECTION XV

OLEO-RESINS

CANADA BALSAM

(Canada Turpentine, Terebinthina Canadensis)

Source &c.—Canada balsam is an oleo-resin obtained by incision from the balsam fir, *Abies balsamea*, Link (N.O. *Coniferæ*), a tree resembling the spruce fir, widely distributed over the *northern United States* and *Canada*, extending to Hudson's Bay. The drug, which has long been known, is collected in Lower Canada.

The tree contains schizogenous oleo-resin ducts, as most coniferous trees do, but they are restricted to the bark, none occurring normally in the wood. In addition, however, to these secretion ducts, cavities are formed which fill with oleo-resin and produce blisters on the smooth trunk of the tree. From these blisters the oleo-resin is obtained by puncturing them with the pointed spout of a can which serves to receive the balsam.

Description.—Canada Balsam is a clear, transparent liquid, about as viscid as honey, and of a pale yellow or greenish-yellow colour, often exhibiting a slight greenish fluorescence. By keeping it becomes more viscid, and finally it gradually dries to a hard resin which remains transparent and shows no disposition to crystallise, a quality that renders it particularly valuable as a medium in which to preserve microscopical preparations. It has an agreeable balsamic odour and a rather bitter and acrid taste. It is completely soluble in chloroform, benzol, and ether, but only partially in alcohol.

The drug is officially designated 'Terebinthina canadensis,' 'Canada turpentine.' The term 'balsam' is frequently limited to such oleo-resins as contain benzoic or cinnamic acids, and as neither of these acids is present in Canada balsam many pharmacognosists prefer to call it a 'turpentine' or 'oleo-resin,' both of which names are certainly strictly correct.

Constituents.—Canada balsam consists of 20 to 25 per cent. of *volatile oil* and 75 to 80 per cent. of *resin*, both of which appear to be analogous to other similar coniferous products, but have not yet been sufficiently accurately investigated. Only about four-fifths of the resin is soluble in alcohol, whereas many coniferous resins are completely soluble.

Resin consists of resin acids + resene

COPAIBA

(Copaiva, Balsam of Copaiba)

Source &c.—Copaiba is an oleo-resin obtained from the trunk of *Copaifera Lansdorfii*, Desf. (N.O. *Leguminosæ*), and other species of *Copaifera*.

The trees from which the official oleo-resin is obtained are large trees attaining over 100 feet in height, indigenous to *Brazil* and the north of South America. The drug, which was highly esteemed by the natives of Brazil and had probably long been used by them as a medicine, was introduced into Europe about the beginning of the seventeenth century.

The oleo-resin is contained in anastomosing, schizogenous secretion ducts that form an extensive network in each zone of the secondary wood of both stem and root, extending throughout the entire length of the zone, resembling therefore in arrangement the laticiferous tissue of the dandelion. These ducts are formed in the young wood and rapidly attain their normal diameter, which is often very considerable; at the level of the insertion of the branches a number of lateral ducts connect zone with zone. In addition to these schizogenous ducts lysigenous cavities also appear to be formed by the breaking down of the cell walls and their probable transformation into resinous or oleo-resinous substances.

The oleo-resin is collected by cutting in the trunk of the tree near the base a cavity sloping inwards and downwards, and penetrating to the centre of the trunk, resembling the 'box' made in the trunk of the turpentine trees. Into this cavity the oleo-resin is discharged; it is transferred to barrels and other vessels for exportation.

The large size of the secretion ducts, and their extensive distribution in each zone of wood throughout the entire length of the tree, render the amount of oleo-resin secreted by each tree very considerable. Even as much as 48 litres is said to have been obtained from a single tree, others again yielding but little.

The drug is exported from the seaports on the northern coast of South America—viz. Para, Maranham, Maracaibo, Savanilla &c., these towns giving their names to the commercial varieties of the drug.

Description.—The oleo-resin, or as it is commonly, but less appropriately, termed balsam (for it contains neither cinnamic nor benzoic acid), varies considerably in consistence. Sometimes it is a thin, yellowish liquid (Para balsam), sometimes as viscid as treacle, brownish-yellow in colour (Maracaibo), and occasionally slightly fluorescent. It has a very characteristic aromatic odour and an unpleasant acrid and rather bitter taste. It is soluble in absolute alcohol, petroleum spirit, and carbon bisulphide, but is insoluble in water.

Its specific gravity varies from 0·916 to 0·993, according to the proportion of volatile oil it contains. Commonly, however, it does not fall below 0·950 or rise above ·990.

The viscid Maracaibo balsam varies from 0·980 to 0·990, whilst the thinner Para balsam ranges from 0·950 to 0·970 (Dieterich). When kept, the balsam becomes, by resinification of the volatile oil, thicker, and the specific gravity increases until finally it may exceed that of water.

Constituents.—Copaiba consists of *resin* and *volatile oil* in varying proportions. Thin varieties of the drug may contain as much as 80 per cent. of volatile oil, whilst thick varieties may contain not more than 20 per cent. These, however, are exceptional figures, the proportion of volatile oil in commercial balsams varying usually between 40 and 60 per cent. As the volatile oil possesses a decided therapeutical value, the British Pharmacopœia requires the drug to contain not less than 40 per cent. of it. The boiling-point of the volatile oil after separation varies from 250° to 270° C., and its specific gravity from 0·88 to 0·91. It rotates the ray of polarised light from 28° to 34° to the left. These are important characters, as they serve to detect the adulteration of copaiba with volatile oils (e.g. turpentine) that would distil over with the copaiba oil and affect its boiling-point or specific gravity, whilst the oil from African copaiba rotates the ray of polarised light to the left.

The resin is acid in its properties and is left, after the removal of the volatile oil as a hard, brittle, amorphous mass. To certain acid resins that have been obtained from copaiba, the names of copaivic, oxycopaivic, and metacopaivic acids have been applied.

The bitter principle may be removed from the balsam by boiling with water. It is present in small proportion only.

Adulterations &c.—Copaiba is liable to adulteration, which, from the varying composition of the genuine drug, is often difficult to detect.

Fixed oils, such as castor oil, render the resin left after the removal of the volatile oil tough, even pasty and difficult to powder, whereas it should be hard, brittle, and easily powdered.

Volatile oils such as turpentine may be detected by the characters of the volatile oil distilled from the drug ; this should boil at about 250° C., the boiling-point of turpentine being about 160° C. It should also deviate the ray of polarised light to the left, that from an African copaiba imported a few years ago deviating it to the right.

Gurjun balsam, an oleo-resin obtained by incision from the trunk of *Dipterocarpus turbinatus* (N.O. *Dipterocarpeæ*) and other species, large trees indigenous to eastern India and Burmah, is used both as a medicine and for various technical purposes. It somewhat resembles copaiba in odour and taste, but is usually much darker (dark red) in colour and fluorescent. Its presence in copaiba may be recognised by adding 4 drops to a mixture of $\frac{1}{2}$ oz. of glacial acetic acid (according to Kebler 1 c.c.) and 4 drops of nitric acid ; a purple or reddish coloration indicates gurjun balsam. The latter adulteration may also be detected by dissolving 2 drops of the balsam in 20 drops of carbon bisulphide and adding a drop of a freshly prepared and cooled mixture of nitric and sulphuric acids ; if gurjun balsam is present a violet coloration will be produced, but it has been shown that a similar colour has been occasionally yielded by genuine balsams.

Uses.—The active principles of copaiba are absorbed into the blood, the volatile oil, at least, being excreted by the kidneys, bronchi, and skin ; hence copaiba produces along the whole genito-urinary tract, as well as in the bronchi, a stimulant and disinfectant action, increasing the mucous secretion and exciting expectoration. It is now chiefly employed in inflammatory affections of the bladder and urethra, and occasionally in chronic bronchitis. The resin has a diuretic action.

ELEMI

Source &c.—Elemi is an oleo-resin obtained in the *Philippine Islands* from an unknown source. It is generally referred to one or more species of *Canarium*, e.g. *C. ~~commune~~*, Linn. (N.O. *Burseraceæ*), but the evidence in support of this assumption is insufficient.

The drug is obtained by making incisions in the tree and promoting the flow of oleo-resin by the application of heat. When first obtained it is probably a clear, viscid, honey-like liquid which, however, rapidly becomes crystalline. It is exported chiefly from Manila, and arrives in this country in lead-lined cases, in a more or less solid condition.

Description.—Elemi when fresh and of good quality is pale yellow in colour, soft and granular, resembling a crystalline honey, but on keeping it gradually becomes firmer and finally hard. It is soluble in alcohol and ether, partially only in petroleum spirit. It has a fragrant, balsamic odour recalling fennel and mace, and a spicy, rather bitter taste. Under the microscope it is seen to contain an abundance of acicular crystals.

Constituents.—The drug consists principally of an *amorphous resin* easily soluble in alcohol. Associated with this are two *crystalline resinous substances*, *α-amyrin* and *β-amyrin*, and from 10 to 17 per cent. of *volatile oil*. Bryoidin, breidin, and elemic acid are crystalline substances present in small proportion only, and the drug also contains a bitter principle that has not yet been isolated.

Uses.—Elemi has been employed in the form of ointment, as a stimulant and disinfectant application. It is now seldom prescribed.

SECTION XVI

BALSAMS

BALSAM OF TOLU

Source &c.—Balsam of Tolu is a balsam obtained by making incisions in the trunk of *Myroxylon Toluifera*, H.B. and K. (N.O. *Leguminosæ*).

The tree is a native of *New Granada*, and occurs plentifully in the forests near the River Magdalena and its tributary the Cauca. The balsam, which receives its name of Tolu from a small town near Cartagena, on the northern coast of New Granada, is collected by cutting a V-shaped notch in the bark, and fixing below it a gourd into which the balsam flows. Many such incisions at varying heights may be made on the same tree, which, however, is much exhausted by the tapping. The contents of these gourds are emptied into skin bags and conveyed to the coast, where the balsam is transferred to tins for exportation to Europe. It is shipped chiefly from Savanilla and Cartagena.

It is a remarkable fact that although the twigs of the tree contain schizogenous secretion ducts, these are soon thrown off and no new ones are formed. The bark of the trunk, from which the balsam is obtained, contains no secretory tissue, and the balsam is probably formed by the transformation of part of the tissue of the bark (or possibly the young wood), a change induced by the incisions made in the tree (compare the production of storax).

Description.—Balsam of Tolu when freshly imported is a soft, tenacious, yellowish-brown, resinous mass, not soft enough to flow, but taking the form of the vessel in which it is kept. By keeping, it gradually hardens to a brownish, and, especially in cold weather, brittle and easily powdered mass which, however, readily softens when warmed. It has an agreeable, fragrant, though not powerful odour, and an acidulous balsamic taste, sticking to the teeth when chewed. A small piece warmed and pressed between two glass slides to a thin film exhibits, when examined by the microscope, numerous colourless crystals embedded in a transparent mass and accompanied by a little vegetable débris.

It is easily soluble in alcohol and chloroform, but only partially soluble in carbon bisulphide, yielding to the latter principally cinnamic acid. The solution in carbon bisulphide leaves when evaporated a crystalline residue that is capable of neutralising not less than 30 per cent. of its weight of potassium hydroxide. These characters are important, as the balsam has been adulterated with other resinous substances soluble in carbon bisulphide, which consequently give the evaporation-residue a resinous instead of crystalline character, and require less potassium hydroxide for their neutralisation.

Constituents.—Tolu balsam was examined by Oberländer (1894), who found it to contain the following constituents: about 7·5 per cent. of an oily liquid consisting of *benzyl cinnamate* with a little *benzyl benzoate*, traces of vanillin and 12 to 15 per cent. of free acid, principally *cinnamic acid*. The *resin*, amounting to about 80 per cent. of the drug, yielded by saponification an alcohol (toluresinotannol), and cinnamic acid, with which was associated a little benzoic acid.

Uses.—Tolu balsam is used chiefly as a pleasant ingredient in cough mixtures.

BALSAM OF PERU

Source &c.—Balsam of Peru is a balsam exuded from the trunk of *Myroxylon Pereiræ*, Klotsch (N.O. *Leguminosæ*), after the bark has been beaten and scorched.

The tree grows in the forests of that part of San Salvador (*Central America*), near the Pacific Ocean, and known as the Balsam Coast, and probably also in other parts of Central America, as, for instance, in Honduras (Dieterich), the drug having received the name ‘ Peruvian ’ from the fact that it was originally sent from San Salvador to Callao, the port of Lima, and thence to Spain.

As in the case of *Myroxylon Toluifera*, the bark of young twigs contains secretion ducts which, however, are soon thrown off, after which no fresh ones are formed. The formation of the balsam is induced by certain treatment to which the bark is subjected, and is, therefore, not a normal secretion of the tree, but a pathological product. Of the exact nature of the changes induced we have no knowledge, but the following is a brief account of the procedure adopted. At the end of the rainy season rings are cut in the trunk, and from these rings longitudinal incisions about 18 inches long are made. The bark is then beaten until it is loosened. When the balsam begins to flow the strips of bark are raised, and plugs of bast inserted to absorb it. As soon as the flow of balsam ceases, the strips of bark are scorched with torches from above downwards, by which a further flow is promoted.

The balsam is separated by boiling the saturated pads with water and straining, or by allowing the balsam to deposit by standing (Dieterich, 1897).

Description.—Balsam of Peru, as seen in commerce, is a rather viscid, oily liquid, resembling common black treacle, but rather thinner, and not of an adhesive or glutinous nature; it appears black in bulk, but in thin layers it is dark reddish-brown and transparent. It has a fragrant, balsamic odour, and although it has no marked taste it produces, when swallowed, a burning sensation in the throat.

Balsam of Peru is heavier than water, its specific gravity varying within narrow limits—viz. from 1·137 to 1·150, being usually between 1·138 and 1·142, and this forms a valuable means by which adulteration can be detected, for many liquids that might be used for that purpose are lighter than water, and would appreciably depress the gravity. It is soluble in chloroform, and also in an equal volume of 90 per cent. alcohol, but with a larger proportion of the latter the mixture becomes turbid. It is practically insoluble in water, that liquid removing from it only a little cinnamic acid.

Its physical characters are so well marked, especially the odour and taste, that the drug is easy to recognise, but the detection of adulteration, especially with inferior qualities of the drug, which appears to be more or less regularly practised, is a more difficult problem.

Constituents.—Balsam of Peru consists essentially of an oily *fluid portion* mixed with a *dark resin*. The fluid portion consists almost entirely of *benzyl benzoate*, with a little *benzyl cinnamate* (cinnameïn), these together constituting about 60 per cent. of the commercial drug, but rather more (71 to 77 per cent.) of the finest qualities of the pure balsam.

The resinous portion, amounting to about 30 per cent. of the commercial drug, is composed of an alcohol, *peruresino-tannol*, combined with *cinnamic* and a little *benzoic acid.*

The drug also contains traces of vanillin and free cinnamic acid.

Adulterations.—Balsam of Peru is, from its high price and nature, liable to adulteration, chiefly with such liquids as alcohol, fixed oils, turpentine, copaiba, and the like. Any such admixture lowers the specific gravity, and can generally be detected by this means. Alcohol can be removed from the balsam by shaking it with water, which in the genuine drug should cause no appreciable diminution in volume. The presence of copaiba and other drugs containing acid resins can be detected by mixing 10 drops of the balsam with 0·4 gramme of lime; with genuine balsam the mixture remains permanently soft, and when warmed until all volatile matter is given off and charring commences, no fatty odour is evolved (absence of fixed oils).[1]

But qualitative tests, such as the lime test, are unsatisfactory, and are being discarded in favour of the quantitative determination of the aromatic constituents and the resin, which gives not only information as to probable adulteration, but places a direct relative value on the drug.

This can easily be effected by exhausting 1 gramme of the balsam with ether, filtering and shaking the ethereal solution, which contains both resin and cinnameïn, with 2 per cent. solution of soda. This removes the resin, whilst the ethereal solution, allowed to evaporate spontaneously, yields a residue of cinnameïn and other aromatic bodies which can then be weighed. The amount of resin present can be determined by acidifying the alkaline liquid, filtering, and weighing; it should not exceed 28 per cent. (Dieterich).

The British Pharmacopœia, by a process slightly differing

[1] Dieterich found that absolutely pure balsam (containing 77 per cent. of aromatic oily constituents) became quite hard with time, but the addition of a little liquid paraffin resulted in the production of a permanently soft mass. It is probable, therefore, that all commercial balsam is adulterated, otherwise even good qualities would not remain soft when mixed with lime.

from the above, demands that five grammes of balsam should yield from 2·85 to 3·00 grammes of aromatic, oily residue, which should require from 11·9 to 12·8 c.c. of normal volumetric alcoholic solution of potassium hydroxide to completely decompose the esters (of cinnamic and benzoic acids) present in it. By a simple calculation it will be found that 11·9 c.c. of the solution of potassium hydroxide decompose exactly 2·83 grammes of chemically pure benzyl cinnamate. Should a residue of 2·85 grammes require more or less than 11·9 c.c. of alkaline solution, the presence of some substance other than benzyl cinnamate would be indicated.[1]

Uses.—Balsam of Peru is antiseptic and disinfectant. It is chiefly used as an external application in certain skin diseases and for bed sores. It has also been employed as a stimulant and disinfectant expectorant in bronchitis.

STORAX

(Styrax)

Source &c.—Storax is a balsam obtained from the trunk of *Liquidambar orientalis*, Miller (N.O. *Hamamelideæ*), a tree of medium size forming forests in the south-west of *Asiatic Turkey*.

Neither the bark nor the wood of the tree possesses the agreeable odour of storax, and under normal conditions this substance is not produced in any part of the plant. But if, in the summer, incisions are made or the bark is gently beaten, not so vigorously as to kill it, a formation of storax takes place, and the balsam soaks into the wounded bark, which can then be stripped off. From the bark thus saturated the balsam is obtained by pressing it, the residue being subsequently mixed with boiling water (or boiled with water) and again pressed. The liquid balsam thus obtained forms the storax of commerce, whilst the pressed bark was formerly an article of commerce under the name of Cortex Thymiamatis. The latter, coarsely ground and mixed with storax, formed 'Styrax calamitus,'

[1] Trog found the fluid portion of the balsam to consist almost entirely of benzyl *benzoate* (not cinnamate) of which 2·52 grammes would be indicated by 11·9 c.c. of volumetric solution of potassium hydroxide.

under which name at the present time a factitious mixture is generally sold.

Although the bark of the tree contains secretion ducts, these have nothing whatever to do with the production of storax. From the researches of Moeller it appears that if the bark is in any way wounded (as by incision or beating), the formation of secretory schizogenous ducts in the young wood is induced; these, by the breaking down of intervening tissue, afterwards form lysigenous cavities in which the balsam is secreted, and from which it exudes into the wounded bark. The secretion is therefore purely pathological, and it is produced in the young wood, subsequently finding its way thence into the bark, with which it is removed when the latter is stripped off.

Description.—Crude storax is a greyish, semi-fluid, viscid substance with an agreeable, aromatic, balsamic odour and a sharp, pungent taste. By long standing it separates into a supernatant, aqueous liquid and a dark-brown, oleo-resinous layer. It is rather heavier than water, and contains usually vegetable débris, amongst which numerous bast fibres may be found. By drying it loses from 17·4 to 25·8 per cent. of water.

The crude drug is purified by dissolving it in three or four times its volume of hot alcohol, filtering, and removing the alcohol by gentle evaporation, care being taken to lose as little of the volatile constituents as possible.

From 13 to 18 per cent. of the crude storax is insoluble in alcohol; the residue consists principally of vegetable débris associated with inorganic matter (Pharmacographia). According to Evers (1896) storax contains from 6 to 9 per cent. of a greyish substance insoluble in alcohol, probably a resin ester of cinnamic acid.

Thus purified, storax is a semi-transparent, yellowish-brown, semi-liquid balsam, entirely soluble in alcohol, ether, chloroform, and carbon bisulphide. It should have a specific gravity of 1·109 and 1·114 taken at 100° C. When mixed with an equal volume of alcohol and shaken with ammonia but little froth is formed, indicating the absence of turpentine, resin, and fixed oils. Nitric acid colours a drop of storax dirty-green.

The specific gravity, the proportion of moisture present, of ash and substances insoluble in alcohol, all give valuable indications of the quality of storax, but no satisfactory process for its quantitative analysis has yet been devised.

Constituents.—Storax contains as principal constituents *storesin* combined with *cinnamic acid* (a white, amorphous powder), *phenylpropyl cinnamate* (an odourless, oily liquid), *styrol* (a very fragrant, oily liquid), cinnamyl cinnamate or *styracin* (colourless, odourless, and tasteless crystals), *ethyl cinnamate*, and *free cinnamic and benzoic acids.* The drug is especially rich in cinnamic acid, yielding over 20 per cent. of that substance.

Uses.—Storax is a local and remote stimulant, antiseptic, and disinfectant, resembling in these respects balsam of Peru, benzoin, &c. It is now seldom used.

SECTION XVII

FIXED AND EMPYREUMATIC OILS, FATS, WAXES, &c.

TAR

(Pix Liquida)

Source.—Tar, or, as it is better termed, wood-tar (*Pix liquida*), to distinguish it from coal-tar (*Pix carbonis*), is a bituminous liquid obtained from the wood of *Pinus sylvestris*, Linn. (N.O. *Coniferæ*), and other species of *Pinus* by destructive distillation.

Various methods have been adopted for the destructive distillation of wood. The rudest consists in constructing a mound of the material and covering it with earth, leaving spaces by which air can be admitted and through which the tar produced can drain off. The wood is fired, and, the heat being carefully controlled, charcoal is left as a residue in the mound, whilst a tarry and an aqueous liquid are collected.

More modern apparatus consists of either upright or horizontal iron retorts arranged singly or in a battery of about twenty. These are heated from without, and the products of distillation may be ranged under three heads:

(i) Gaseous products analogous to coal-gas; these are conducted back to the hearth and burnt, serving to economise fuel, or they are stored in a gasometer until required for some such purpose.

(ii) Watery products; water containing acetic acid, methyl alcohol, acetone, &c.; these pass over and are condensed. They serve as a source of acetic acid, methyl alcohol, &c.

(iii) Tarry products; these separate from the watery liquid on standing.

Coniferous wood is chiefly employed, as it yields more tar than the wood of foliage trees (beech, birch &c.) From the former 15 to 20 per cent. of tar may be obtained, from the latter 6 to 8 per cent.

Description.—Tar is a dark-brown or blackish, semi-liquid substance, with a peculiar aromatic odour and a bitter, pungent taste; it is heavier than water, its specific gravity varying from 1·02 to 1·15. By keeping, it becomes thicker, and acquires a granular appearance, due to the formation of minute crystals (probably pyrocatechin, resin acids, &c.). Water agitated with it acquires a yellow colour and acid reaction (distinction from coal-tar, which imparts to water an alkaline reaction). The filtered aqueous liquid is coloured red by very dilute (0·1 per cent.) solution of ferric chloride, and dark olive green by a drop of the official test solution (5 per cent.) of the same substance (distinction from juniper tar oil). Tar is completely soluble in ten volumes of alcohol.

Constituents.—The composition of tar is very complex; the following are its chief constituents: benzene, toluene, xylene, and styrol; phenol, cresol, guaiacol and its homologues; pyrocatechin and paraffin. The most important of these, as far as the medicinal activity is concerned, are probably pyrocatechin, phenol, cresol, guaiacol, and their homologues.

Tar from coniferous woods, which alone is official, is especially rich in guaiacol and its homologues, beech-tar in guaiacol and pyrogallol derivatives, birch-tar in guaiacol and benzophenol derivatives.

Uses.—Tar is used as an external stimulant and antiseptic in certain skin diseases; given internally in the form of pills or syrup, it acts as a disinfectant and deodorant of offensive discharges from the bronchial tubes.

COAL-TAR

(Pix Carbonis)

Source &c.—Coal-tar is obtained by the destructive distillation of coal in iron or clay retorts. The gaseous products that are formed during the process constitute ordinary illuminating gas; the liquid products are a watery solution of ammonium carbonate, sulphide, &c., and a heavy, dark, viscid, tarry liquid, coal-tar. The retort contains a porous, carbonaceous residue, coke.

Description.—Coal-tar is a nearly black, viscid liquid, with a strong, penetrating, disagreeable odour ; it is heavier than water, its specific gravity varying from 1·1 to 1·2. It is only slightly soluble in water, to which it imparts an alkaline reaction (distinction from wood-tar). It consists of a large number of substances, amongst which benzene, toluene, xylene, phenol, cresol, naphthalene, anthracene, and pitch may be mentioned.

Uses.—The chief medicinal use of coal-tar is as an antiseptic application in certain skin diseases.

JUNIPER-TAR OIL

(Huile de Cade, Oil of Cade, Oleum Cadinum)

Source &c.—Juniper-tar oil is obtained by the destructive distillation of the wood of *Juniperus Oxycedrus*, Linn., and possibly of other species of *Juniperus*, although upon this point, as well as upon the mode of distillation, exact information is wanting.

It is prepared chiefly in the mountains in the south of France, near Nismes and Toulon, and the following account of the distillation was furnished by one of the peasants engaged in the work (Amory, 1885).

The dry portions of the wood, roots, leaves, twigs, &c., of the plant are gathered in all seasons of the year by the peasants in the department of Var. These are all cut up into small pieces and carefully laid one upon another, so as to facilitate free combustion ; a fire is kindled, and the whole is then covered up with earth, so as to hermetically seal it from the air, and the products of the dry distillation *per descensum* rudely conveyed into wooden buckets or barrels. The thin product thus obtained is carried by peasants into Nismes or Toulon. There is reason to believe that other allied species of *Juniperus* are used either by accident or design.

Description.—Huile de Cade is a dark reddish-brown or nearly black liquid, with a tarry, but by no means disagreeable, odour and a bitter, acrid taste. It is less viscid than wood-tar, having an oily consistence. The specific gravity is usually rather less than that of water (about 0·990), but in some (old) specimens it is rather higher. It is completely soluble in ether and chloroform, partially in cold but almost completely in boiling alcohol. Water agitated with it dissolves but little, acquiring a yellowish colour and an acid reaction (distinction from coal-tar). The filtered aqueous solution assumes a reddish colour with a very dilute solution of ferric chloride (distinction from birch-tar), but an olive-brown colour with the official test solution (5 per cent.) of the same reagent (distinction from ordinary wood-tar).

Constituents.—In composition juniper-tar oil probably closely resembles wood-tar, although accurate information on this point is wanting. A *terpene*, known as *cadinene*, of the formula $C_{15}H_{24}$ has been isolated from it. Cadinene is also a constituent of many volatile oils.

Uses.—Juniper-tar oil is used as an application in various skin diseases.

OLIVE OIL

Source &c.—Olive oil is the oil expressed from the pericarp of the ripe fruit of the olive tree, *Olea europæa*, Linn. (N.O. *Oleaceæ*).

The olive is a small tree widely distributed by cultivation, especially in the countries bordering on the *Mediterranean*, and has been introduced into *America* (California), where it promises so well and is increasing so rapidly that that country will probably soon be independent of Europe for her supply of olive oil.

The tree produces a small, ovoid, drupaceous fruit about ½ inch to 1 inch in length, which, whilst unripe, is green in colour, and then contains mannite in the cells of the pericarp; in this state it is pickled and used as a table relish. As the fruits ripen the mannite disappears and the cells become filled with a fixed oil, the colour at the same time changing from green to purple. They are collected in the winter and spring (December to April) when ripe or nearly ripe, crushed, and subjected to a moderate pressure. The crude oil that flows from the press is run into tubs and mixed with water; the latter removes colouring matter and other impurities from the oil, and the oil, after it has completely separated from the water by standing, is skimmed off; in this way the finest quality of olive oil is obtained. The marc is mixed with hot water and pressed again, this time more strongly, and thus a second quality of oil is obtained. The residue, allowed to ferment, yields a third and even a fourth quality of oil. Sometimes the entire fruits are thrown into heaps and allowed to ferment; on pressing, the whole of the oil is obtained, but it is of inferior quality, and is used principally for technical purposes.

Description.—For medicinal use only the first pressings, obtained without heat, should be employed. Such oil has a pale yellow or greenish-yellow colour, a slight characteristic odour, and a bland taste without rancidity. Its specific gravity varies from 0·914 to 0·919. It is liquid at ordinary temperatures, but when cooled to 10° C. it often assumes a pasty consistence, from deposition of solid fats, and at 0° C. it becomes a nearly solid, granular mass.

Constituents.—Olive oil consists chiefly of *olein*, *palmitin*, and *arachin*, the last two constituents separating out in the solid form when the oil is cooled. By saponification these three compounds yield respectively oleic, palmitic, and arachic acids and glycerin.

Adulterations.—Olive oil is liable to adulteration with other cheaper oils, such as cotton-seed oil, earth-nut oil (from the seed of *Arachis hypogæa*, Linn., *Leguminosæ*), sesame oil (from the seed of *Sesamum indicum*, Linn., *Pedaliaceæ*), &c.

Cotton-seed oil is officially directed to be tested for by shaking 10 cubic centimetres of the suspected oil with 2 c.c. of the following reagent (a modification of Becchi's):

Silver nitrate	1 gramme.
Absolute alcohol	100 cubic centimetres.
Ether	20 ,, ,,
Nitric acid	1 drop.

and heating the mixture in a water-bath for ten minutes, when no darkening should take place.

The test is said to fail if the cotton-seed oil has been previously heated, and such specific tests are now being generally abandoned in favour of the determination of the quantity of iodine the oil is capable of combining with, the specific gravity, and other constants. For olive oil the gravity is very constant, varying usually between 0·916 and 0·918, and the oil is capable of absorbing from 81 to 85 per cent. of iodine (Hübl's test). For details of these and other tests for ascertaining the purity of olive oil, reference should be made to works on analytical chemistry, such as Allen's 'Commercial Organic Analysis,' 2nd Edition, Vol. II. Part I.

COD-LIVER OIL

(Oleum Morrhuæ)

Source &c.—Cod-liver oil is the oil extracted from the fresh liver of the cod, *Gadus Morrhua*, Linn. (Sub-kingdom *Vertebrata*, Class *Pisces*, Order *Teleostei*).

The cod inhabits the north Atlantic Ocean in great numbers, leaving the deeper seas and approaching the coasts, chiefly of Norway and Newfoundland, towards spawning time, that is, from January to April. During that time immense quantities of the fish are taken both by nets and lines. The livers are cut out whilst the fish is quite fresh, the healthy ones selected, and, after the removal of the gall bladders, subjected to a gentle heat, usually about 70° C. (according to the British Pharmacopœia not exceeding 82·2° C.). The oil that separates is drawn off and exposed to a low temperature (about −5° C.), at which a considerable quantity of fatty matter separates in a solid form. This is removed by filtration and pressure, and the oil thus purified forms the finest medicinal oil.

Inferior qualities of the oil are obtained from the residual livers (to which are added the unhealthy and injured livers previously rejected), by subjecting them to a higher temperature. Much oil, also of inferior quality but suitable for many technical purposes, is obtained by keeping the livers until they are partially decomposed, skimming off the oil that has separated, and heating and pressing the residual livers; such oil is usually of a brownish colour.

After the livers have been removed and the offal separated the fish are dried, and form an important article of commerce. The chief seats of the cod fishery are the Loffoden Islands, off the north-west coast of Norway, and shallow banks off Newfoundland.

Description.—Cod-liver oil should be of a pale yellow colour, and have a slight fishy, but not rancid, odour. Its specific gravity should vary from 0·920 to 0·930; it is readily soluble in ether and chloroform, but sparingly in alcohol. It may be

Obtained
Gadus Morrhua N.O. Teleostei. Newfoundland.

distinguished from vegetable oils by the violet colour which is developed when a drop of sulphuric acid is added to a few drops of the oil on a porcelain slab (indicating the presence of cholesterin).

Constituents.—Cod-liver oil consists principally of *olein* (about 70 per cent.) and *palmitin* (about 25 per cent.), together with a little *stearin*, the two latter separating out in the solid form when the oil is cooled. It contains traces of free fatty acids, *cholesterin* (about 0·3 per cent.), *lipochrome*, traces of *various alkaloidal bodies* (morrhuine, aselline, butylamine, &c.), and minute *traces of iodine*.

Adulteration.—Cod-liver oil is liable to adulteration with the oil from the livers of other species of *Gadus* &c., as well as with seal oil. The latter contains no cholesterin, and may be distinguished by the sulphuric acid test (see above); 1 gramme of the oil should not neutralise more than 0·002 grammes of potassium hydroxide (limit of acidity), nor should it combine with less than 1·15 or more than 1·34 grammes of iodine (Dieterich) (1·53 to 1·68, Sage and Parry). For further analytical details reference should be made to Allen's 'Commercial Organic Analysis,' 2nd Edition, Vol. II. Part I.

BEESWAX

(Cera flava ; Cera alba)

Source &c.—Beeswax is the wax separated from the honeycomb of the hive bee, *Apis mellifica*, Linn. (Sub-kingdom *Annulosa*, Class *Insecta*, Order *Hymenoptera*).

Wax is a material secreted by the bee on the under surface of its body, and employed to form the walls of the cells of the honeycomb. After the separation of the honey the residual wax is purified by melting with water, separating, and straining; it then forms the yellow wax of commerce. White wax is obtained by exposing thin bands of yellow wax for several weeks to the action of air and sunlight, occasionally watering it, and if necessary remelting, to promote the bleaching by exposing fresh surfaces to these influences. Yellow wax may also be bleached by chemical means, such as the action of chromic or nitric acid, but the resulting white wax contains then other products, resulting from the chemical action, the presence of which is undesirable. Such white wax is excluded, by the official description, from use in pharmacy.

Description.—Yellow wax is a yellowish or brownish-yellow solid, with an agreeable, honeylike odour, breaking with a granular fracture, and not unctuous to the touch. It is readily and entirely soluble in hot oil of turpentine, but yields not more than 3 per cent. to cold alcohol, 50 per cent. to cold ether, and nothing to water or to boiling solution of sodium hydroxide, the two latter liquids after filtration being neither turbid, nor becoming turbid on the addition of hydrochloric acid.

The specific gravity of wax varies from 0·960 to 0·970, and its melting-point from 62·5° C. to 64° C. These limits are narrow, and the specific gravity and melting-point often afford very valuable information as to the purity of the sample under examination.

Constituents.—Beeswax consists principally of *myricin* (*melissyl palmitate*), with which is associated free *cerotic acid* and an aromatic body, *cerolein*.

Adulteration.—Beeswax is liable to adulteration with solid paraffin, with various fats and waxes of vegetable or animal origin, with resin, stearic acid, &c. The melting-point and specific gravity are two very important constants, varying within narrow limits, and of great service in indicating adulteration.

Paraffin and bodies belonging to this class are not attacked by hot, concentrated sulphuric acid, whereas beeswax is entirely destroyed; hence if 5 grammes of beeswax are heated for fifteen minutes with 25 grammes of concentrated sulphuric acid to 160° C., and the mixture afterwards cooled and diluted with water, no solid, waxlike body should separate.

Resin (colophony) would be dissolved by cold alcohol, to which genuine beeswax yields not more than 3 per cent.

Soap would be removed by hot water, and the filtrate would become cloudy when acidified with hydrochloric acid from separation of the fat acid.

Stearic acid, Japan wax, tallow, and all fats easily saponified, would be converted into soap by the action of boiling solution of sodium hydroxide, which after separation and filtration would be rendered turbid by hydrochloric acid from separation of the free fat acids.

Starch (which might be added to white wax) would be detected by boiling with water and applying the iodine test.

Inorganic substances, such as kaolin, would be detected in the ash, and by their insolubility in turpentine.

For further details of the analysis of beeswax, reference may be made to Allen's 'Commercial Organic Analysis,' 2nd Edition, Vol. II.

SPERMACETI

(Cetaceum)

Source &c.—Spermaceti is a concrete, fatty substance obtained mixed with oil from the head of the sperm whale, *Physeter macrocephalus* (Sub-kingdom *Vertebrata*, Class *Mammalia*, Order *Cetacea*).

The sperm whale inhabits the *Pacific*, *Atlantic*, and *Indian Oceans*. Its head is of enormous size, occupying about one-third of the animal, which varies from 50 to 70 feet in length. The greater part of the head consists of a huge depression or cavity lying in front of the skull and above the upper jaw. This cavity, as well as other smaller cavities in the body of the animal, is filled with a liquid oil (sperm oil). After the whale has been captured these cavities are emptied of their oil, which on keeping deposits a quantity of crystalline matter. This, the spermaceti, is separated by pressure and purified by remelting, and washing with dilute solution of sodium hydroxide to free it from the last traces of oil; the spermaceti separated from the soap thus produced, and from excess of free alkali, forms as it cools crystalline masses.

Description.—Spermaceti occurs in translucent, crystalline masses, pearly white in colour and unctuous to the touch; it has but little odour or taste. Its specific gravity varies from 0·94 to 0·95 (Kebler, 0·905 to 0·945), and its melting-point from 46° C. to 50° C. (Kebler, 42° to 47°). It is insoluble in water and cold alcohol, but soluble in ether, chloroform, and boiling alcohol, crystallising from the latter solvent on cooling.

Constituents.—It consists principally of *cetyl palmitate*, together with a small proportion of esters of other fat acids.

Adulteration.—Spermaceti has been adulterated with stearic acid, which, in common with other fat acids, may be detected by the amount of volumetric solution of sodium hydroxide required to neutralise; 0·2 gramme of spermaceti dissolved in 20 cubic centimetres of alcohol should be made alkaline by one drop of volumetric solution of soda.

The purity of spermaceti may be judged by its pearly, crystalline appearance, by its not exceeding the above limit of acidity, and by its requiring between 125 and 135 milligrammes of potassium hydroxide to saponify one gramme of the drug.

from Ovis Aries

SUET
(Sevum)

n. O. Ungulata.

Source &c.—The official suet is mutton suet, obtained from the abdomen of the sheep, *Ovis Aries*, Linn. (Sub-kingdom *Vertebrata*, Class *Mammalia*, Order *Ungulata*). It is purified by thoroughly crushing it so as to break the membranous vesicles in which the fat is contained, melting, and straining. During the cooling it should be stirred, so as to prevent the constituents of higher melting-point separating in a more or less granular form.

Description.—Suet should be white, smooth, and uniform in appearance, and possess a slight characteristic odour, but be free from rancidity. It melts at about 45° C. to 49° C., and has a specific gravity of 0·948 to 0·953 (at 15° C.).

Constituents.—It consists principally of *stearin* and *palmitin* (about 80 per cent.), associated with *olein* (about 20 per cent.).

Sus, Scrofa

LARD
(Adeps)

n.O. Ungulata

Source &c.—Lard is the purified fat from the abdomen of the hog, *Sus scrofa* (Sub-kingdom *Vertebrata*, Class *Mammalia*, Order *Ungulata*).

The abdominal fat of the hog is obtained in the form of flat, leafy masses known as 'flare.' These should be first washed to free them from any salt that may have been used to preserve them, then stripped as far as possible of external membrane, and hung in a current of air for a few hours to dry. They must then be crushed or comminuted in any suitable manner, such as by beating in a stone mortar or passing through a mincing machine, in order to break the membranous vesicles and liberate the fat contained in them. If this were not done, either the fat would be retained in the vesicles or so high a temperature would have to be applied that the fat would acquire an unpleasant taste and odour. The crushed fat is then exposed to a temperature which should not exceed 57° C. (in order to avoid the evil results of too great a heat); when the fat has completely melted it should be strained through fine muslin and gently stirred till cool, avoiding any form of beating which would introduce air into the melted fat and favour the development of rancidity. If not stirred the lard is liable to assume a granular condition, from the crystallisation of the constituents of higher melting-point (stearin and palmitin).

Description.—Lard is a uniform, soft, white, fatty substance melting at about 38° C. and having at 15° C. a specific gravity of about 0·934 to 0·938. It has a slight fatty, but not rancid or otherwise disagreeable odour, nor should it be granular in appearance.

It should be entirely soluble in ether.

Constituents.—Lard consists of about 40 per cent. of *stearin* and *palmitin* mixed with about 60 per cent. of *olein*, but these proportions are subject to a little variation, and with them both melting-point and specific gravity.

Adulteration &c.—Lard is liable to contain common salt, which is often added to preserve it for domestic use; it may be tested for chlorides by boiling with water, cooling, filtering the aqueous liquid, and adding nitrate of silver and nitric acid. Starch, which might be added to give it a whiter appearance, could also be detected in the filtrate by solution of iodine.

But the most frequent adulterant of lard is cotton-seed oil, which has been found in American lard, large quantities of which have been imported. It is officially tested for as follows: a solution of 0·05 gramme of silver nitrate in 5 cubic centimetres of alcohol, to which a drop of nitric acid has been added, is heated with 5 cubic centimetres of melted lard on a water-bath for five minutes, and then vigorously shaken; the fatty layer which separates on standing should not darken in colour. The test depends upon the reduction of the silver salt by some unknown constituent of the cotton-seed oil; this constituent, however, may be destroyed (? completely) by heating the cotton-seed oil, and the test in that case fails to reveal its presence. Recourse must then be had to the determination of the amount of iodine with which the sample is capable of combining (iodine number) and other factors, for details of which reference should be made to one of the works dealing with this subject.

MANNA

Source &c.—Manna is a saccharine exudation from the stem of the manna ash, *Fraxinus Ornus*, Linn. (N.O. *Oleaceæ*), a small tree widely distributed over *southern Europe*, and cultivated especially in *Sicily* for the production of manna.

The trees are considered fit for yielding manna when they are about ten years old. Every day a transverse or oblique incision is made through the bark on one side of the stem; the saccharine liquid that exudes flows down the stem in favourable seasons, and dries to stalactitic masses, but in rainy weather it drops from the trunk and is caught upon cactus leaves (more strictly stems), placed beneath it, yielding an inferior quality. In the following year the tree is cut upon the opposite side, and in the succeeding year again on the first side. The stem is then exhausted, the tree is cut down, and from the stool two or more shoots are allowed to grow, which in ten years are again ready for tapping. In good seasons about a pound of manna is obtained from each stem.

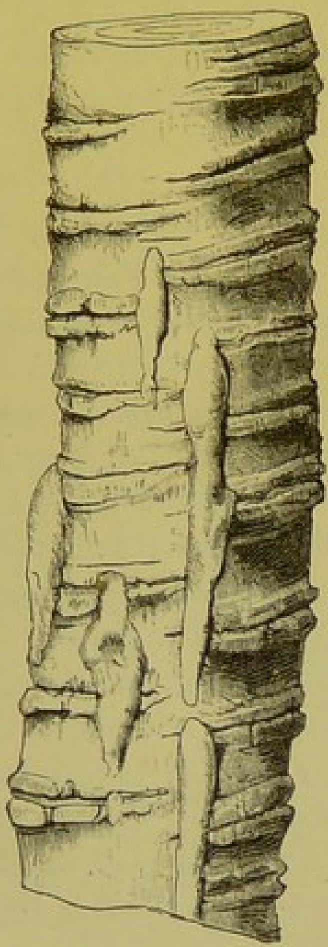


FIG. 208.—Portion of the stem of a Manna tree, showing the incisions and adhering manna. (Vogl.)

Description.—The finest qualities of manna, known in commerce as 'flake manna,' are in stalactitic pieces about 4 or 6 inches long and 1 inch wide, which are more or less conspicuously three-sided, one of the sides (that which has been next the stem) being concave and smooth. It is yellowish-white in colour and very brittle, even friable, exhibiting when broken an indistinctly crystalline structure. It has a slight agreeable odour and a sweet taste.

Inferior qualities of manna are of a darker, brownish-yellow colour, and composed of broken flakes agglutinated into a more or less sticky, gummy mass.

Constituents.—Manna consists principally of *mannite* (mannitol), $C_6H_8(OH)_6$, of which it contains as much as 80 per cent. Mannite is a well-defined, crystalline substance belonging to the class of alcohols (a hexahydric alcohol), and is widely diffused throughout the vegetable kingdom. It is associated in manna with *dextrose*, *mucilage*, inorganic substances, and with a minute quantity of a fluorescent substance, *fraxin*, which imparts to alcoholic solutions of manna, especially of inferior qualities, a faint fluorescence.

Uses.—Manna is used medicinally as a gentle laxative.

Varieties.—The term 'manna' was originally applied to the saccharine exudation from certain Oriental plants, and was subsequently extended to that from the manna ash and other plants. Hence at the present time a number of such exudations of varying origin and varying composition are classed together as 'mannas.' The following are the most important:

Oak Manna, produced by the puncture of a small species of *Coccus* on the leaves and acorn-cups of *Quercus Vallonea*, Kotschy, and *Q. persica*, Jaub. et Spach. (N.O. *Cupuliferæ*). It is collected in Kurdistan and used as a food.

Alhagi Manna, from *Alhagi Maurorum*, DC. (N.O. *Leguminosæ*), in Persia.

Tamarisk Manna, from *Tamarix gallica*, var. *mannifera*, Ehrenb. (N.O. *Tamariscineæ*), in Syria and Persia.

Astragalus Manna, from various species of *Astragalus* (N.O. *Leguminosæ*), in Persia.

Briançon Manna, from the larch, *Larix europæa*, DC. (N.O. *Coniferæ*), in southern France.

CAMPHOR

Source &c.—Camphor or laurel camphor, as it is often termed to distinguish it from other substances to which the same (generic) name is applied, is a colourless, crystalline substance obtained from the camphor tree, *Cinnamomum Camphora*, Nees and Eberm. (N.O. *Laurineæ*), a tree of immense size, attaining as much as 13 feet in diameter, and forming large forests in *Formosa* and *Japan*, and growing also in abundance on the Chinese continent. It has also been introduced into Florida, where it flourishes, as well as India, Australia, New Zealand, &c. At the present time Formosa and Japan supply the world with camphor, a small quantity only being exported from the mainland of China.

All parts of the plant contain a volatile oil, one of the constituents of which is camphor. The drug is, however, obtained from the wood only. The tree is felled, the wood cut with an adze diagonally to the grain, and beaten to separate it into small pieces. These are then subjected to a very crude process of sublimation with water-vapour, the chips being suspended on a meshed frame over a pan of boiling water, and covered with a closely fitting earthenware dome. From the crude mass thus obtained by a combined process of sublimation and distillation, there drains, on standing, a yellowish oil; this is exported in large quantities and known as camphor oil. The camphor is subsequently purified by sublimation, the vapour being condensed either in glass vessels into compact cakes ('bells') or in large chambers into small crystals ('flowers of camphor'); the latter are often compressed into rectangular tablets.

The camphor oil is subjected to cold, by which it deposits a further quantity of camphor, and is then redistilled. The lightest oils are used for paints &c., the next heavier (containing safrol), as a foundation for perfuming soap, whilst from the next eugenol, the aromatic constituent of clove oil, is abstracted. The crude camphor oil has been recommended as an embrocation for rheumatism.

Description.—Camphor is a colourless, transparent, crystalline substance, with a characteristic odour and a pungent, bitterish taste followed by a sensation of cold. Its composition corresponds to the formula $C_{10}H_{16}O$, and its specific gravity is about 0·995. It melts at 175° C., boils at 204° C., and is volatile at ordinary temperatures. It is freely soluble in alcohol, ether, chloroform, and olive oil, but very slightly in water. Triturated with chloral hydrate, menthol, phenol, or thymol, it yields an oily liquid.

Uses.—The drug is employed externally as a weak antiseptic, stimulant, and sedative; internally it is stimulant, sedative, and diaphoretic.

SECTION XVIII

ANIMAL SUBSTANCES

from. n.o.

CANTHARIDES

Cantharis Vesicatoria Coleoptera..

(Spanish Flies, Cantharis)

Hung

Source &c.—Cantharides are the dried beetles, *Cantharis vesicatoria*, Latr. (Sub-kingdom *Annulosa*, Class *Insecta*, Order *Coleoptera*).

The number of beetles known to possess vesicating properties is very large, and includes numerous species, but only a few are employed for that purpose, and of these latter one only is official.

Cantharides, or, as they are frequently termed, Spanish flies, are widely distributed over southern Europe; they are gregarious and inhabit chiefly ash trees, privets, elders, &c. They are collected in the very early morning before sunrise, whilst they are unable to use their wings, by shaking them from the trees on to cloths placed beneath; they are killed by exposing them to the fumes of burning sulphur or of ammonia, or by stove heat. When fresh they possess a powerful, disagreeable odour, which diminishes by keeping.

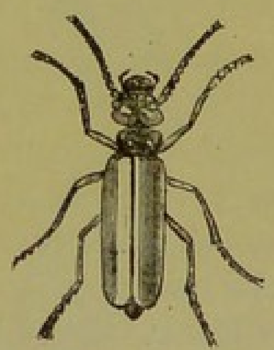


Fig. 209.—Spanish blistering beetle, *Cantharis vesicatoria*. (Maisch.)

Description.—Cantharides are about $\frac{3}{4}$ to 1 inch long, $\frac{1}{4}$ inch broad, smooth, and of a shining green or coppery green colour. The wing-cases are long and narrow, and conceal two transparent, brown, membranous wings. Each insect possesses three pairs of legs and one pair of antennæ.

Constituents.—The principal constituent of cantharides is a definite crystalline body, *cantharidin*, which, although almost insoluble in water and only sparingly soluble in alcohol, dissolves readily in acetic ether and in chloroform. With caustic alkalies (potassium or sodium hydroxide) it unites to form soluble salts, and there is evidence to show that in the beetles it exists partly as free cantharidin, partly in combination in the form of salts soluble in water. The soft parts of the insect are the chief seat of cantharidin. Good cantharides contain about 0·5 per cent., but occasionally 0·8 or even 1 per cent. is found.

In addition to this substance the beetles contain about 12 per cent. of fixed oil.

Uses.—Cantharides possess rubefacient and vesicant properties; given internally, the drug acts as an irritant poison.

Varieties &c.—The drug is but seldom adulterated. Occasionally the Rose beetle (*Cetonia aurata*, Linn.) is found mixed with it; it has a very similar colour, but is easily distinguished by being much broader.

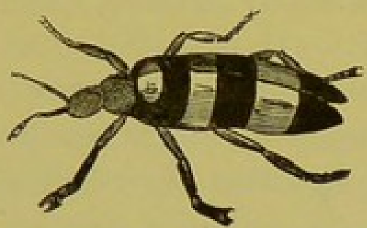


Fig. 210.—Chinese blistering beetle, *Mylabris Sidæ* (= *M. phalerata*, Pall.). (Maisch.)[1]

Chinese Blistering Beetles.—Large quantities of blistering beetles are regularly imported from China, but they are so distinct from the official cantharides that an admixture, with the entire insects at least, would be at once detected. Two species are imported, differing most conspicuously in size.

1. *Mylabris Sidæ*, Fab. (*M. phalerata*, Pall.), is the larger; it varies from $\frac{1}{2}$ inch to rather more than an inch in length, and from $\frac{1}{4}$ to $\frac{3}{8}$ inch in breadth. It is black in colour, but the wing-cases are traversed by three broad, brownish-yellow bands. These bands, when examined under a strong lens, are seen to bear black, bristly hairs. The beetles inhabit China, Bombay, Assam, &c.

2. *Mylabris Cichorii*, Fab., is on the average smaller than the foregoing; it varies from $\frac{3}{8}$ to $\frac{3}{4}$ inch in length, but is marked with similar yellow bands, which, however, are usually brighter in colour. The chief distinction of this species lies in the yellow downy pubescence with which the yellow bands are covered, the hairs on the black bands being black. It inhabits China and eastern India.

Chinese blistering beetles are richer in cantharidin than the

[1] Maisch's figure is apparently erroneously named *M. Cichorii*.

official cantharides, containing from 1 to 1·2 per cent. They would form a useful source of this substance.

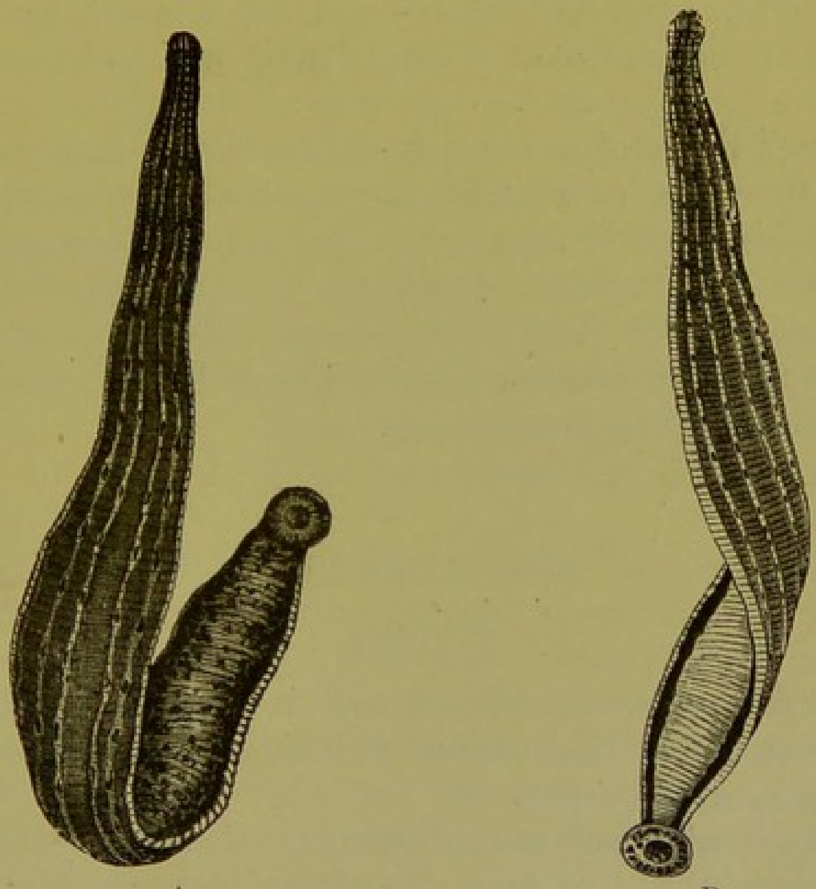
In addition to these, several other blistering beetles find their way occasionally to London, e.g. *M. lunata*, Pallas, and *M. bifasciata*, Oliv., from south Africa, *Epicauta Gorhami*, Mars, from Japan &c.

Fam. n.o.

LEECH

Sanguisuga Officinalis (Hirudo) ~~Sanguisuga~~ Hirudinea

Source &c.—Leeches are aquatic worms, and are bred in ponds for medicinal use, chiefly in Germany (near Hanover) and in the south of France (near Marseilles). Two varieties are official—viz. the speckled leech, *Sanguisuga medicinalis*,



A B

FIG. 211.—Leech. A, speckled leech, *Sanguisuga medicinalis*. B, green leech, *Sanguisuga officinalis*. (Moeller.)

Savigny, and the green or Hungary leech, *Sanguisuga officinalis*, Savigny (Sub-kingdom *Annulosa*, Class *Annelida*, Order *Hirudinea*); they may be distinguished by the ventral surface, which in the former is of a greenish-yellow colour, spotted with

Sa

black, whilst in the latter it is olive green, surrounded with a black line.

Although the back of the leech is marked with numerous (about 100) annulations, the body is not divided into distinct segments. It tapers towards each extremity, and is provided at each with a sucking-disc by which it can attach itself to any object. The anterior disc, which is smaller than the posterior, contains three jaws radiating from a common centre; each jaw is furnished with a number of minute teeth, and resembles a portion of a circular saw. The animal attaches itself by means of its anterior sucker to the skin, which is thereby slightly raised; the three jaws, by a saw-like movement, produce three slits which unite to form the characteristic triradiate cut, and the leech gorges itself with blood; it then relinquishes its hold, and drops from the skin. The blood which it has drawn is so slowly digested that a single meal will last for several months.

Although the leech is hermaphrodite, that is, both sexes are united in the same individual, it is incapable of self-fertilisation. It reproduces itself by means of eggs, and the young require about five years to arrive at maturity.

The quantity of blood that a leech will draw is not large (from 1 to 2 fluid drachms), but the flow of blood from the cut can be maintained by fomentation.

COCHINEAL

Coccus Cacti. (Coccus) Hemiptera mexico

Source &c.—Commercial cochineal is the dried, fecundated, female insect, *Coccus Cacti*, Linn. (Sub-kingdom *Annulosa*, Class *Insecta*, Order *Hemiptera*).

The cochineal insects are indigenous to Central America and Mexico, where they live upon the fleshy branches of various species of *Nopalea* (*Cactaceæ*). The production of aniline dyes has, however, largely diminished the trade in cochineal, and at the present time the insects bred in the *Canary Islands* form the bulk of the commercial drug.

The insects are of a bluish-red colour and very minute, measuring about $\frac{1}{20}$ inch in length, and the male alone is provided with wings. After fecundation the female insects rapidly increase in size, and develop abundance of a red colouring matter. They are then brushed off the plants and killed either by the fumes of burning sulphur or charcoal, or by hot water or stove heat; by the first method the waxy secretion with which the body of the insect is covered, and which imparts to it a whitish appearance, is left intact (silver grain cochineal), but by the use of heat this wax is melted and the colour changes from whitish to dark reddish-black (black grain cochineal). They are then dried in the sun, during which process they shrivel to about one-third of their size. The number of harvests varies with the climate; in the Canary Islands there are generally two.

Description.—The dried cochineal insects of commerce are about $\frac{1}{5}$ inch long, oval in outline, flattish or slightly concave on one side and arched on the other. They are of a purplish-black or purplish-grey colour, and transversely wrinkled. They scarcely show any resemblance to insects, but when macerated in water they swell considerably, and then the three pairs of legs can be discerned. They are brittle, and easily reduced to a dark-red or puce-coloured powder.

Constituents.—Cochineal contains up to 10 per cent. of a red colouring matter, *carminic acid*, which is obtainable in small, red, prismatic crystals; it is soluble in water, alcohol, and in alkaline solutions. The drug also contains fat (about 10 per cent.) and wax (about 2 per cent.), together with albuminoids, inorganic matter, &c.

The exact methods by which commercial carmine is produced are trade secrets; the preparation contains about 15 per cent. of water, 50 per cent. of carminic acid, 7 per cent. of ash, and about 20 per cent. of nitrogenous substances. It appears to be produced by precipitating infusions of cochineal by alum, in the presence of lime salts and either albumen or gelatin.

Preputial follicles of Castor Fiber

CASTOR

Rodentia

(Castoreum)

Source &c.—The drug that is known by this name consists of the dried preputial follicles of the beaver, *Castor Fiber*, Linn. (Sub-kingdom *Vertebrata*, Class *Mammalia*, Order *Rodentia*).

The beaver inhabits principally the Hudson's Bay territory, but is found also in western Russia, in Siberia, and elsewhere, living chiefly, if not entirely, upon vegetable matter, such as roots, bark, &c. of trees.

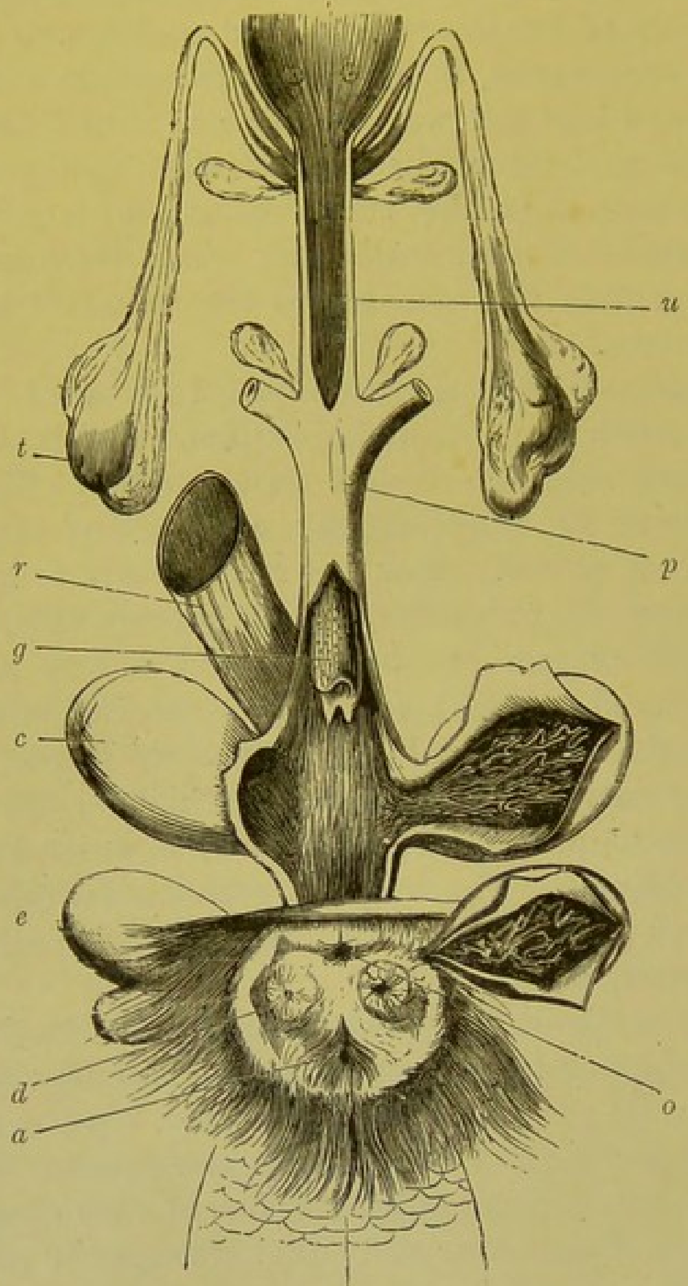


FIG. 212.— Sexual organs of male Beaver, showing the position of the two castor sacs, *c*, communicating by a common aperture with the preputial canal. The latter and one of the castor sacs have been opened. *t*, testicle; *u*, urethra; *c*, castor sacs; *g*, gland of penis; *p*, penis; *r*, rectum; *a*, anus; *e*, anal gland; *d*, aperture of anal gland; *o*, preputial orifice *f*, undersurface of tail. (Moeller, after Brandt.)

The generative organs of the beaver are concealed in a hollow or cloaca. Into the preputial (or vaginal) canal there open two large glands, one on each side. These glands, cut from both male and female animal and dried, form the commercial drug. In the fresh state they contain a whitish or yellowish creamy substance, but as they dry this becomes dark in colour. Our supplies are derived almost entirely from the Hudson's Bay territory.

Description.—The dried glands are of a dark-brownish or greyish colour, pear-shaped, and about 3 inches long. They are frequently connected in pairs by a portion of the preputial or vaginal canal which has been cut away with them. They are firm, heavy, and solid, and possess a characteristic, empyreumatic, and not altogether agreeable odour. They contain a brown or reddish-brown resinous secretion, in which, under the microscope, spherical grains of crystalline calcium carbonate can be detected, often in considerable quantity. The secretion varies much both in quantity and appearance, being sometimes pale in colour and soft, sometimes hard and dark.

Constituents.—The composition of the resinous secretion appears to be subject to great variation, due probably to the age of the animal, the time of year at which it was killed, and the time the drug has been kept. The amount of *moisture* present may be as much as 40 per cent., *resinous matter soluble in alcohol* about 40 to 70 per cent., *fatty matter soluble in ether* about 8 per cent. A crystalline substance, *castorin*, has been detected, but not investigated. *Salicin*, *benzoic acid*, and *phenol* are also said to be present. The characteristic odour is due to a volatile oil.

Varieties.—Russian castor, formerly more highly esteemed than the American, is now very rarely imported. It resembles the American, but has a more agreeable, less empyreumatic odour.

moschus moschiferus
secretions from follicles of.

MUSK

Ruminantia

(Moschus)

Ungulata

Asia

Source &c.—Musk is the dried secretion from the preputial follicles of the musk deer, *Moschus moschiferus*, Linn. (Sub-kingdom *Vertebrata*, Class *Mammalia*, Order *Ungulata*).

The musk deer is a small, graceful animal about the size of the roebuck, and inhabits a large area in central Asia, extending from the Caspian Sea to the eastern boundaries of the Chinese Empire. The male animal, which alone produces the musk, bears on its belly, a short distance behind the navel and just in front of the preputial canal, a small sac produced by an infolding of the skin. This sac is the musk sac or musk pod, and it contains a soft, unctuous, brownish substance, musk, which is remarkable for its intense, penetrating, and persistent odour. The outer surface is covered with hairs and is provided with a small canal, serving for the discharge of the secretion, debouching close to the preputial orifice.

The animals are snared or shot, and the musk pods cut out and dried; they are then wrapped singly in paper and packed about twenty-five together in a small rectangular box covered with silk; this box is known as a 'caddy.'

Most of the musk of European commerce is obtained from Thibet or from the Chinese province of Szechuen (Tonquin musk); it is conveyed down the Yangtse-Kiang river to Shanghai, whence it is exported. Smaller quantities are obtained from the southern Chinese province of Yunan (Yunan musk), and some finds its way viâ Nepaul or Assam to Calcutta (Nepaul musk, Assam musk).

The musk pods are classified by the Chinese into three qualities, or 'piles' as they are termed. In London they are again examined, probed with a knife &c., and again classified into piles, pile 1 consisting of genuine pods, whilst those of pile 3 are obviously sophisticated.

Description.—The best variety of the drug is that known as Tonquin. This is imported in pods wrapped in paper and packed in 'caddies.' The pods are nearly circular or sometimes distinctly oval in outline and lenticular in shape; they resemble small dark flattened cakes about 2 to 2½ inches in diameter and ¾ to 1 inch thick. On one of the flattened surfaces (the lower surface of the pod as attached to the animal) is a circular or oval piece of brown skin about 1½ inch in diameter; this is part of the hide of the animal, and exhibits when closely examined a central or nearly central small orifice (the orifice of the pod), around which are arranged tangentially directed hairs. The latter vary from whitish to brown in colour; those near the orifice are naturally short, but those a little distance removed have been clipped, and are stiff and bristly.

The remainder of the pod is covered with a very thin, soft, supple membrane, and appears dark brown in colour when the pod is filled with musk. It often exhibits a fine steel-blue iridescence, whence the term 'blue skin,' by which this variety of Tonquin pods is known. This thin blue skin is the inner skin of the pod; the outer skin, which is tough and fibrous, having been carefully stripped off with the exception of the circular piece surrounding the orifice. By this means the appearance of the pod is improved and its value enhanced. Good pods weigh about 1 oz. to $1\frac{1}{4}$ oz., and contain about half that weight of granular musk which fills them loosely.

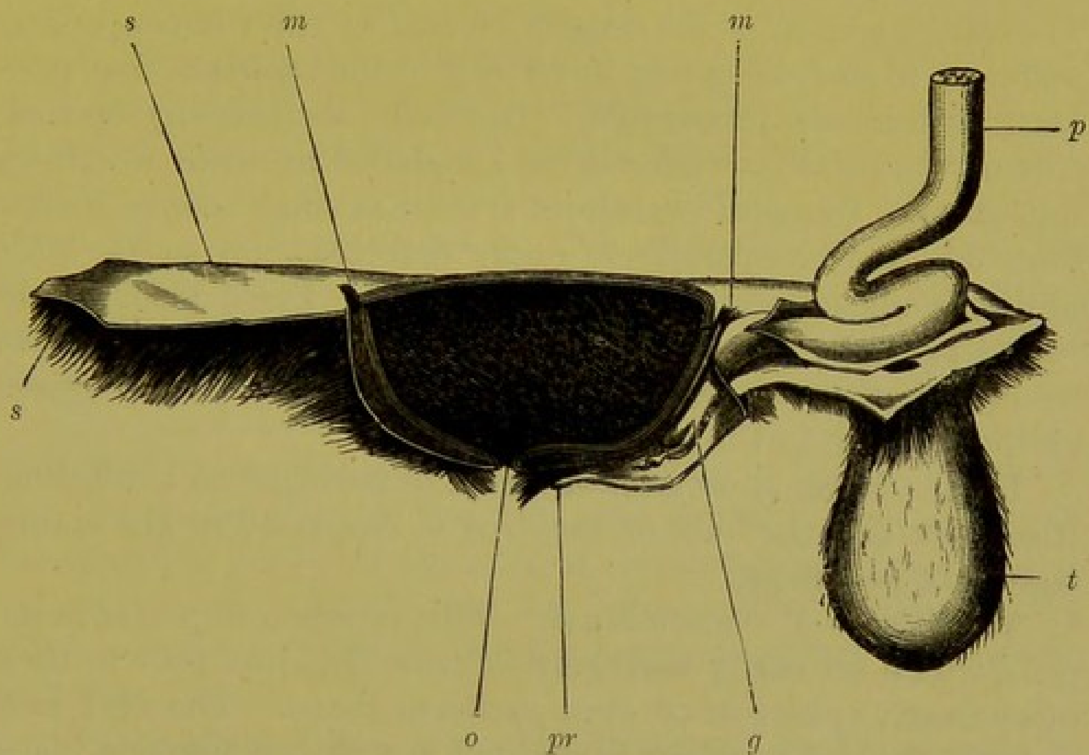


FIG. 213.—Musk pod and generative organs of the Musk Deer. *s*, skin; *p*, penis; *t*, scrotum; *g*, gland of the penis; *pr*, preputial orifice; *o*, orifice of the musk sac; *m*, muscular coat of musk sac. (Moeller, after Brandt.)

The pods from which the outer skin has not been removed are also imported; these are known as 'natural skin,' 'thick skin,' or 'old style' pods. They are usually convex on the lower surface, which is covered with the hide of the animal, but nearly flat on the upper surface, and there protected by a tough, fibrous but hairless skin.

The musk contained in the pods is always moist, and often has a strongly ammoniacal odour. It can be freed from moisture and ammonia by exposing it to the air, and then forms dark reddish-brown unctuous grains with which occasional short hairs are mixed; it possesses a strong characteristic odour and bitter taste.

Constituents.—The odorous constituent of musk is still quite unknown. The drug contains moisture, fatty matter, proteids, and inorganic substances. Water dissolves from 50 to 75 per cent. of it, but alcohol only 10 to 12 per cent. It should not contain more than 15 per cent. of moisture, or yield on incineration more than 8 per cent. of ash.

Adulterations.—Musk is liable to gross adulteration, which is in some cases easy to detect, but in others exceedingly difficult. The sophistication of the drug is effected by the Chinese, and is practised to such an extent as to lead to the assertion that pure musk is scarcely procurable. The pods are skilfully opened, part of the musk is removed and replaced by some worthless substitute. Inorganic substances, such as small stones, leaden shot, &c., are comparatively easily detected, and so are such adulterations as scraps of leather or horn. Dried blood would yield a red ash, whereas the ash of genuine musk is whitish. Resin and other substances soluble in spirit would be recognised by the increase in the alcoholic extract.

Uses.—Musk is occasionally used in medicine as a diffusible stimulant, but the bulk of the drug is employed in the manufacture of perfumes.

Varieties.—1. *Yunan Musk.*—This variety is imported in the pods, which are easily distinguished from Tonquin pods by their more nearly spherical or even pyriform shape. The skin rises towards the orifice, which is situated in a little depression; near the margin of the pod are two small nipples which, with the depressed orifice, bear a fancied resemblance to a pig's eyes and snout, hence the common term 'pig-faced pods,' by which these are known. They are imported both in the natural pod and blue skin. The musk is nearly equal in value to Tonquin.

2. *Assam and Nepaul Musk.*—These varieties are usually imported grained, and are distinguished by the odour. If pure they are of good quality.

3. *Cabardine Musk* is mostly exported from the northern Chinese ports to Japan; a little musk of inferior quality is also brought to Nishni-novgorod, whence it finds its way to London.

Ovis aries: THYROID GLAND Ungulata.

Source &c.—The drug officially known as 'Thyroideum Siccum' is a powder prepared from the fresh and healthy thyroid gland of the sheep.

The gland is one of the so-called ductless glands, many of which are known; they are so termed because they possess no evident duct, and therefore it is not known how the secretions they produce enter the system. In the case of the thyroid gland it is certain that a secretion is produced, and that it plays an important part in the human economy, for the disease known as myxœdema (a swelling of the subcutaneous and other connective tissues) is accompanied by atrophy of the thyroid gland, and can be produced in some animals by removing the gland. The knowledge of this fact has led to the use of the thyroid glands of certain animals, especially of the sheep, as a remedy for myxœdema in human beings.

The gland is situated in the throat of the animal, and consists of two almond-shaped lobes connected at their extremities. It is firm in consistence and solid, and resembles in appearance the muscular tissue of the animal, but is devoid of the fibrous structure that characterises the latter. The weight of the gland varies considerably, but the average appears to be about 66 grains.

Constituents.—The active constituent of the gland remains still unknown, although numerous substances (thyroglandin, thyroiodin, iodo-globulin, thyreo-antitoxine) have been put forward as such. Most of these are ill-defined organic substances containing iodine. It appears certain that the active constituent is soluble in water and in diluted glycerin; from these solutions it can be separated by acidifying with phosphoric acid and neutralising with lime water, the precipitated calcium phosphate carrying the active constituent down with it (White). Experience has shown that this precipitate is really active, and analysis has shown it to contain minute traces only of iodine (Swinton, 1898). The iodine compounds previously alluded to are therefore probably not the active constituent or not the only one.

Uses.—The dried gland and an extract prepared from it are used as remedies for myxœdema.

CLASSIFICATION ACCORDING TO NATURAL ORDERS, ARRANGED ALPHABETICALLY

N. O

Natural Order and Name	Part used	Page
Ampelideæ		
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Aroideæ		
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Hemidesmus indicus	Root	348
Ascomycetes		
Claviceps purpurea	Entire plant	197
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,, Sabina	Herb	189
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,, succinifer	,,	426
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